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Northwest Training and Testing

Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement

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NAVSEA NAVAL SEA SYSTEMS COMMAND
NAVAL AIR SYSTEMS COMMAND

Northwest Training and Testing Activities Draft Supplemental Environmental Impact Statement/ Overseas Environmental Impact Statement

Volume 1

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DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT/ OVERSEAS ENVIRONMENTAL IMPACT STATEMENT for NORTHWEST TRAINING AND TESTING

Lead Agency:	United States Department of the Navy
Cooperating Agency:	National Marine Fisheries Service United States Coast Guard
Title of the Proposed Action:	Northwest Training and Testing
Designation:	Draft Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement

Abstract

The United States Department of the Navy (Navy) prepared this Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement (Supplemental) in compliance with the National Environmental Policy Act (NEPA) of 1969 (42 United States Code section 4321 et seq.); the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA (Title 40 Code of Federal Regulations sections 1500 et seq.); Navy Procedures for Implementing NEPA (32 Code of Federal Regulations section 775); and Executive Order 12114, *Environmental Effects Abroad of Major Federal Actions*. This Supplemental evaluates the potential environmental impacts of conducting training and testing activities after November 2020 in the Northwest Training and Testing Study Area (Study Area). The Study Area is made up of air and sea space in the eastern north Pacific Ocean region, located adjacent to the northwest coast of the United States, to include the Strait of Juan de Fuca, Puget Sound (including Hood Canal), and the Western Behm Canal in southeastern Alaska. Three alternatives were analyzed in this Supplemental:

- The No Action Alternative represents no Navy training and testing activities at sea or in the airspace associated with the Proposed Action within the Study Area, and presents the resulting environmental effects from taking no action when compared with the effects of the Proposed Action.
- Alternative 1 reflects a representative year of training and testing to account for the natural fluctuation of training cycles, testing programs, and deployment schedules that generally limit the maximum level of training and testing from occurring for the reasonably foreseeable future. These training and testing activities include new activities at sea, as well as activities that are currently ongoing and have historically occurred in the Study Area.
- Alternative 2 reflects the maximum number of training activities that could occur within a given year and assumes that the maximum level of activity would occur for the reasonably foreseeable future. As under Alternative 1, this alternative includes new and ongoing activities.

In this Supplemental, the Navy analyzed potential impacts on environmental resources resulting from activities under Alternatives 1 and 2. The resources evaluated include sediments and water quality, air quality, marine habitats, marine mammals, sea turtles, birds, marine vegetation, marine invertebrates, fishes, cultural resources, American Indian and Alaska Native traditional resources, socioeconomic resources and environmental justice, and public health and safety.

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Executive Summary

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ES Executive Summary

ES.1 Introduction

The United States (U.S.) Department of the Navy (Navy) has prepared this Draft Supplemental Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) (hereinafter referred to as Supplemental) to supplement the impact analysis contained in the 2015 *Northwest Training and Testing Final Environmental Impact Statement/Overseas Environmental Impact Statement* (U.S. Department of the Navy, 2015) (hereinafter referred to as the 2015 NWTT Final EIS/OEIS) pursuant to 40 Code of Federal Regulations (CFR) Section 1502.9(c). This Supplemental considers ongoing and future activities conducted at sea, updates training and testing requirements, incorporates new information from an updated acoustic effects model, updates marine mammal density data, and incorporates evolving and emergent best available science. It also supports the issuance of federal regulatory permits and authorizations under the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA) using the most current and best available science and analytical methods to assess potential environmental impacts on the species covered by those regulations.

ES.2 Purpose of and Need for Proposed Military Readiness Training and Testing Activities

As identified in the 2015 NWTT Final EIS/OEIS, the purpose of the Proposed Action is to ensure that the Navy meets its statutory mission, which is to maintain, train, and equip combat-ready naval forces capable of winning wars, deterring aggression, and maintaining freedom of the seas.

ES.3 Scope and Content of the Environmental Impact Statement/Overseas Environmental Impact Statement

In this Supplemental, the Navy reanalyzed training and testing activities that could potentially affect the human environment. Since the completion of the 2015 NWTT Final EIS/OEIS, new information has become available and is incorporated in this analysis. New information specifically addressed in this Supplemental includes updates to training and testing requirements, an updated acoustic effects model, updated marine mammal density data, and evolving and emergent best available science. The range of alternatives in this Supplemental includes the No Action Alternative and two action alternatives. In this Supplemental, the Navy analyzes direct, indirect, cumulative, short-term, and long-term impacts, and the irreversible and irretrievable commitment of resources that may result from the Proposed Action. The Navy is the lead agency for the Proposed Action and is responsible for the scope and content of this Supplemental. The U.S. Coast Guard is a cooperating agency as this document assesses potential impacts of U.S. Coast Guard activities that support the Navy and occur in the Study Area. The National Oceanic Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) is serving as a cooperating agency because the scope of the Proposed Action and alternatives involve activities that have the potential to impact protected resources under their jurisdiction by law and special expertise, including marine mammals, threatened and endangered species, Essential Fish Habitat, and National Marine Sanctuaries. The National Oceanic Atmospheric Administration's authorities and special expertise is based on their statutory responsibilities under the Marine Mammal Protection Act of 1972, as amended (MMPA; 16 United States Code [U.S.C.] 1361 et seq.), the Endangered Species Act of 1973 (ESA; 16 U.S.C. 1531 et seq.), the Magnuson-Stevens Fishery Conservation and Management Act, and the National Marine Sanctuaries Act (16 U.S.C. sections 1431-1445c-1). In addition, NMFS, in accordance with 40 CFR 1506.3 and 1505.2, intends to adopt this Supplemental and issue a separate Record of Decision associated with its decision to grant or deny the Navy's request for an incidental take authorization pursuant to Section 101(a)(5)(A) of the MMPA and the regulatory requirements of 50 CFR section 216 et seq.

In accordance with the Council on Environmental Quality (CEQ) Regulations, 40 CFR part 1505.2, the Navy will issue a Record of Decision (ROD) that provides the rationale for choosing one of the alternatives.

ES.4 Government and Public Involvement

In an effort to maximize public participation and ensure the public's input is considered, the Navy conducted scoping for this Supplemental.

Public scoping began with the issuance of the Notice of Intent in the *Federal Register* (FR) on August 22, 2017 (82 FR 39779). The Navy extended the public scoping period, publishing a Notice of Extension of Scoping Period in the *Federal Register* on September 20, 2017 (82 FR 43950). To further notify the public of the scoping period, the Navy published advertisements in 17 newspapers, distributed press releases, mailed notification letters and postcards to key stakeholders and parties previously expressing an interest in this project, and provided notification via the project website and email. Public scoping comments were accepted during the 45-day scoping period from August 22, 2017 to October 6, 2017. In total, the Navy received 786 comment submissions from federal agencies, state agencies, federally recognized tribes, nongovernmental organizations, individuals, and community groups. The Navy considered all scoping comments in preparing this Supplemental.

ES.4.1 Draft Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement

This Draft Supplemental was prepared to assess potential impacts of the Proposed Action on the environment. The Proposed Action in this Supplemental reflects changes to the Proposed Action presented in the 2015 NWTT Final EIS/OEIS, for which a ROD was issued to support training and testing activities. Proposed military readiness activities are generally consistent with those at-sea activities analyzed in the 2015 NWTT Final EIS/OEIS and are representative of activities the military has been conducting in the Study Area for decades. This Draft Supplemental assessed potential impacts of all the alternatives (Alternative 1, Alternative 2, and the No Action Alternative).

ES.5 Proposed Action and Alternatives

The Navy proposes to continue conducting military readiness training and testing activities throughout the NWTT Study Area (Figure ES-1). The activities associated with the Proposed Action are to be conducted at sea and select Navy pierside and harbor locations, as they were in the 2015 NWTT Final EIS/OEIS. These proposed activities are generally consistent with those at-sea activities analyzed in the 2015 NWTT Final EIS/OEIS. In order to achieve and maintain Fleet readiness through this Supplemental, the Navy

- analyzes at-sea activities necessary to meet readiness requirements beyond 2020 and into the reasonably foreseeable future, including any changes to those activities previously analyzed, and reflects the most up-to-date compilation of training and testing activities deemed necessary to accomplish military readiness requirements;

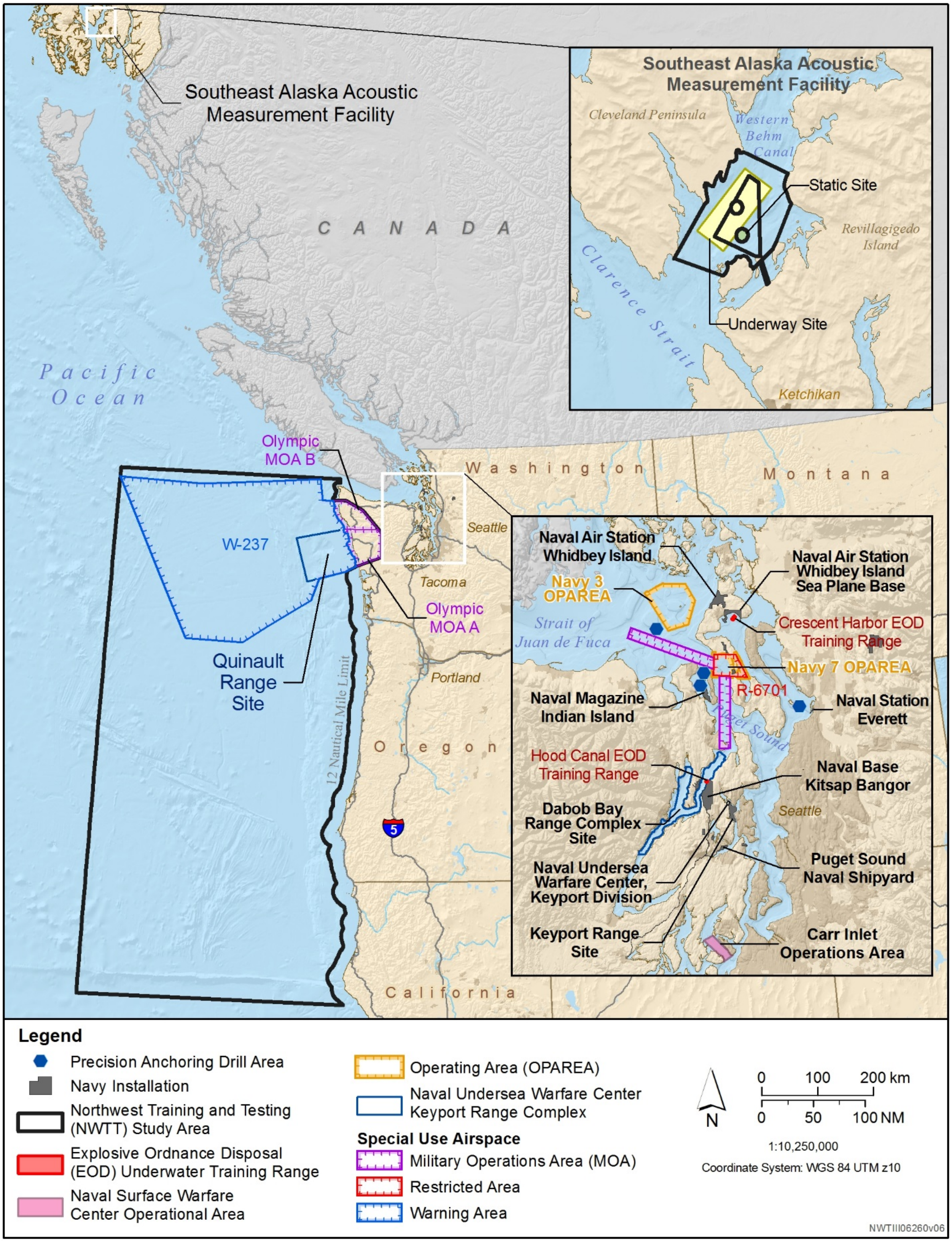

Figure ES-1: Northwest Training and Testing Study Area

- adjusts (both increases and decreases) various military readiness activities from the 2015 NWTT Final EIS/OEIS to the level needed to meet readiness requirements beyond 2020 and into the reasonably foreseeable future;
- re-analyzes potential impacts when needed to incorporate new information or new stressors;
- updates the environmental impact analyses in the 2015 NWTT Final EIS/OEIS and its supporting documents to account for changes to tempo of activity (including discontinuation of some activities assessed in 2015), renaming or combining related types of activities, and assessing new activities, such as those involving high-energy lasers, to enable the Navy to adopt new technology and capabilities;
- updates environmental analyses with the best available science and most current acoustic analysis methods to evaluate the potential effects of military readiness activities on the marine environment; and
- supports reauthorization of incidental takes of marine mammals under the MMPA and incidental takes of threatened and endangered marine species under the ESA.

ES.5.1 No Action Alternative

The No Action Alternative is required by CEQ regulations as a baseline against which the impacts of the Proposed Action are compared. CEQ guidance identifies two approaches in developing the No Action Alternative (46 *Federal Register* 18026). One approach for activities that have been ongoing for long periods of time is for the No Action Alternative to be thought of in terms of continuing the present course of action, or current management direction or intensity, such as the continuing Navy training and testing at sea in the Study Area at current levels, even if renewed authorizations under the MMPA and ESA are required. Under this approach, which was used in the 2015 NWTT Final EIS/OEIS, the analysis compares the effects of continuing current activity levels (i.e., the "status quo") with the effects of the Proposed Action. The second approach depicts a scenario where no authorizations or permits are issued, in which the Proposed Action does not take place, and the resulting environmental effects from taking no action are compared with the effects of implementing the proposed action. The Navy applied the second approach in this Supplemental in response to comments expressed to the 2015 NWTT Final EIS/OEIS and during the scoping process of this Supplemental. Additionally, the second approach further supports NMFS' regulatory process by presenting the scenario where no authorization will be issued.

Cessation of military at-sea training and testing activities in the NWTT Study Area would mean that the Navy would not meet its statutory requirements and would be unable to properly defend itself and the United States from enemy forces, unable to successfully detect enemy submarines, and unable to safely and effectively use its weapons systems or defensive countermeasures. Navy personnel would essentially not obtain the unique skills or be prepared to safely and effectively use sensors, weapons, and technologies in realistic scenarios required to accomplish the overall mission. Consequently, the No Action Alternative is inherently unreasonable because it does not meet the purpose and need.

ES.5.2 Alternative 1 (Preferred Alternative)

This Alternative consists of an adjustment from the level of military readiness activities analyzed in the 2015 NWTT Final EIS/OEIS, accounting for changes in the types and tempo (increases or decreases) of activities necessary to meet current and future military readiness requirements beyond 2020.

- **Adjustments to Tempo of Training and Testing Activities.** This alternative includes changes to training and testing requirements necessary to accommodate current and future readiness requirements, including new at-sea activities as well as activities subject to previous analysis that are currently ongoing and have historically occurred in the Study Area.

Alternative 1 reflects a level of training and testing activities to be conducted, with adjustments from the 2015 NWTT Final EIS/OEIS, that account for changes in the types and tempo of activities necessary to meet current and future military readiness requirements beyond 2020.

ES.5.3 Alternative 2

Alternative 2 consists of all activities and the same type of training and testing activities that would occur under Alternative 1. Alternative 2 also considers an increase in tempo of some training and testing activities. Alternative 2 reflects the maximum number of training and testing activities that could occur every year. Under this alternative, the Navy would be enabled to meet the highest levels of required military readiness in order to respond to threats posed by nation states that possess, or will soon possess, near-peer capabilities. This allows for the greatest flexibility for the Navy to maintain readiness when considering potential changes in the national security environment, fluctuations in training and deployment schedules, and anticipated global demands.

ES.6 Summary of Environmental Effects

Environmental effects that might result from the implementation of the Navy's Proposed Action have been analyzed in this Supplemental. Physical resources that were considered for re-evaluation in this Supplemental are the same as those that were analyzed in the 2015 NWTT Final EIS/OEIS and include sediments and water quality (Section 3.1) and air quality (Section 3.2). Biological resources (including threatened and endangered species) considered include marine habitats (Section 3.3), marine mammals (Section 3.4), sea turtles (Section 3.5), birds (Section 3.6), marine vegetation (Section 3.7), marine invertebrates (Section 3.8), and fishes (Section 3.9). Human resources considered in this Supplemental include cultural resources (Section 3.10), American Indian and Alaska Native traditional resources (Section 3.11), socioeconomic resources and environmental justice (Section 3.12), public health and safety (Section 3.13), and cumulative impacts (Chapter 4).

New information specifically addressed in this Supplemental includes updates to military readiness requirements (Chapter 2, Description of Proposed Action and Alternatives), an updated acoustic effects model (U.S. Department of the Navy, 2018), updated marine mammal density data (U.S. Department of the Navy, In prep), and evolving and emergent science.[1] The Navy and NMFS continue to apply the best available science to all impact analyses in this Supplemental. Because of the significance of acoustics and explosives as potential stressors to marine species, and in light of new research and criteria related to acoustics and explosives, the Navy's approach to acoustic and explosives analysis used in this Supplemental is updated. For a discussion on differentiating sound and noise, see Appendix D (Acoustic

[1] For the 2015 NWTT Final EIS/OEIS, the Navy used a new modeling system known as the Navy Acoustics Effects Model and marine mammal density information, developed by the Navy in cooperation with NMFS, that was the best available information at the time. The Navy Acoustics Effects Model has been refined, marine mammal density estimates have been updated, and NMFS published new criteria in 2018 which have been incorporated into the model analysis.

and Explosive Concepts), Section D.1.2 (Signal Versus Noise). Also, there have been changes in the energy stressors analyzed in this Supplemental (Section 3.0.3.3, Energy Stressors).

Table ES-1 summarizes the potential environmental impacts of the Proposed Action. All sections of the 2015 NWTT Final EIS/OEIS were reviewed to determine if there was relevant new science that needed to be updated/incorporated into this Supplemental. To the extent there was new science, it is reflected in each of the sections in Chapter 3 (Affected Environment and Environmental Consequences). There was also a re-assessment of effects determinations in each section of Chapter 3.

Table ES-1: Summary of Environmental Impacts for the No Action Alternative, Alternative 1, and Alternative 2

Resource Category	Summary of Impacts
Section 3.1 Sediments and Water Quality	The Navy considered all stressors that could potentially impact sediments and water quality as a result of the Proposed Action. The following conclusions have been reached for the project alternatives: **<u>No Action Alternative:</u>** • Discontinuing training and testing under the No Action Alternative would lessen the potential for impacts on sediments and water quality from training and testing activities. **<u>Alternative 1 (Preferred Alternative):</u>** • Explosives and explosives byproducts, metals, chemicals, and other materials expended during training and testing described in this Supplemental could result in short-term and long-term impacts on sediments and water quality. Some chemical, physical, or biological changes in sediment or water quality could be measurable, but most would be negligible. Regulatory thresholds and guidelines established for measuring impacts on sediment and water quality would not be exceeded. **<u>Alternative 2:</u>** • The number of training and testing activities with the potential to impact sediments and water quality under Alternative 2 would increase slightly over what is proposed for Alternative 1. However, this increase as compared to Alternative 1 would have no appreciable change on the impact conclusions as summarized above under Alternative 1. Regulatory thresholds and guidelines established for measuring impacts on sediments and water quality would not be exceeded.

Table ES-1: Summary of Environmental Impacts for the No Action Alternative, Alternative 1, and Alternative 2 (continued)

Resource Category	Summary of Impacts
Section 3.2 Air Quality	The Navy considered all stressors that could potentially impact air quality as a result of the Proposed Action. The following conclusions have been reached for the project alternatives: **<u>No Action Alternative:</u>** • Discontinuing training and testing under the No Action Alternative would improve the ambient air quality as the amount of pollutants being emitted would decrease. **<u>Alternative 1 (Preferred Alternative):</u>** • All of the air emissions sources proposed are mobile sources and do not impact the current attainment status of the Air Quality Control Regions in the Study Area. Therefore, changes to air quality under Alternative 1 would be considered minor and localized; changes to air quality from hazardous air pollutants are not expected to be detectable. **<u>Alternative 2:</u>** • The number of training and testing activities under Alternative 2 would increase slightly over what is proposed for Alternative 1. However, this increase as compared to Alternative 1 would have no appreciable change on the impact conclusions as summarized above under Alternative 1; changes to air quality from hazardous air pollutants are not expected to be detectable.

Table ES-1: Summary of Environmental Impacts for the No Action Alternative, Alternative 1, and Alternative 2 (continued)

Resource Category	Summary of Impacts
Section 3.3 Marine Habitats	The Navy considered all stressors that could potentially impact marine habitats as a result of the Proposed Action. The following conclusions have been reached for the project alternatives: **No Action Alternative:** • Discontinuing training and testing under the No Action Alternative would lessen the potential for impacts on marine habitats from training and testing activities, but would not measurably improve the condition of marine habitats throughout the Study Area. **Alternative 1 (Preferred Alternative):** • Under Alternative 1, most explosives would occur at or near the ocean surface, minimizing impacts to habitat. Explosives use at or near the seafloor would occur in previously disturbed soft bottom areas where explosives have been used for decades. Impacts on marine habitats from physical disturbance and strike stressors under Alternative 1 would be minimal and recoverable because (1) the activities that could come into contact with marine habitats would be located in previously disturbed areas; (2) most activities and local disturbances of the surface water are short term in nature, with some temporary increase in suspended sediment in shallow areas; (3) sand substrate would be expected to shift back following a disturbance through tidal energy or storm-generated waves; (4) in-water devices are deployed at depths where they would not likely come in contact with marine habitat; and (5) Navy protective measures are implemented. Most military expended materials would be released in the open ocean, where substrates would primarily be clays and silts. Because of their small total footprint size in the Inland Waters, military expended materials would not be expected to change the habitat structure. Impacts from seafloor devices would be minimal and recoverable because they would be used in previously disturbed areas. Therefore, impacts to marine habitats from explosives, physical disturbance and strike, military expended materials, and seafloor devices would be negligible. **Alternative 2:** • The number of training and testing activities under Alternative 2 would increase slightly over what is proposed for Alternative 1. However, this increase as compared to Alternative 1 would have no appreciable change on the impact conclusions as summarized above under Alternative 1 for marine habitats; impacts to marine habitats from explosives, physical disturbance and strike, military expended materials, and seafloor devices would be negligible.

Table ES-1: Summary of Environmental Impacts for the No Action Alternative, Alternative 1, and Alternative 2 (continued)

Resource Category	Summary of Impacts
Section 3.4 Marine Mammals	The Navy considered all stressors that could potentially impact marine mammals as a result of the Proposed Action. The following conclusions have been reached for the project alternatives: **<u>No Action Alternative:</u>** • Discontinuing training and testing under the No Action Alternative would lessen the potential for impacts on marine mammals that may result from training and testing activities. **<u>Alternative 1 (Preferred Alternative):</u>** • The use of sonar and other transducers have the potential to expose marine mammals to sound-producing activities that would present risks to individual marine mammals that could include temporary or permanent hearing threshold shift, auditory masking, physiological stress, or behavioral responses. A small number of minor to moderate behavioral reactions or temporary hearing threshold shifts to an individual animal over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected. • The use of explosive munitions in the water or near the water's surface present a risk to marine mammals located in close proximity to the explosion, because the resulting shock waves can cause injury or result in the death of an animal. If a marine mammal is located farther from an explosion, the impulsive, broadband sounds introduced into the marine environment may cause permanent or temporary hearing threshold shifts, auditory masking, physiological stress, or behavioral responses. Because most estimated impacts from explosions are behavioral responses or temporary hearing threshold shifts, and because the numbers of marine mammals potentially impacted by explosives are small as compared to each species' respective abundance, long-term consequences for the species or stocks would not be expected.

Table ES-1: Summary of Environmental Impacts for the No Action Alternative, Alternative 1, and Alternative 2 (continued)

Resource Category	Summary of Impacts
Section 3.4 Marine Mammals (continued)	• The use of in-water electromagnetic devices and high-energy lasers have the potential to result in impacts on marine mammals. The likelihood and magnitude of energy impacts depends on the proximity of marine mammals to the activity. Based on the relatively weak strength of the electromagnetic field created by Navy activities, a marine mammal would have to be in close proximity for there to be any effect, and impacts on migrating behaviors and navigation are not anticipated. Statistical probability analyses demonstrate with a high level of certainty that a marine mammal would not be struck by a high-energy laser. Activities using in-water electromagnetic devices or high-energy lasers are temporary and localized in nature, and may result in short-term and minor impacts on individuals, but would not result in long-term impacts on marine mammal populations. • The use of vessels, in-water devices, military expended materials, and seafloor devices have the potential to result in physical disturbance and strike impacts on marine mammals. The potential for impacts mainly depends on the proximity of the vessel, device, or expended material to a marine mammal or group of marine mammals. Since the Navy does not anticipate a substantive change in the level of vessel use for training and testing compared to the level of vessel use over the previous several decades, the potential for striking a marine mammal with a vessel, device, or expended material is considered low. Physical disturbance of individual marine mammals due to vessel movements may also occur, but any stress response associated with avoidance behavior would not be severe enough to have long-term consequences for individual marine mammals. There are no recorded or reported instances of marine mammals being struck or disturbed by in-water devices; therefore, impacts on individuals or long-term consequences to marine mammal populations are not anticipated from the use of in-water devices. Potential impacts from military expended materials and seafloor devices are determined through statistical probability analyses. These analyses suggest a very low potential for marine mammals to be struck by expended materials or seafloor devices. Long-term consequences to marine mammal populations from vessels, in-water devices, military expended materials, and seafloor devices associated with Navy training and testing activities are not anticipated.

Table ES-1: Summary of Environmental Impacts for the No Action Alternative, Alternative 1, and Alternative 2 (continued)

Resource Category	Summary of Impacts
Section 3.4 Marine Mammals (continued)	• The use of wires, cables, decelerators/parachutes, and biodegradable polymers would have the potential to result in impacts on marine mammals through entanglement. The potential for impacts is dependent on the probability that a marine mammal would encounter an expended item, the physical properties of the item, and the likelihood that a marine mammal could become entangled in a particular item. The physical characteristics (e.g., strength, flexibility, length) of wires and cables and decelerators/parachutes suggest that, although unlikely, it would be possible for a marine mammal to become entangled in these items. However, there have been no known instances of entanglement of any marine mammals involving the use of wires and cables associated with Navy training and testing activities. Unlike other entanglement stressors, biodegradable polymers only retain their strength for a relatively short period of time; therefore, the potential for entanglement by a marine mammal would be limited to a very brief period before the polymer deteriorates. The longer the biodegradable polymer remains in the water, the weaker and more brittle it becomes, making it increasingly likely to break. Short-term impacts on individual marine mammals and long-term impacts on marine mammal populations from entanglement associated with Navy training and testing activities are not anticipated. • Use of military expended materials have the potential to result in impacts on marine mammals due to ingestion of expended materials by marine mammals. Marine mammals that forage along the water surface or within the water column are less likely to encounter ingestion stressors as they sink through the water column to the seafloor. Most expended materials that would remain floating or suspended within the water column are typically too small to pose a risk of intestinal blockage to any marine mammal that encounters them. Bottom-feeding marine mammals would be more likely to encounter expended materials that have already sunk to the seafloor. In the unlikely event that a marine mammal encounters and ingests an expended item, the individual may be negatively affected if the material becomes lodged in the digestive tract. The likelihood that a marine mammal would encounter and then ingest a military expended item associated with Navy training and testing activities is considered low. Short-term impacts on individual marine mammals and long-term consequences to marine mammal populations from expended materials associated with Navy training and testing activities are not anticipated.

Table ES-1: Summary of Environmental Impacts for the No Action Alternative, Alternative 1, and Alternative 2 (continued)

Resource Category	Summary of Impacts
Section 3.4 Marine Mammals (continued)	• Marine mammals have the potential to be exposed to several secondary impacts associated with Navy training and testing activities in the Study Area. These secondary impacts, which include (1) explosives, (2) explosives byproducts and unexploded ordnance, (3) metals, (4) chemicals, and (5) transmission of marine mammal diseases and parasites, would result from direct impacts on marine mammal habitat or an effect on prey availability in the Study Area. In-water explosions have the potential to injure or kill prey species; however, based on the conclusions in Section 3.3 (Marine Habitats), Section 3.8 (Marine Invertebrates), and 3.9 (Fishes), impacts would not substantially impact prey availability. Explosives byproducts encased in unexploded munitions residing on the seafloor are not expected to result in any impacts on marine mammals. In the event that a marine mammal encounters an unexploded munition on the seafloor that is small enough to ingest, and ingests the item, the animal would likely reject the item, because it is not a familiar prey item. As described in Section 3.1 (Sediments and Water Quality), explosives byproducts and unexploded munitions would have no lasting or meaningful effects on water quality, would therefore not impact marine mammal habitat, and would not constitute a secondary impact on marine mammals. Metals are introduced into the water and sediments from targets, munitions, and other expended materials. Evidence from a number of studies indicate that elevated metal concentrations are localized to the immediate vicinity of the degrading item and that no bioaccumulation of metals was observed in studies specifically designed to look for bioaccumulation of metals. Other types of chemicals (e.g., fuel used by torpedoes and associated combustion products) would be introduced into marine mammal habitat. These chemicals would either quickly become undetectable or would have only a minimal and localized impact on sediments and water quality in the Study Area. As described in Section 3.1 (Sediments and Water Quality), there is no evidence that chemicals originating from Navy activities would alter water quality to an extent that would result in overall habitat degradation for marine mammals. Transmission of marine mammal diseases and parasites from the Navy's trained marine mammals used in training activities analyzed in this document to wild marine mammals in the Study Area is unlikely, because the Navy adheres to strict protocols to prevent these types of impacts. Secondary impacts on marine mammals from Navy training and testing activities in the Study Area are not expected to have short-term or long-term impacts on individual marine mammals or on marine mammal populations. **<u>Alternative 2:</u>** • The number of training and testing activities under Alternative 2 would increase slightly over what is proposed for Alternative 1. However, this increase as compared to Alternative 1 would have no appreciable change on the impact conclusions as summarized above under Alternative 1 for marine mammals.

Table ES-1: Summary of Environmental Impacts for the No Action Alternative, Alternative 1, and Alternative 2 (continued)

Resource Category	Summary of Impacts
Section 3.5 Sea Turtles	The Navy considered all stressors that could potentially impact sea turtles as a result of the Proposed Action. The following conclusions have been reached for the project alternatives: **No Action Alternative:** • Discontinuing training and testing under the No Action Alternative would lessen the potential for impacts on sea turtles, but would not measurably improve the status of sea turtle populations. **Alternative 1 (Preferred Alternative):** • The use of sonar and other transducers, explosives, aircraft, vessels, and weapons have the potential for limited impacts on sea turtles because sea turtles have limited hearing abilities. If a sea turtle is close enough to a source using a frequency within a sea turtle's hearing range, the sea turtle may exhibit short-term behavioral reactions or may exhibit no reaction at all. No long-term consequences to sea turtle populations would be expected. • In-water electromagnetic devices are not expected to result in population-level impacts for sea turtles due to the low-intensity, localized potential impact area, and short duration of use. The use of high-energy lasers associated with testing activities are not expected to impact sea turtles as a result of the very low probability of a direct strike by a high-energy laser. • Use of vessels and in-water devices, military expended materials, and seafloor devices may cause short-term disturbance to an individual turtle within the Study Area due to sea turtles striking or being struck by vessels, in-water devices, military expended materials, or seafloor devices. However, due to the low numbers of sea turtles potentially impacted by these activities, population-level effects are unlikely. • Entanglement through the use of wires and cables, and decelerators/parachutes may cause short-term or long-term disturbance to an individual sea turtle. However, due to the physical characteristics of wires, cables and decelerators/parachutes, combined with the behavior of the species, population-level impacts are not expected. Sea turtles do not occur where biodegradable polymer testing would take place, so that activity would not affect sea turtles.

Table ES-1: Summary of Environmental Impacts for the No Action Alternative, Alternative 1, and Alternative 2 (continued)

Resource Category	Summary of Impacts
Section 3.5 Sea Turtles (continued)	• The use of military expended materials may cause short-term or long-term disturbance to an individual sea turtle due to ingestion of munitions and military expended materials other than munitions used in training activities. However, the potential impacts of exposure to munitions are not expected to result in population-level impacts. • Sea turtles would be exposed to multiple secondary causes of impact associated with Navy training and testing activities in the Study Area. These stressors include (1) explosives and explosives byproducts (including unexploded ordnance), (2) metals, (3) chemicals, and (4) other materials. In addition to directly affecting turtles and turtle habitat, underwater explosions could affect other species in the food web, including prey species upon which sea turtles feed. Any impacts from explosives would be temporary, only occurring during activities involving explosives, with no lasting effect on prey availability or the pelagic food web. Potential impacts from explosives and explosives byproducts, metals, chemicals, or other materials would be inconsequential and not detectable for these training and testing activities. Several Navy training and testing activities introduce potentially harmful chemicals and other materials into the marine environment. Various life stages of sea turtles could be indirectly impacted by chemicals and other materials via sediment near the object (e.g., within a few inches), but these potential effects would diminish rapidly as the chemicals degrade to less toxic elements and compounds. Although sea turtles may be exposed to contaminants in sediments and in the water column, and may have ingested contaminated sediments or prey items that may also have been exposed to contaminants in water and sediments, it is extremely unlikely that sea turtles would be indirectly impacted by explosives and explosives byproducts, metals, chemicals or other materials released during training and testing activities. **Alternative 2:** The number of training and testing activities under Alternative 2 would increase slightly over what is proposed for Alternative 1. However, this increase as compared to Alternative 1 would have no appreciable change on the impact conclusions as summarized above under Alternative 1 for sea turtles.

Table ES-1: Summary of Environmental Impacts for the No Action Alternative, Alternative 1, and Alternative 2 (continued)

Resource Category	Summary of Impacts
Section 3.6 Birds	The Navy considered all stressors that could potentially impact birds as a result of the Proposed Action. The following conclusions have been reached for the project alternatives: **No Action Alternative:** • Discontinuing training and testing under the No Action Alternative would lessen the potential for impacts on birds, but would not measurably improve the status of bird populations. **Alternative 1 (Preferred Alternative):** • The use of sonar and other transducers associated with training and testing activities could expose diving bird species to in-water sound sources. Similarly, aircraft noise, vessel noise, and weapons firing noise could impact birds located above the water's surface. Most sonar use, aircraft noise, vessel noise, and weapons firing noise occur offshore, so the chance for an exposure would be low to birds located nearshore, where bird occurrence is more likely. In addition, impacts to individuals, if any, are expected to be minor and limited; therefore, no long-term consequences to individuals are expected. • The use of explosives during training and testing activities could result in a disturbance to a bird's behavior, and/or lethal or non-lethal injuries. Explosives are used either far offshore where bird occurrence is less likely or on established ranges where the explosive activity is closely monitored. Short-tailed albatross can occur far offshore, but their sparse populations and the low number of offshore explosive activities would make an explosive encounter with a short-tailed albatross unlikely. Marbled murrelet occurrence near shore and in the Inland Waters could expose them to underwater detonation training activities. However, these activities are closely monitored before, during, and after each detonation, with no recorded impact to marbled murrelets. • The use of in-water electromagnetic devices would not impact bird species because of the low strength of the electromagnetic field, the small range of the electromagnetic field, and the short exposure that any bird could experience. Impacts from the use of in-air electromagnetic devices (primarily radar) would be very unlikely due to the dispersed nature of the activities that include radar use. The use of high-energy lasers is extremely unlikely to result in a direct strike of a marine bird.

Table ES-1: Summary of Environmental Impacts for the No Action Alternative, Alternative 1, and Alternative 2 (continued)

Resource Category	Summary of Impacts
Section 3.6 Birds (continued)	• Birds are unlikely to be impacted by physical disturbance and strike stressors (aircraft, aerial targets, vessels, in-water devices, and military expended materials). • Birds are unlikely to be entangled by guidance wires and fiber optic cables, which would rapidly sink in the water column. Decelerators and parachutes, which have weights and metal clips attached to them that facilitate their descent to the seafloor and minimize the time when entanglement could occur, would be unlikely to entangle a bird. Biodegradable polymers retain their strength for a relatively short period of time; therefore, the potential for entanglement by a marine bird would be limited. Furthermore, the longer the biodegradable polymer remains in the water, the weaker it becomes, making it more brittle and likely to break. • The use of military expended materials and munitions may cause short-term or long-term disturbance to an individual bird due to ingestion of munitions used in training activities. However, the potential impacts of exposure to munitions are not expected to result in population-level impacts. • Stressors from training and testing activities could pose secondary or indirect impacts on birds via habitat, sediment, and water quality. These include (1) impacts on habitats for birds, and (2) impacts on prey availability. Secondary impacts from underwater explosions would be temporary, and no lasting impact on prey availability or the pelagic food web would be expected. Training and testing activities would not result in a decrease in the quantity or quality of bird populations or habitats, or prey species and habitats. Although metals are introduced into seawater and sediments as a result of Navy training and testing activities, it is extremely unlikely that birds would be indirectly impacted by these metals via the water. **Alternative 2:** The number of training and testing activities under Alternative 2 would increase slightly over what is proposed for Alternative 1. However, this increase as compared to Alternative 1 would have no appreciable change on the impact conclusions as summarized above under Alternative 1 for birds.

Table ES-1: Summary of Environmental Impacts for the No Action Alternative, Alternative 1, and Alternative 2 (continued)

Resource Category	Summary of Impacts
Section 3.7 Marine Vegetation	The Navy considered all stressors that could potentially impact marine vegetation as a result of the Proposed Action. The following conclusions have been reached for the project alternatives: **No Action Alternative:** • Discontinuing training and testing under the No Action Alternative would lessen the potential for impacts of these training and testing activities on marine vegetation, but would not measurably improve the status of marine vegetation in the Study Area. **Alternative 1 (Preferred Alternative):** • Physical disturbance and strike and the use of underwater explosives could affect marine vegetation by destroying individual plants or damaging parts of plants, but are not expected to result in detectable changes in survival or propagation, and are not expected to result in population-level impacts on marine plant species. Changes in sediment and water quality due to these training and testing activities are not likely to be detectable; thus no detectable changes are expected in marine vegetation growth, survival, propagation, or population-level impacts. • Neither state or federal standards or guidelines for sediments nor water quality would be violated by proposed training and testing activities. Because of these conditions, population-level impacts on marine vegetation are likely to be inconsequential and undetectable. Therefore, because these standards and guidelines are structured to protect human health and the environment, and the proposed activities do not violate them, no indirect impacts are anticipated on marine vegetation from the training and testing activities proposed by Alternative 1. **Alternative 2:** • The number of training and testing activities under Alternative 2 would increase slightly over what is proposed for Alternative 1. However, this increase as compared to Alternative 1 would have no appreciable change on the impact conclusions as summarized above under Alternative 1 for marine vegetation.

Table ES-1: Summary of Environmental Impacts for the No Action Alternative, Alternative 1, and Alternative 2 (continued)

Resource Category	Summary of Impacts
Section 3.8 Marine Invertebrates	The Navy considered all stressors that could potentially impact marine invertebrates as a result of the Proposed Action. The following conclusions have been reached for the project alternatives: **<u>No Action Alternative:</u>** • Discontinuing training and testing under the No Action Alternative would lessen the potential for impacts on marine invertebrates from these training and testing activities, but would not measurably improve the status of invertebrate populations or subpopulations. **<u>Alternative 1 (Preferred Alternative):</u>** • The use of sonar and other transducers, in-water electromagnetic devices, high-energy lasers, wires and cables, parachutes/decelerators, and military expended materials of ingestible size associated with training and testing activities would have a negligible impact on marine invertebrate species. • Use of explosives, vessels and in-water devices, military expended materials and seafloor devices, associated with training and testing activities may impact individual marine invertebrates and groups of marine invertebrates. However, these activities are unlikely to impact populations or subpopulations of marine invertebrates. • Stressors that could pose secondary or indirect impacts on marine invertebrates include (1) explosives and explosives byproducts; (2) metals; (3) chemicals; and (4) other materials such as targets, chaff, and plastics. Indirect impacts of explosives and unexploded ordnance on marine invertebrates via water are likely to be inconsequential and not detectable. Concentrations of metals and chemicals in water are extremely unlikely to be high enough to cause injury or mortality to marine invertebrates; therefore, indirect impacts of metals or chemicals via water absorption are likely to be inconsequential and not detectable. The only other material that could impact marine invertebrates via sediment is plastics. Marine invertebrates are most at risk from potentially harmful chemicals in plastics via ingestion or bioaccumulation. Marine invertebrates could be indirectly impacted by chemicals from plastics but, absent bioaccumulation, these impacts would be limited to ingestion of the material. Because of these conditions, population-level impacts on marine invertebrates attributable to Navy-expended materials are likely to be inconsequential and not detectable. **<u>Alternative 2:</u>** • The number of training and testing activities under Alternative 2 would increase slightly over what is proposed for Alternative 1. However, this increase as compared to Alternative 1 would have no appreciable change on the impact conclusions as summarized above under Alternative 1 for marine invertebrates.

Table ES-1: Summary of Environmental Impacts for the No Action Alternative, Alternative 1, and Alternative 2 (continued)

Resource Category	Summary of Impacts
Section 3.9 Fishes	The Navy considered all stressors that could potentially impact fishes as a result of the Proposed Action. The following conclusions have been reached for the project alternatives: **No Action Alternative:** • Discontinuing training and testing under the No Action Alternative would lessen the potential for impacts from these training and testing activities on fishes, but would not measurably improve the status of fish populations or subpopulations. **Alternative 1 (Preferred Alternative):** • The use of sonar and other transducers, explosives, and in-water electromagnetic devices, may affect fishes. Impacts, however, are expected to be temporary and infrequent as most activities would be temporary, localized, and infrequent. More severe impacts such as mortality or injury could lead to permanent or long-term consequences for individuals, but overall long-term consequences for fish populations are not expected. • The use of vessels and in-water devices, aircraft, weapons, military expended materials, seafloor devices, wires and cables, parachutes/decelerators, and military expended materials of ingestible size associated with training and testing activities may affect fishes. However, because the number of fishes potentially impacted by these activities is low, population-level impacts are unlikely. • Navy training and testing activities could pose secondary or indirect impacts on marine invertebrates via habitat, sediment, or water quality. These include (1) explosives and byproducts; (2) metals; (3) chemicals; (4) other materials such as targets, chaff, and plastics; and (5) impacts on fish habitat. Secondary impacts from underwater explosions would be temporary, and no lasting impact on prey availability or the pelagic food web would be expected. Indirect impacts of underwater detonations and explosive ordnance use under the Proposed Action would not result in a decrease in the quantity or quality of fish populations or fish habitats in the Study Area. Metals, chemicals, and other materials are introduced into seawater and sediments as a result of Navy training and testing activities. Indirect impacts of metals to fishes via water involve concentrations that are several orders of magnitude lower than concentrations achieved via bioaccumulation in the sediments. It is extremely unlikely that fishes would be indirectly impacted by toxic metals via sediment or water. Secondary effects on prey and habitat from the release of metals, chemicals, and other materials into the marine environment during training and testing activities are not anticipated.

Table ES-1: Summary of Environmental Impacts for the No Action Alternative, Alternative 1, and Alternative 2 (continued)

Resource Category	Summary of Impacts
Section 3.9 Fishes (continued)	**<u>Alternative 2:</u>** • The number of training and testing activities under Alternative 2 would increase slightly over what is proposed for Alternative 1. However, this increase as compared to Alternative 1 would have no appreciable change on the impact conclusions as summarized above under Alternative 1 for fishes.
Section 3.10 Cultural Resources	The Navy considered all stressors that could potentially impact cultural resources as a result of the Proposed Action. The following conclusions have been reached for the project alternatives: **<u>No Action Alternative:</u>** • Discontinuing the training and testing activities would result in fewer 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 on submerged cultural resources. **<u>Alternative 1 (Preferred Alternative):</u>** • Training and testing activities would occur in the same locations and in a similar manner as were analyzed previously. In spite of increases proposed under Alternative 1, and as described in the 2015 NWTT Final EIS/OEIS, these physical disturbance and strike stressors remain unlikely to impact cultural resources. As stated in the 2015 NWTT Final EIS/OEIS, the impact of physical disturbance and strike stressors on cultural resources would be insignificant because (1) the types of activities associated with towed systems are conducted in areas where the sea floor is deeper than the length of the tow lines, and (2) devices are designed and operated within the water column and do not contact the seafloor. Activities involving towed and other in-water devices are not expected to impact submerged cultural resources. In-water crawlers would not disturb the bottom enough to disturb buried or imbedded archaeological resources. Therefore, activities involving military expended materials are not expected to impact submerged cultural resources.

Table ES-1: Summary of Environmental Impacts for the No Action Alternative, Alternative 1, and Alternative 2 (continued)

Resource Category	Summary of Impacts
Section 3.10 Cultural Resources	There would be no impact of military expended materials on cultural resources under Alternative 1 because: (1) most anticipated expended munitions would be small objects and fragments that would slowly drift to the seafloor after striking the ocean surface, (2) expended materials would not alter the archaeological or cultural characteristics of the submerged cultural resource if they should sink on the resource itself or in the vicinity, and (3) it is unlikely these materials would come into contact with or remain on submerged cultural resource. • Mine Neutralization EOD Training activities would remain at the same location and event amount (13) under Alternative 1 as discussed in the 2015 NWTT Final EIS/OEIS. These events would occur in designated and well-established EOD Training Ranges where no cultural resources have been identified. It is unlikely that these resources could be disturbed by the use of seafloor devices. Therefore, activities involving seafloor devices are not expected to impact submerged cultural resources. • For these reasons, physical disturbance and strike stressors in the Study Area would not impact cultural resources. • Since the noise exposure within the Olympic MOAs and W-237 is within the DoD's Noise Zone 1, on-land historic properties are not analyzed further, and there would be no significant impact on the seven properties that are listed or eligible for listing in the NRHP from noise in the Olympic MOAs. **Alternative 2:** • The number of activities that would create acoustic and physical disturbance and strike stressors would not increase significantly under Alternative 2 compared to Alternative 1; therefore, impacts on cultural resources under Alternative 2 would be the same as described under Alternative 1.

Table ES-1: Summary of Environmental Impacts for the No Action Alternative, Alternative 1, and Alternative 2 (continued)

Resource Category	Summary of Impacts
Section 3.11 American Indian and Alaska Native Traditional Resources	The Navy considered all stressors that could potentially impact American Indian and Alaska Native traditional resources as a result of the Proposed Action. The following conclusions have been reached for the project alternatives: **No Action Alternative:** • Discontinuing training and testing under the No Action Alternative would lessen the potential for impacts from those training and testing activities on American Indian and Alaska Native traditional resources. **Alternative 1 (Preferred Alternative):** • Navy training and testing activities could temporarily impede Tribal access to portions of their usual and accustomed fishing grounds in the Inland Waters of the Study Area, but no impacts are expected in the Offshore Area or to Alaska Native protected tribal resources in the Western Behm Canal. Training and testing activities are not expected to have a measurable effect on the availability of marine resources for harvest by Tribes. The potential for loss of or damage to fishing gear from Navy training and testing activities is low. **Alternative 2:** • The number of training activities that could impede Tribal access and result in damage to fishing gear would increase slightly under Alternative 2 compared to Alternative 1, resulting in a slight increase in the probability of the Navy's activities impeding access to portions of usual and accustomed fishing grounds or damaging fishing gear.

Table ES-1: Summary of Environmental Impacts for the No Action Alternative, Alternative 1, and Alternative 2 (continued)

Resource Category	Summary of Impacts
Section 3.12 Socioeconomic Resources	The Navy considered all stressors that could potentially impact socioeconomic resources as a result of the Proposed Action. The following conclusions have been reached for the project alternatives: **No Action Alternative:** • Discontinuing training and testing under the No Action Alternative would lessen the potential for impacts on commercial transportation and shipping, commercial and recreational fishing, and tourism and recreation from the proposed training and testing activities, but ceasing the proposed training and testing activities could have negative impacts on the socioeconomic resources of coastal areas in Washington State, Oregon, and Northern California. **Alternative 1 (Preferred Alternative):** • Impacts on socioeconomic resources are expected to be minor because inaccessibility to areas of co-use would be localized and temporary, the Navy's strict standard operating procedures would minimize physical disturbance and strikes of commercial and recreational watercraft, most airborne activities would occur well out to sea far from tourism and recreation locations, aircraft activities in the Olympic MOAs are expected to have negligible impacts on socioeconomic resources, and impacts to commercially important marine species are not expected. • There would be no disproportionately high impacts or adverse effects on any low-income populations or minority populations. **Alternative 2:** • The number of many training and testing activities under Alternative 2 would increase slightly over what is proposed for Alternative 1. However, this increase is not expected to appreciably change the potential for impacts on socioeconomic resources over what is analyzed for Alternative 1, as the types of impacts would be the same.

Table ES-1: Summary of Environmental Impacts for the No Action Alternative, Alternative 1, and Alternative 2 (continued)

Resource Category	Summary of Impacts
Section 3.13 Public Health and Safety	The Navy considered all stressors that could potentially impact public health and safety as a result of the Proposed Action. The following conclusions have been reached for the project alternatives: **No Action Alternative:** • Discontinuing training and testing under the No Action Alternative would lessen the potential for health and safety impacts from the training and testing activities to the public, but would not measurably improve the public's health and safety. **Alternative 1 (Preferred Alternative):** • The use of sonar, underwater explosives, radar, lasers, aircraft, vessels, in-water devices/targets, munitions, and seafloor devices would not adversely affect public health and safety because standard operating procedures are in place to ensure that there is no overlap between military and non-military activities. In addition, training and testing activities would not appreciably change the water quality in the region. **Alternative 2:** • The number of training and testing activities under Alternative 1 would increase slightly under Alternative 2, but the types of impacts would be the same as under Alternative 1. Training and testing activities would not impact public health and safety because standard operating procedures prevent overlap between military and non-military activities and would not appreciably change the water quality in the region.

Notes: Supplemental = Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement, Navy = United States Department of the Navy, U.S. = United States.

ES.6.1 Cumulative Impacts

The analysis in the 2015 NWTT Final EIS/OEIS stated that impacts to sediments and water quality, air quality, marine habitats, marine vegetation, cultural resources, socioeconomic resources, and public health and safety would be negligible, or at worst short-term and localized. Those conclusions remain valid for this Supplemental, and it remains unlikely that these short-term, localized impacts would overlap in time and space with other future actions that produce similar impacts. Therefore, the short-term impacts are not expected to contribute to cumulative impacts.

Regarding marine mammals, sea turtles, birds, fishes, and American Indian and Alaska Native traditional resources, the cumulative impacts analysis for this Supplemental revealed:

- Past human activities have impacted these resources to the extent that several marine mammal, sea turtle, bird, and fish species occurring in the Study Area are ESA-listed.
- The use of sonar and other non-impulsive sound sources under Alternative 1 and Alternative 2 has the potential to disturb or injure marine mammals and sea turtles. However, the incremental contribution of Alternatives 1 or 2 to cumulative impacts would be negligible.
- Explosive detonations and vessel strikes under Alternative 1 and Alternative 2 have the potential to disturb, injure, or kill marine mammals, sea turtles, fish, and birds. However, no population-level effects are expected, and the incremental contribution of Alternatives 1 or 2 to cumulative impacts would be negligible.
- Aircraft activities under Alternative 1 and Alternative 2 have the potential to disturb, injure, or kill birds; however, the incremental contribution of Alternatives 1 and 2 to cumulative impacts on bird populations would be low.
- Alternatives 1 and 2 could result in impacts on American Indian protected tribal resources and other traditional resources, because impeding access to areas of co-use such as usual and accustomed fishing grounds, even of short duration, may prevent fishing in limited seasons.

The aggregate impacts of past, present, and other reasonably foreseeable future actions are expected to result in significant impacts on some individual marine mammal and sea turtle species in the Study Area. Alternative 1 or Alternative 2 would contribute to cumulative impacts; however, marine mammal and sea turtle mortality and injury from non-Navy actions associated with commercial fisheries, commercial vessel strikes, and entanglement in marine debris are leading causes of direct mortality to marine mammals and sea turtles (Carretta et al., 2017; Helker et al., 2017; Lent & Squires, 2017; National Marine Fisheries Service, 2016; National Oceanic and Atmospheric Administration Marine Debris Program, 2014; Read et al., 2006). In summary, based on the analysis presented in Sections 3.4 (Marine Mammals), 3.5 (Sea Turtles), 3.6 (Birds), 3.9 (Fishes), and 3.11 (American Indian and Alaska Native Traditional Resources), the current aggregate impacts of past, present, and other reasonably foreseeable future actions are not significantly different than the assessment in the 2015 NWTT Final EIS/OEIS. For these resource sections Alternatives 1 or 2 would contribute to and increase cumulative impacts, but the relative contribution would be negligible compared to other non-Navy actions.

The analysis presented in Chapter 3 (Affected Environment and Environmental Consequences) and Chapter 4 (Cumulative Impacts) indicate that the incremental contribution of Alternative 1 or Alternative 2 to cumulative impacts on sediments and water quality, air quality, marine habitats, marine vegetation, cultural resources, socioeconomic resources, and public health and safety would be negligible.

ES.7 Standard Operating Procedures, Mitigation, and Monitoring

Within the Study Area, the Navy implements standard operating procedures, mitigation measures, and marine species monitoring and reporting. Navy standard operating procedures have the indirect benefit of reducing potential impacts on marine and terrestrial resources. Mitigation measures are designed to help reduce or avoid potential impacts on marine and terrestrial resources. Marine species monitoring efforts are designed to track compliance with take authorizations under the MMPA or ESA (or both), evaluate the effectiveness of mitigation measures, and improve understanding of the effects training and testing activities have on marine resources.

ES.7.1 Standard Operating Procedures

The Navy currently employs standard practices to provide for the safety of Navy and non-Navy personnel and equipment, including ships and aircraft, as well as the success of the training and testing activities. In many cases there are incidental environmental, socioeconomic, and cultural benefits resulting from standard operating procedures. Standard operating procedures serve the primary purpose of providing for safety and mission success, and are implemented regardless of their secondary benefits. Because standard operating procedures are crucial to safety and mission success, the Navy will not modify them as a way to further reduce effects to environmental resources. Due to their importance for maintaining safety and mission success, standard operating procedures have been considered as part of the Proposed Action under each alternative, and therefore are included in the Chapter 3 (Affected Environment and Environmental Consequences) environmental analyses for each resource.

ES.7.2 Mitigation

The Navy recognizes that the Proposed Action has the potential to impact the environment. Unlike standard operating procedures, which are established for reasons other than environmental benefit, mitigation measures are modifications to the Proposed Action that are implemented for the sole purpose of reducing a specific potential environmental impact on a particular resource. The Navy is coordinating with NMFS on these measures through the consultation and permitting processes. The Navy and NMFS RODs, MMPA Regulations and Letters of Authorization, National Historic Preservation Act consultation, the Government-to-Government process, and ESA Biological Opinions will document all mitigation that the military will implement under the Proposed Action.

For the purposes of the ESA Section 7 consultation, the mitigation measures proposed in this Supplemental may be considered by NMFS and U.S. Fish and Wildlife Service (USFWS) as beneficial actions taken by the Federal agency or applicant (50 CFR 402.14[g][8]). If necessary to satisfy requirements of the ESA, NMFS and USFWS may develop an additional set of measures contained in reasonable and prudent alternatives, reasonable and prudent measures, or conservation recommendations in any Biological Opinion issued for this Proposed Action.

Pursuant to the Navy's government-to-government consultations with federally recognized American Indian and Alaska Native Tribes, agreements, both formal and informal, on protocols or tribal mitigations may be developed to reduce or eliminate impacts on protected tribal treaty reserved rights and protected tribal resources.

Mitigation measures that the military will implement under the Proposed Action are organized into two categories: procedural mitigation and mitigation areas. Procedural mitigation is mitigation that will be implemented whenever and wherever an applicable military readiness activity takes place within the

Study Area. Mitigation areas are geographic locations within the Study Area where the military will implement additional mitigation during all or part of the year.

The geographic mitigation areas proposed by the Navy, described in Table ES-2, include a continuation from the 2015 NWTT Final EIS/OEIS with the addition of the Olympic Coast National Marine Sanctuary (for limits on mid-frequency 1 [MF1] sonar use), the humpback whale Stonewall and Heceta bank biologically important areas from May to November, the humpback whale Point St. George biologically important area from July to November, the gray whale Northern Puget Sound biologically important area from March to May, and live hard bottom, artificial reefs, shipwrecks and other seafloor resources areas.

Table ES-2: Summary of Geographic Mitigation

Mitigation Area Description
Stressor or Activity • Sonar • Explosives • Physical disturbance and strikes
Mitigation Requirements • **Seafloor Resource Mitigation Areas (year-round)** – Within the anchor swing circle of live hard bottom, artificial reefs, and shipwrecks, the Navy will not conduct precision anchoring (except in designated anchorages). – Within a 350-yd. radius of live hard bottom, artificial reefs, and shipwrecks, the Navy will not conduct explosive mine countermeasure and neutralization activities or explosive mine neutralization activities involving Navy divers (except in designated locations), and the Navy will not place mine shapes, anchors, or mooring devices on the seafloor (except in designated areas). • **50 Nautical Mile Coastal Buffer Mitigation Area (year-round)** – Within the 50 Nautical Mile Coastal Buffer Mitigation Area, the Navy will not conduct: (1) explosive training activities, (2) explosive testing activities (with the exception of explosive Mine Countermeasure and Neutralization Testing activities), (3) non-explosive missile training activities, and (4) non-explosive torpedo training activities. Should national security present a requirement to conduct these activities in the 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. • **20 Nautical Mile Coastal Buffer Mitigation Area (year-round)** – Within the 20 Nautical Mile Coastal Buffer Mitigation Area, the Navy will not conduct non-explosive large-caliber gunnery training activities and non-explosive bombing training activities. Should national security present a requirement to conduct these activities in the 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. • **12 Nautical Mile Coastal Buffer Mitigation Area (year-round)** – Within the 12 Nautical Mile Coastal Buffer Mitigation Area, the Navy will not conduct non-explosive small- and medium-caliber gunnery training activities and Anti-Submarine Warfare Tracking Exercise – Helicopter, Maritime Patrol Aircraft, Ship, or Submarine training activities. Should national security present a requirement to conduct these activities in the 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.

Table ES-2: Summary of Geographic Mitigation (continued)

Mitigation Area Description
<u>**Mitigation Requirements (continued)**</u> • <u>**Olympic Coast National Marine Sanctuary Mitigation Area (year-round)**</u> – Within the Olympic Coast National Marine Sanctuary Mitigation Area, the Navy will not conduct more than 32 hours of MF1 mid-frequency active sonar during training annually and will not conduct non-explosive bombing training activities. Should national security present a requirement to conduct more than 32 hours of MF1 mid-frequency active sonar during training annually or conduct non-explosive bombing training activities in the 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. – Within the Olympic Coast National Marine Sanctuary Mitigation Area, Naval Sea Systems Command will not conduct more than 33 hours of MF1 mid-frequency active sonar during testing annually (except within the portion of the mitigation area that overlaps the Quinault Range Site) and will not conduct explosive Mine Countermeasure and Neutralization Testing activities. Should national security present a requirement for Naval Sea Systems Command to conduct more than 33 hours of MF1 mid-frequency active sonar during testing annually (except within the portion of the mitigation area that overlaps the Quinault Range Site) or conduct explosive Mine Countermeasure and Neutralization Testing activities in the 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. • <u>**Stonewall and Heceta Bank Mitigation Area (May – November)**</u> – Within the Stonewall and Heceta Bank Mitigation Area, the Navy will not use MF1 mid-frequency active sonar or explosives during training and testing from May to November. Should national security present a requirement to use MF1 mid-frequency active sonar or explosives during training and testing from May to November, 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. • <u>**Point St. George Mitigation Area (July – November)**</u> – Within the Point St. George Mitigation Area, the Navy will not use MF1 mid-frequency active sonar or explosives during training and testing from July to November. Should national security present a requirement to use MF1 mid-frequency active sonar or explosives during training and testing from July to November, 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. • <u>**Puget Sound and Strait of Juan de Fuca Mitigation Area (year-round)**</u> – Within the Puget Sound and Strait of Juan de Fuca Mitigation Area, the Navy will not use hull-mounted mid-frequency active sonar during training and testing, except during active sonar pierside maintenance or testing. Should national security present a requirement to use hull-mounted mid-frequency active sonar during training and testing (except during active sonar pierside maintenance or testing), 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. – Within the Puget Sound and Strait of Juan de Fuca Mitigation Area, the Navy will not use high-frequency active sonar during training and testing, except during: (1) Civilian Port Defense – Homeland Security Anti-Terrorism/Force Protection Exercises, (2) testing in designated Naval Sea Systems Command testing ranges, and (3) active sonar pierside maintenance or testing. Should national security present a requirement to use high-frequency active sonar during training and testing (other than during the excepted activities listed above), 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.

Table ES-2: Summary of Geographic Mitigation (continued)

Mitigation Area Description
• **<u>Puget Sound and Strait of Juan de Fuca Mitigation Area (year-round) (continued)</u>** – Within the Puget Sound and Strait of Juan de Fuca Mitigation Area, the Navy will require units to obtain approval from the appropriate designated Command authority prior to: (1) the use of active sonar during Civilian Port Defense – Homeland Security Anti-Terrorism/Force Protection Exercises, and (2) conducting ship and submarine active sonar pierside maintenance or testing. • **<u>Northern Puget Sound Mitigation Area (March – May)</u>** – Within the Northern Puget Sound Mitigation Area, the Navy will not conduct Civilian Port Defense – Homeland Security Anti-Terrorism/Force Protection Exercises from March to May. Should national security present a requirement to conduct Civilian Port Defense – Homeland Security Anti-Terrorism/Force Protection Exercises from March to May, 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.

ES.7.3 Monitoring

As described in the 2015 NWTT Final EIS/OEIS, the Navy remains committed to demonstrating environmental stewardship while executing its National Security Mission and complying with the suite of federal environmental laws and regulations, and providing required and relevant reports to appropriate regulatory agencies.

Consistent with the cooperating agency agreement with NMFS, mitigation and monitoring measures presented in this Supplemental focus on the requirements for protection and management of marine resources. Since monitoring will be required for compliance with the Final Rule issued for the Proposed Action under the MMPA, details of the monitoring program are being developed in coordination with NMFS through the regulatory process.

The Integrated Comprehensive Monitoring Program is intended to coordinate monitoring efforts across all regions where the Navy trains and to allocate the most appropriate level and type of effort for each range complex. The current Navy monitoring program is composed of a collection of “range-specific” monitoring plans, each developed individually as part of MMPA and ESA compliance processes as environmental documentation was completed. These individual plans establish specific monitoring requirements for each range complex and are collectively intended to address the Integrated Comprehensive Monitoring Program top-level goals. A Scientific Advisory Group of leading marine mammal scientists developed recommendations that would serve as the basis for a Strategic Plan for Navy monitoring. The Strategic Plan is intended to be a primary component of the Integrated Comprehensive Monitoring Program and provide a “vision” for Navy monitoring across geographic regions—serving as guidance for determining how to most efficiently and effectively invest the marine species monitoring resources to address Integrated Comprehensive Monitoring Program top-level goals and satisfy MMPA regulatory requirements. The objective of the Strategic Plan is to continue the evolution of Navy marine species monitoring towards a single integrated program, incorporating Scientific Advisory Group recommendations, and establishing a more transparent framework for soliciting, evaluating, and implementing monitoring work across the Navy’s range complexes and testing ranges.

ES.7.4 Reporting

The Navy continues to document and report to the appropriate regulatory agencies (e.g., NMFS, USFWS) relevant aspects of training and testing activities in order to reduce environmental impacts and improve future environmental assessments. Initiatives include exercise and monitoring reporting, stranding response planning, and reporting of any incidents if they occur (e.g., vessel or aircraft strikes).

ES.7.5 Other Considerations

ES.7.5.1 Consistency with Other Federal, State, and Local Plans, Policies and Regulations

Based on an evaluation of consistency with statutory obligations, the Navy's proposed training and testing activities would not conflict with the objectives or requirements of federal, state, regional, or local plans, policies, or legal requirements. The Navy is consulting and will continue to consult with regulatory agencies as appropriate during the NEPA process and prior to implementation of the Proposed Action to ensure all legal requirements are met.

ES.7.5.2 Relationship Between Short-Term Use of the Human Environment and Maintenance and Enhancement of Long-Term Productivity

In accordance with NEPA, this Supplemental provides an analysis of the relationship between a project's short-term impacts on the environment and the effects that these impacts may have on the maintenance and enhancement of the long-term productivity of the affected environment. The Proposed Action may result in both short- and long-term environmental effects. However, the Proposed Action would not be expected to result in any impacts that would reduce environmental productivity; permanently narrow the range of beneficial uses of the environment; or pose long-term risks to health, safety, or the general welfare of the public. See Chapter 3 (Affected Environment and Environmental Consequences) and Appendix J (Airspace Noise Analysis for the Olympic Military Operations Areas).

ES.7.5.3 Irreversible or Irretrievable Commitment of Resources

For the alternatives including the Proposed Action, most resource commitments are neither irreversible nor irretrievable. Most impacts are short-term and temporary or, if long lasting, are negligible. No habitat associated with threatened or endangered species would be lost as result of implementation of the Proposed Action. Since there would be no building or facility construction, the consumption of materials typically associated with such construction (e.g., concrete, metal, sand, fuel) would not occur. Energy typically associated with construction activities would not be expended and irreversibly lost.

Implementation of the Proposed Action would require the use of fuels by aircraft, ships, and ground-based vehicles. Since fixed- and rotary-wing flight and ship activities could increase, relative total fuel use could increase. Therefore, if total fuel consumption increased, this nonrenewable resource would be considered irretrievably lost.

ES.7.5.4 Energy Requirements and Conservation Potential of Alternatives and Mitigation Measures

Resources that will be permanently and continually consumed by project implementation include water, electricity, natural gas, and fossil fuels; however, the amount and rate of consumption of these resources would not result in significant environmental impacts or the unnecessary, inefficient, or wasteful use of resources. Prevention of the introduction of potential contaminants is an important component of mitigation of the preferred alternative's adverse impacts. To the extent practicable, considerations in the prevention of introduction of potential contaminants are included.

Sustainable range management practices are in place that protect and conserve natural and cultural resources and preserve access to training areas for current and future training requirements while addressing potential encroachments that threaten to impact range and training area capabilities.

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Appendices

Acronyms and Abbreviations

Acronym	Definition
µPa	micropascal
°	Degree(s)
A-A	Air-to-Air
A-S	Air-to-Surface
ac.	Acre(s)
AMRAAM	Advanced Medium-Range Air-to-Air Missile
ANSI	American National Standards Institute
APE	Area of Potential Effect
ATCAA	Air Traffic Control Assigned Airspace
BIA	Biologically Important Area
BO	Biological Opinion
C	Celsius
CD	Consistency Determination
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cm	Centimeter(s)
CMP	Coastal Management Program
CO	carbon monoxide
CZMP	Coastal Zone Management Plan
dB	decibels
dB re 1 µPa	decibels referenced to 1 micropascal
dBA	A-weighted decibels
dBA re 20 µPa	A-weighted decibel(s) referenced to 20 micropascals
dBA re 20 $\mu Pa\text{-}s^2$	A-weighted decibel(s) referenced to 20 micropascals squared seconds
DBRC	Dabob Bay Range Complex
DCAST	Data Collection and Scheduling Tool
DNL	Day Night Average Sound Level
DNL_r	Onset Rate Adjusted Day Night Level
DoD	Department of Defense
DPS	Distinct Population Segment
EA	Environmental Assessment
EC	Ecosystem Component
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EFHA	Essential Fish Habitat Assessment
EIS	Environmental Impact Statement
EO	Executive Order
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
F	Fahrenheit
FAA	Federal Aviation Administration
FICAN	Federal Interagency Committee on Aircraft Noise
FICON	Federal Interagency Committee on Noise
FICUN	Federal Interagency Committee on Urban Noise
FMP	Fisheries Management Plan
ft.	Foot/Feet
$ft.^2$	Square Feet
FR	Federal Register
HAPC	Habitat Area of Particular Concern
HARM	High-Speed Anti-Radiation Missile
HCP	Habitat Conservation Plan
HE-ET	High Explosive - Electronic Time

Acronym	Definition
HF	High frequency
Hz	Hertz
kHz	kilohertz
INRMP	Integrated Natural Resource Management Plan
kg	Kilogram
km	Kilometer
lb.	Pound(s)
L_{dn}	Day-Night Average Sound Level
L_{dnr}	Onset Rate Adjusted Day-Night Average Sound Level
L_{max}	Maximum Received Noise Level
LOA	Letter of Authorization
LRM	Logistical regression model
m	Meter(s)
MARPOL	International Convention for the Prevention of Pollution from Ships
MAX	Maximum
MBTA	Migratory Bird Treaty Act
mERM-Q	Mean Effects Range Median Quotient
MF	Mid-frequency
mg/L	Milligrams per Liter
mi.	Mile(s)
$mi.^2$	Square mile(s)
min.	Minute(s)
mm.	Millimeter(s)
MMA	Multi Mission Maritime Aircraft
MMPA	Marine Mammal Protection Act
MOA	Military Operations Area
MPA	Marine Protected Area
MRNMap	MOA and Route NoiseMap Model
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSL	Mean Sea Level
N	North
NAAQS	National Ambient Air Quality Standards
NAS	Naval Air Station
NASWI	Naval Air Station Whidbey Island
NAVBASE	Naval Base
Navy	United States Department of the Navy
NBK	Naval Base Kitsap
NDBC	National Data Buoy Center
NEPA	National Environmental Policy Act
NEW	Net Explosive Weight
NHPA	National Historic Preservation Act
NM	Nautical Mile(s)
NMFS	National Marine Fisheries Service
NO_X	nitrogen oxides
NOAA	National Oceanic Atmospheric Administration
NOTAM	Notices to Airmen
NRHP	National Register of Historic Places
NS	Naval Station
NTM	Notice to Mariners
NWTT	Northwest Training and Testing
OCNMS	Olympic Coast National Marine Sanctuary
OEIS	Overseas Environmental Impact Statement
OPAREA	Operational Area
OSHA	Occupational Safety and Health Organization
Pa-s	Pascal second(s)
PCE	Primary Constituent Element
$PM_{2.5}$	particulate matter ≤ 2.5 microns in diameter
PM_{10}	particulate matter ≤ 10 microns in diameter

Acronym	Definition
psi-ms	per square inch per millisecond
PTS	Permanent threshold shift
QRS	Quinault Range Site
RDX	Royal Demolition Explosive
ROD	Record of Decision
SAR	Stock Assessment Reports
SCUBA	Self-contained Underwater Breathing Apparatus
SEAFAC	Southeast Alaska Acoustic Measurement Facility
SEL	Sound Exposure Levels
SHARP	Sierra Hotel Aviation Reporting Program
SOC	Species of Concern
SO_x	sulfur oxides
SPL	Sound Pressure Level
SRKW	Southern Resident Killer Whale
SUA	Special Use Airspace
TOC	total organic carbon
TPS	Transit Protection System
TS	Threshold Shift
TTS	Temporary threshold shift
U&A	usual and accustomed
U.S.	United States
U.S.C.	United States Code
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service
UUV	Unmanned Underwater Vehicle
VAQ	Electronic Attack Squadron
VOC	Volatile Organic Compounds
yd.	Yard

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1 Purpose and Need

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1 Purpose and Need

1.1 Introduction

The United States (U.S.) Department of the Navy (Navy) has prepared this supplement to the October 2015 *Final Northwest Training and Testing Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS)* (U.S. Department of the Navy, 2015), hereinafter referred to as the 2015 NWTT Final EIS/OEIS, pursuant to 40 Code of Federal Regulations (CFR) section 1502.9(c)(2). The Navy proposes to conduct training activities (hereinafter referred to as "training") and research, development, testing, and evaluation (hereinafter referred to as "testing") activities in the Northwest Training and Testing (NWTT) Study Area (Figure 1.1-1). The Study Area includes the at-sea areas off the coast of Washington, Oregon, and northern California; in the Western Behm Canal, Alaska; and at select Navy pierside and harbor locations. Training and testing activities, collectively referred to as "military readiness activities," that prepare the Navy to fulfill its mission to protect and defend the United States and its allies, have the potential to impact the environment. The Navy prepared this Supplemental EIS/OEIS (hereinafter referred to as this Supplemental) to comply with the National Environmental Policy Act (NEPA) and Executive Order 12114, *Environmental Effects Abroad of Major Federal Actions,* by assessing the potential environmental impacts associated with the proposed military readiness activities to be conducted within the Study Area.

This Supplemental was prepared to update the Navy's assessment of the potential environmental impacts associated with proposed training and testing to be conducted at sea. These proposed activities are generally consistent with those analyzed in the 2015 NWTT Final EIS/OEIS, and are representative of activities the military has conducted in the Study Area for decades. These military readiness activities include the use of active sonar and other acoustic sources, as well as the use of explosives and other types of training and testing.

New information specifically addressed in this Supplemental includes updates to training and testing requirements and activities, an updated acoustic effects model[1], updated marine mammal density data, and evolving and emergent best available science. Using the updated information, the Navy will seek the reissuance of federal regulatory permits and authorizations under the Marine Mammal Protection Act (MMPA) and Endangered Species Act (ESA) to support training and testing requirements within the Study Area upon the expiration of current authorizations and consultation in 2020. The Navy will consult with the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service to renew these authorizations and issue appropriate permits.

The United States is facing increased global disorder, characterized by a decline in the long-standing rules-based international order—creating a more complex and volatile security environment. Major conflicts, terrorism, outlaw actions, and natural disasters all have the potential to threaten the national security of the United States. The security, prosperity, and vital interests of the United States are increasingly tied to other nations because of the close relationships between the United States and other national economies. The Navy operates on the world's oceans, seas, and coastal areas—the

[1] The 2015 NWTT Final EIS/OEIS used a new modeling system known as the Navy Acoustics Effects Model and marine mammal density information, developed by the Navy in cooperation with the National Marine Fisheries Service, that was the best available information at the time. The Navy Acoustics Effects Model has been refined, marine mammal density estimates have been updated, NMFS has published new criteria, and criteria used in the acoustic model have been revised.

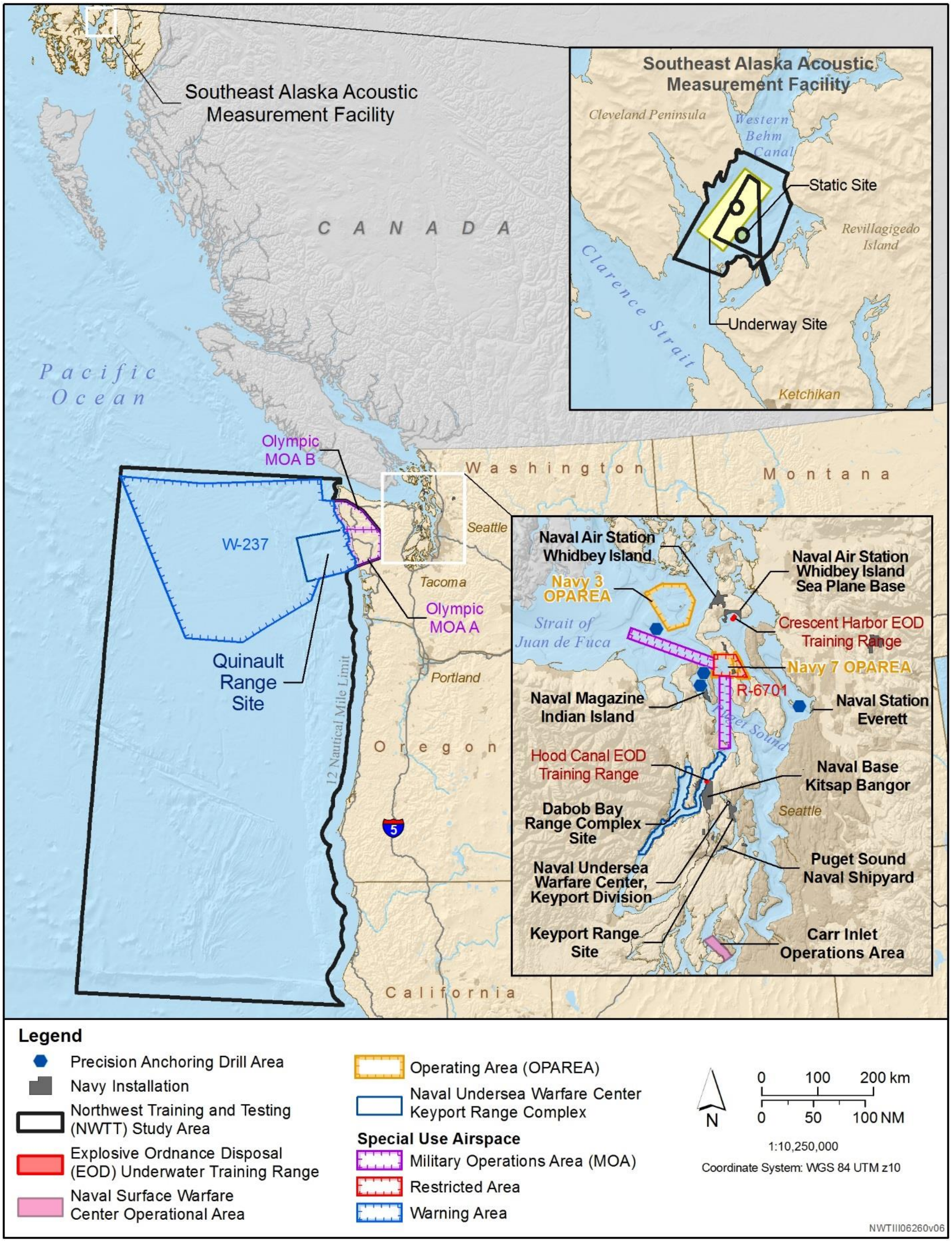

Figure 1.1-1: Northwest Training and Testing Study Area

international maritime domain—on which 90 percent of the world's trade and two-thirds of its oil are transported. The majority of the world's population also lives within a few hundred miles of an ocean. The U.S. Navy carries out training and testing activities to be able to protect the United States against its potential adversaries, to protect and defend the rights and interests of the United States and its allies to move freely on the oceans, and to provide humanitarian assistance.

The 2015 NWTT Final EIS/OEIS Study Area consisted of three components: (1) the Offshore Area, (2) the Inland Waters, and (3) the Western Behm Canal, Alaska. Collectively, for the purposes of this Supplemental, these areas are unchanged and continue to be referred to as the Study Area (Figure 1.1-1).

1.2 The Navy's Environmental Compliance and At-Sea Policy

In 2000, the Navy completed a review of its environmental compliance requirements for exercises and training at sea. The Navy then instituted the "At-Sea Policy" (U.S. Department of the Navy, 2000) to ensure compliance with applicable environmental regulations and policies, and preserve the flexibility necessary for the Navy and Marine Corps to train and test at sea. This policy directed, in part, that Fleet Commanders develop a programmatic approach to environmental compliance at sea for ranges and operational areas (OPAREAs) within their respective geographic areas of responsibility (U.S. Department of the Navy, 2000). Those ranges affected by the "At-Sea Policy" are designated water areas, sometimes containing instrumentation, that are managed by the Navy and used to conduct training and testing activities. Some ranges are further broken down into OPAREAs to better manage and deconflict military readiness activities.

In 2005, the Navy and the National Oceanic and Atmospheric Administration reached an agreement on a coordinated programmatic strategy for assessing certain environmental effects of military readiness activities at sea. The Navy is currently in the third phase (Phase I and Phase II were described in Section 1.2, The Navy's Environmental Compliance and At-Sea Policy, of the 2015 NWTT Final EIS/OEIS) of implementing this programmatic approach, which covers similar types of Navy training and testing activities in the same NWTT Study Area analyzed in Phase II. As was done in Phase I and Phase II, the Navy will use the Phase III analysis to support regulatory consultations and a request for a letter of authorization under the MMPA and incidental take statements under the ESA. Given that the training and testing activities and many areas of environmental analysis remain similar to those addressed in Phase II, and the same Study Area is used for the proposed activities, the Navy determined a Supplemental to be appropriate for Phase III of the Navy's environmental compliance planning in the NWTT Study Area. For further discussion of the first two phases, please see Section 1.2 (The Navy's Environmental Compliance and At-Sea Policy) of the 2015 NWTT Final EIS/OEIS.

1.3 Proposed Action

The Navy's Proposed Action, described in detail in this Supplemental in Chapter 2 (Description of Proposed Action and Alternatives), is to conduct military readiness training and testing activities in the Study Area (Figure 1.1-1).

1.4 Purpose and Need

The Navy and NMFS (as a cooperating agency under the provisions of NEPA) have coordinated from the outset and developed this document to meet each agency's separate and distinct NEPA obligations and support the independent decision making of both agencies. The Navy's purpose for the Proposed Action is to ensure that the Navy meets its statutory mission, which is to maintain, train, and equip combat-ready naval forces capable of winning wars, deterring aggression, and maintaining freedom of the seas. This mission is achieved in part by conducting training and testing within the Study Area in accordance with established Navy military readiness requirements. The sections that follow provide a description of the need for military readiness activities.

The Navy will request reauthorization from NMFS to "take" marine mammals incidental to conducting training and testing activities in the Study Area by Level A and B harassment, serious injury, or mortality. Take under the MMPA is defined as "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." For military readiness activities, harassment is defined as "(i) any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment] or (ii) any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered [Level B harassment]."

The purpose of issuing incidental take authorizations is to provide an exception to the take prohibition in the MMPA and to ensure that the Navy's proposed training and testing activities comply with the MMPA and implementing regulations. Incidental take authorizations may be issued as either (1) regulations and associated LOAs under section 101(a)(5)(A) of the MMPA, or (2) Incidental Harassment Authorizations (IHAs) under section 101(a)(5)(D) of the MMPA. An IHA can be issued only when there is no potential for serious injury or mortality or where any such potential can be negated through required mitigation measures. Because some of the activities under the Proposed Action may create a potential for lethal takes or takes that may result in serious injury that could lead to mortality, the Navy is requesting rulemaking and the issuance of LOAs for this action.

NMFS's purpose is to evaluate the Navy's Proposed Action pursuant to NMFS's authority under the MMPA, and to make a determination whether to issue incidental take regulations and LOAs, including any conditions needed to meet the statutory mandates of the MMPA. To authorize the incidental take of marine mammals, NMFS evaluates the best available scientific information to determine whether the take would have a negligible impact on the affected marine mammal species or stocks and an unmitigable impact on their availability for taking for subsistence uses (not relevant here for Navy's Proposed Action). NMFS must also prescribe permissible methods of taking, other "means of effecting the least practicable adverse impact" on the affected species or stocks and their habitat, and monitoring and reporting requirements. NMFS cannot issue an incidental take authorization unless it can make the required findings. The need for NMFS's action is to consider the impacts of the Navy's activities on marine mammals and meet NMFS' obligations under the MMPA. This Draft Supplemental analyzes the environmental impacts associated with issuance of the requested authorization of the take of marine mammals incidental to the training and testing activities (and their corresponding mitigation measures) within the Study Area. The analysis of mitigation measures considers benefits to species or stocks and their habitat, and analyzes the practicability and efficacy of each measure. This analysis of mitigation measures was used to support requirements pertaining to mitigation, monitoring, and reporting that would be specified in final MMPA regulations and subsequent LOAs.

1.4.1 Why the Navy Trains

As described above, the Navy is statutorily mandated to protect U.S. national security by being ready, at all times, to effectively prosecute war and defend the nation by conducting operations at sea. The Navy is essential to protecting U.S. national interests, considering that 70 percent of the earth is covered in water, 80 percent of the planet's population lives within close proximity to coastal areas, and 90 percent of global commerce is conducted by sea. Naval forces must be ready for a variety of military operations to deal with the dynamic, social, political, economic, and environmental issues that occur in today's world. Through its continuous presence on the world's oceans, the Navy can respond to a wide range of situations because, on any given day, over one-third of its ships, submarines, and aircraft are deployed overseas. Units must be able to respond promptly and effectively while forward deployed. This presence helps to dissuade aggression, which prevents conflict escalation, and provides the President with options to promptly address global contingencies. Before deploying, naval forces must train to develop a broad range of capabilities to respond to threats, from full-scale armed conflict in a variety of different geographic areas and environmental conditions to humanitarian assistance and disaster relief efforts. Training prepares Navy personnel to be proficient in operating and maintaining the equipment, weapons, and systems they will use to conduct their assigned missions. The training process provides personnel with an in-depth understanding of their individual limits and capabilities; the training process also helps the testing community improve new weapon systems' capabilities and effectiveness. Refer to Chapter 1, Section 1.4.1 (Why the Navy Trains) in the 2015 NWTT Final EIS/OEIS for additional information on Navy training.

1.4.2 Optimized Fleet Response Training

The Fleet Response Plan that the Navy operated under during Phase I and II emphasized constant readiness, with the number of personnel and vessels that had to be ready to deploy on short notice identified in the plan. However, due to world events and the increasing need for naval forces to be located overseas, Navy vessels deployed for longer periods than previously planned, resulting in longer maintenance periods. Therefore, the Fleet Response Plan no longer represented fleet readiness preparation requirements.

In December 2014, the Navy initiated the Optimized Fleet Response Plan, which better aligns manning distribution with operational requirements; optimizes maintenance and modernization plans; improves the overall quality of work and life balance for personnel; and ensures that forces deploy with the right capabilities, properly trained and equipped to meet mission objectives. The Optimized Fleet Response Plan outlines the training activities required to achieve a state of military readiness that will enable Navy personnel to execute operations as ordered by their Commanders, to include responding to a conflict. The plan uses a building-block approach and proceeds in five phases: maintenance, basic, advanced, integrated, and sustainment, as depicted in Figure 1.4-1.

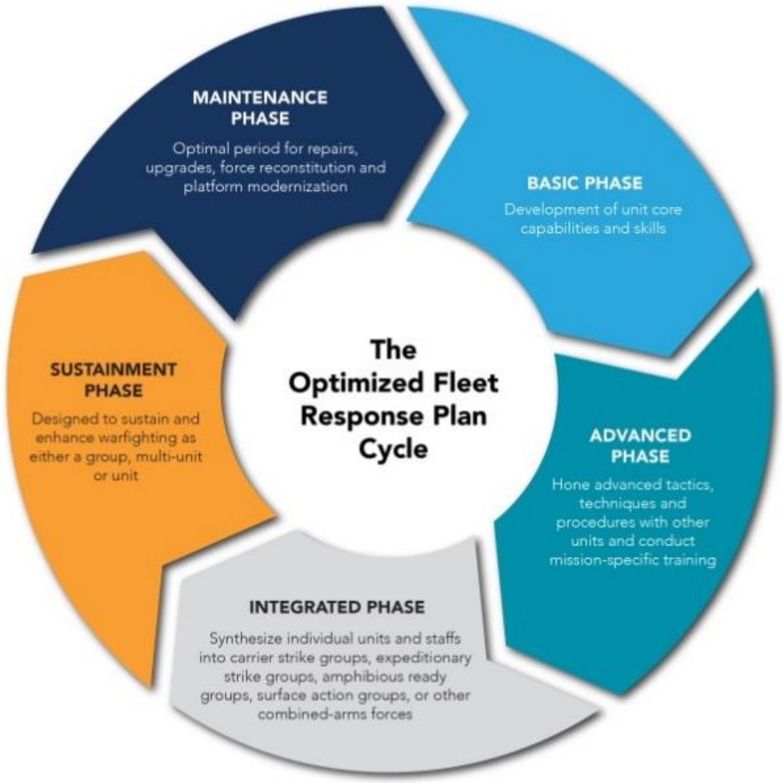

Figure 1.4-1: Optimized Fleet Response Plan

1.4.3 Why the Navy Tests

The Navy's research and acquisition community, including research-funding organizations, laboratory facilities, and systems commands, have a mission to provide weapons, systems, and platforms for the Navy to support its missions and ensure a technological edge over the United States' potential adversaries. This community is at the forefront of researching, developing, testing, evaluating, acquiring, and delivering modern platforms, systems, and related equipment to meet fleet capability and readiness requirements. The Navy's research funding organizations and laboratories concentrate primarily on the development of new science and technology, and the initial testing of concepts that are relevant to the Navy of the future. As a result, systems commands develop ship, aircraft, and weapons products that support all Navy platforms throughout their life cycles from systems acquisition through sustainment to end of life. Refer to Chapter 1, Section 1.4.3 (Why the Navy Tests) in the 2015 NWTT Final EIS/OEIS for additional information on Navy testing.

The Navy's research and acquisition community operating in the Study Area includes the following commands:

- Naval Air Systems Command, which develops, tests, acquires, delivers, and sustains naval aviation aircraft, unmanned aerial systems, weapons, and systems
- Naval Sea Systems Command, which develops, acquires, delivers, and maintains surface ships, submarines, unmanned vehicles, and weapon system platforms

1.5 Overview and Strategic Importance of Existing Range Complexes and Testing Ranges

The range complexes analyzed in this Supplemental have existed for decades, many dating back to the early 1900s. Range use and infrastructure have developed over time as military readiness requirements in support of modern warfare have evolved. The Study Area for this Supplemental is the same as that covered in the 2015 NWTT Final EIS/OEIS; the Navy is not proposing to change or expand the Study Area.

Proximity of the Navy's training and testing areas to naval homeports and air stations creates efficiency in the utilization of government resources as well as safe conditions in which naval forces may train and test. Training and testing events taking place in close proximity to naval homeports and naval air stations occur in areas equipped with robust search and rescue capabilities, medical facilities, and divert airfields, all of which are necessary to safely execute training and testing activities at sea. Fuel is saved and equipment is exposed to less wear when ranges are near where the platforms are based. The proximity of training to homeports also ensures that Sailors and Marines do not need to spend unnecessary time away from their families during the training cycle. Less time away from home is an important factor in military readiness, morale, and retention. The proximate availability of the Navy's training and testing areas in the Pacific Northwest is critical to Navy efforts in these areas.

Systems commands also require access to a realistic environment to conduct testing. The systems commands frequently conduct tests on fleet range complexes and use fleet assets to support the testing. The Study Area must provide the flexibility to meet diverse testing requirements, given the wide range of various advanced platforms and systems and capabilities that the fleets and systems commands must demonstrate before certification for utilization by the fleet. This is important because testing in controlled conditions similar to those in which technology could be employed enhances combat readiness.

1.6 The Environmental Planning Process

NEPA and Executive Order 12114 requires federal agencies to examine the environmental impacts of their proposed actions within the United States and its territories. An EIS/OEIS is a detailed public document that assesses the potential effects that a major federal action might have on the human environment (includes the natural and biological environment). The Navy undertakes environmental planning for major Navy actions occurring throughout the world in accordance with applicable laws, regulations, and Executive Orders.

A supplemental EIS is prepared when the agency makes substantial changes in the proposed action that are relevant to environmental concerns (40 CFR section 1502.9(c)(1)(i)), or there are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts (40 CFR section 1502.9(c)(1)(ii)). An agency may also supplement a final EIS when the agency determines that the purpose of NEPA will be furthered by doing so (40 CFR section 1502(c)(2)).

Pursuant to 40 CFR section 1502.9(c)(1), the Navy has prepared this Supplement to the 2015 NWTT Final EIS/OEIS. This Supplemental will consider future activities conducted at sea, and updated training and testing requirements; incorporate new information from an updated acoustic effects model and updated marine mammal density data; and incorporate evolving and emergent best available science. It will also support any reissuance of federal regulatory permits and authorizations under the MMPA and the ESA using the best available science and analytical methods to assess potential environmental impacts.

1.6.1 National Environmental Policy Act Requirements

When developing a supplement to an existing EIS/OEIS, the first step in the NEPA process (Figure 1.6-1) is to prepare a Notice of Intent. The Notice of Intent is published in the *Federal Register* and in local newspapers, and provides an overview of the proposed action and the scope of the Supplemental (see Appendix G, Federal Register Notices). The Notice of Intent is also the first step in engaging the public, initiating the scoping process.

Scoping is an early and open process for developing the "scope" of issues to be addressed in an EIS and for identifying significant issues related to a proposed action. In accordance with the Council on Environmental Quality regulations for implementing the requirements of NEPA, scoping is not required for a supplement to a draft or final EIS; however, in an effort to maximize public participation and ensure the public's input was considered, the Navy chose to conduct a scoping period for this Supplemental.

After the scoping process, a Draft Supplemental is prepared to assess potential impacts of the proposed action and alternatives on the environment. When completed, a Notice of Availability is published in the *Federal Register*, and notices are placed in local or regional newspapers announcing the availability of the Draft Supplemental. The Draft Supplemental is circulated for public review and comment. Public meetings may also be scheduled to further inform the public and solicit their comments.

The Final Supplemental addresses all public comments received on the Draft Supplemental. Responses to public comments may include factual corrections, supplements, or modifications to analysis, and inclusion of new information. Additionally, responses may explain why the comments do not warrant further agency response.

Finally, the decision-maker will issue a Record of Decision no earlier than 30 days after the Final Supplemental is made available to the public.

For a description of how the Navy complies with each of these requirements during the development of this NWTT Supplemental, please see Chapter 8 (Public Involvement and Distribution).

Figure 1.6-1: National Environmental Policy Act Process

1.6.2 Executive Order 12114

Executive Order 12114 of 1979, *Environmental Impacts Abroad of Major Federal Actions*, furthers the purpose of NEPA by directing federal agencies to provide for informed environmental decision making for major federal actions outside the United States and its territories. Presidential Proclamation 5928, issued December 27, 1988, extended the exercise of U.S. sovereignty and jurisdiction under international law to 12 nautical miles (NM); however, the proclamation expressly provides that it does not extend or otherwise alter existing federal law or any associated jurisdiction, rights, legal interests, or obligations. Thus, as a matter of policy, the Navy analyzes environmental effects and actions within 12 NM under NEPA (an EIS) and those effects occurring beyond 12 NM under the provisions of EO 12114 (an OEIS).

1.6.3 Other Environmental Requirements Considered

The Navy must comply with all applicable federal environmental laws, regulations, and executive orders as discussed in the 2015 NWTT Final EIS/OEIS. Further information can be found in Chapter 6 (Additional Regulatory Considerations).

1.7 Scope and Content

In this Supplemental, the Navy analyzed at-sea military readiness activities that could potentially impact human and natural resources, especially marine mammals, sea turtles, and other marine resources. Since the completion of the 2015 NWTT Final EIS/OEIS, new information has become available and is incorporated in this analysis. The range of alternatives includes the No Action Alternative and two action alternatives. This Supplemental updates the 2015 analysis of direct, indirect, and cumulative impacts that may result from the Proposed Action. The Navy is the lead agency for the Proposed Action and is responsible for the scope and content of this Supplemental; however, there are two designated cooperating agencies pursuant to 40 CFR section 1501.6. The U.S. Coast Guard is a cooperating agency as this document assesses potential impacts of U.S. Coast Guard activities that support the Navy in the Study Area. The National Oceanic Atmospheric Administration's (NOAA) NMFS is serving as a cooperating agency because the scope of the Proposed Action and alternatives involves activities that have the potential to impact protected resources under their jurisdiction by law and special expertise, including marine mammals, threatened and endangered species, Essential Fish Habitat, and National Marine Sanctuaries. NOAA's authorities and special expertise is based on their statutory responsibilities under the MMPA, the ESA, the Magnuson-Stevens Fishery Conservation and Management Act, and the National Marine Sanctuaries Act (16 United States Code sections 1431-1445c-1). In addition, NMFS, in accordance with 40 CFR sections 1506.3 and 1505.2, may adopt this EIS/OEIS and issue a separate Record of Decision associated with its decision to grant or deny the Navy's request for an incidental take authorization pursuant to Section 101(a)(5)(A) of the MMPA.

Under this Supplemental, the Navy has evaluated the potential environmental impacts of training and testing activities within the NWTT Study Area involving different types of platforms and weapons systems, including EA-18G Growler aircraft. In the Pacific Northwest, separate NEPA documents were prepared for EA-18G "Growler" Airfield Operations, Electronic Warfare Training, and Naval Special Operations Training. The Navy prepares separate NEPA documents covering different proposed activities because each document is focused on a specific proposed action, is separated from other actions by its purpose and need, has independent utility, has different timing, and involves differing geographic locations. Specifically, this Supplemental, which is designed to address the Navy's statutory responsibility to maintain ready forces, analyzes the potential impacts of training and testing activities from the year 2020 forward.

The EIS for EA-18G "Growler" Airfield Operations at Naval Air Station Whidbey Island Complex (U.S. Department of the Navy, 2018a), which is designed to address an increase in such aircraft and associated personnel slated to occur in the near future, is focused on aircraft operations in and around Naval Air Station Whidbey Island Complex and installation facility improvements required by the operation of the Growler at Whidbey Island. Similarly, the Environmental Assessment covering Electronic Warfare Training in the Pacific Northwest (U.S. Department of the Navy, 2014) was focused on an immediate need to secure permits for driving emitter trucks on inland forest roads on federal and state property in the Olympic Peninsula to support ongoing electronic warfare training occurring in the Offshore Area (see Figure 2.2-2); also, the Environmental Assessment for Naval Special Operations

Training in Western Washington State (U.S. Department of the Navy, 2018b) supports training activities specifically for naval special operations personnel.

While the Navy has analyzed, and is currently analyzing, various proposed actions in the area, those proposed actions are not preconditions for the training and testing activities occurring in the NWTT Study Area and covered by this Supplemental. Training and testing in the NWTT Study Area would continue if regulatory and permitting actions were approved, regardless of the decisions made regarding EA-18G "Growler" Airfield Operations, Electronic Warfare Training, or Naval Special Operations Training. This Supplemental does consider the cumulative impacts from these three projects as well as other past, present, and reasonable foreseeable future actions in Chapter 4 (Cumulative Impacts).

A cumulative impact is the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. The scope of the cumulative impacts analysis involves both the geographic and temporal extent of the effects in which the coincidental effects could be expected to occur. For this analysis, the Study Area is resource-specific, as identified in Chapter 3 for each respective resource area. The time frame for the cumulative impacts centers on the timing of the Proposed Action.

1.8 Organization of This Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement

This Supplemental is organized as follows:

- Chapter 1 (Purpose and Need) describes the purpose of and need for the Proposed Action.
- Chapter 2 (Description of Proposed Action and Alternatives) describes the Proposed Action, proposed changes to the 2015 NWTT Final EIS/OEIS implemented actions projected to take place starting in 2020, and alternatives to be carried forward for analysis.
- Chapter 3 (Affected Environment and Environmental Consequences) describes the existing conditions of the affected environment and potential environmental consequences on those resources requiring additional discussion or analysis beyond what was analyzed in the 2015 NWTT Final EIS/OEIS.
- Chapter 4 (Cumulative Impacts) describes the analysis of cumulative impacts, which are the impacts of the Proposed Action when added to past, present, and reasonably foreseeable future actions.
- Chapter 5 (Mitigation) describes the measures the Navy evaluated that could mitigate impacts on the environment.
- Chapter 6 (Additional Regulatory Considerations) describes considerations required by NEPA and describes how the Navy complies with other federal, state, and local plans, policies, and regulations.
- Chapter 7 (List of Preparers) includes a list of preparers of this Supplemental.
- Chapter 8 (Public Involvement and Distribution) describes the public participation process.
- References are provided at the end of each section.
- Appendices provide technical information that support this Supplemental analyses and conclusions.

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2 Description of Proposed Action and Alternatives

Supplemental Environmental Impact Statement/

Overseas Environmental Impact Statement

Northwest Training and Testing

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2 Description of Proposed Action and Alternatives

The United States (U.S.) Department of the Navy (Navy) proposes to conduct military readiness activities, which include training (referred to as "training"), and research, development, testing, and evaluation (referred to as "testing") activities in the Northwest Training and Testing (NWTT) Study Area. This Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) (Supplemental) is being prepared to assess the potential environmental impacts associated with proposed training and testing activities to be conducted within the NWTT Study Area. These proposed activities are generally consistent with those analyzed in the October 2015 *Final Northwest Training and Testing Environmental Impact Statement/Overseas Environmental Impact Statement* (U.S. Department of the Navy, 2015), hereinafter referred to as the 2015 NWTT Final EIS/OEIS, and are representative of activities the Navy has been conducting in the Study Area for decades.

In this chapter, the military builds upon the purpose and need to train and test (as described in Chapter 1, Purpose and Need) by describing the Study Area and identifying the primary mission areas for which these training and testing activities are conducted. Each warfare community (e.g., aviation, surface, submarine, and expeditionary) conducts training and testing activities that contribute to their success in a primary mission area. Each primary mission area requires unique skills, sensors, weapons, and technologies to accomplish the mission. For example, under the anti-submarine warfare primary mission area, surface, submarine, and aviation warfare communities each utilize different skills, sensors, and weapons to locate, track, and eliminate submarine threats. The testing community contributes to the success of anti-submarine warfare by anticipating and identifying technologies and systems that respond to the needs of the warfare communities. See the 2015 NWTT Final EIS/OEIS, Section 2.3 (Descriptions of Sonar, Ordnance/Munitions, Targets and Other Systems Employed in Northwest Training and Testing Activities) for complete descriptions.

This chapter describes the activities that comprise the Proposed Action for this Supplemental that are necessary to meet training and testing requirements beyond 2020 and into the reasonably foreseeable future. These activities are then analyzed for their potential effects on the environment in the resource-specific chapters of this Supplemental. For further details regarding specific training and testing activities, please see Appendix A (Navy Activities Descriptions). The Navy intends to request from the National Marine Fisheries Service (NMFS) an incidental take authorization under the Marine Mammal Protection Act (MMPA), and an incidental take statement under the Endangered Species Act (ESA) from both NMFS and the U.S. Fish and Wildlife Service for marine species (see Chapter 3, Affected Environment and Environmental Consequences). Relative to compliance with the National Environmental Policy Act, NMFS' Proposed Action will be a direct outcome of responding to the Navy's request for an incidental take authorization pursuant to the MMPA.

2.1 Description of the Northwest Training and Testing Study Area

The NWTT Study Area (Figure 2.2-1) for this Supplemental is the same as analyzed in the 2015 NWTT Final EIS/OEIS (Section 2.1, Description of the Northwest Training and Testing Study Area). Military activities in the Study Area occur (1) on the ocean surface, (2) beneath the ocean surface, and (3) in the air.

To aid in the description of the ranges covered in this Supplemental, the Study Area is divided into three distinct geographic and functional subdivisions. See the 2015 NWTT Final EIS/OEIS, Section 2.1 (Description of the Northwest Training and Testing Study Area) for a complete description of the Study Area. Not all activities occur throughout the Study Area; most are limited to one or two of the three range subdivisions. All of the training and testing activities proposed in this Supplemental would occur in one or more of these three range subdivisions:

- The Offshore Area (see Figure 2.2-2 below and the 2015 NWTT Final EIS/OEIS, Section 2.1.1 – Description of the Offshore Area)
- The Inland Waters (see Figure 2.2-3 below and the 2015 NWTT Final EIS/OEIS, Section 2.1.2 – Description of the Inland Waters, with one correction; the total area of Restricted Area 6701 is 22 NM^2, not 56 NM^2 as described in the 2015 NWTT Final EIS/OEIS)
- Western Behm Canal, Alaska (see Figure 2.2-4 below and the 2015 NWTT Final EIS/OEIS, Section 2.1.3 – Description of the Western Behm Canal, Alaska)

2.2 Primary Mission Areas

The Navy categorizes many of its training and testing activities into functional warfare areas called primary mission areas. The Navy's proposed activities for NWTT generally fall into the following five primary mission areas:

- air warfare
- anti-submarine warfare
- electronic warfare
- mine warfare
- surface warfare

The potential environmental impacts of water-based naval special operations training activities conducted at the unit level within offshore (coastal) and inland waters were evaluated in the 2015 NWTT Final EIS/OEIS, and Record of Decision signed on October 31, 2016. The NWTT Final EIS/OEIS included water-based training activities that did not have a land-based component. Additionally, NWTT only provided environmental coverage for Naval Special Warfare "Personnel Insertion/Extraction-Submersible" at five locations and it did not include activities inside the 3 NM limit from Westport to the Columbia river. The 2010 Northwest Training Range Complex (NWTRC) EIS/OEIS, and Record of Decision signed on October 10, 2010, evaluated "NSW (Naval Special Warfare) Training" from Port Townsend marina to Naval Magazine Indian Island. This training was twice a year for up to three weeks. It included land-based activities (over the beach and special reconnaissance) and limited water-based activities (launch and recovery from Port Townsend, Insertion and Extraction and Diver/Swimmer). The NWTT and the NWTRC EIS/OEISs do not analyze the full range of activities, locations, and duration needed, or provide the diversity required of naval special operations personnel. A separate analysis, the Environmental Assessment for Naval Special Operations in Western Washington State, will supersede the same Naval Special Warfare activities ("Personnel Insertion/Extraction-Submersible" and "NSW Training") identified in the NWTT EIS/OEIS and NWTRC EIS/OEIS, respectively. A separate document better captures the land and cold water naval special warfare activities, some of which are not within the NWTT Study Area, but must be assessed as a whole.

Most activities addressed in this Supplemental are categorized under one of these primary mission areas; activities that do not fall within one of these areas are listed as "other activities." Each warfare community (aviation, surface, and subsurface) may train in some or all of these primary mission areas. The research and acquisition community also categorizes most, but not all, of its testing activities under these primary mission areas. A description of the sonar, munitions, targets, systems and other material used during training and testing activities within these primary mission areas is provided in Appendix A (Navy Activities Descriptions).

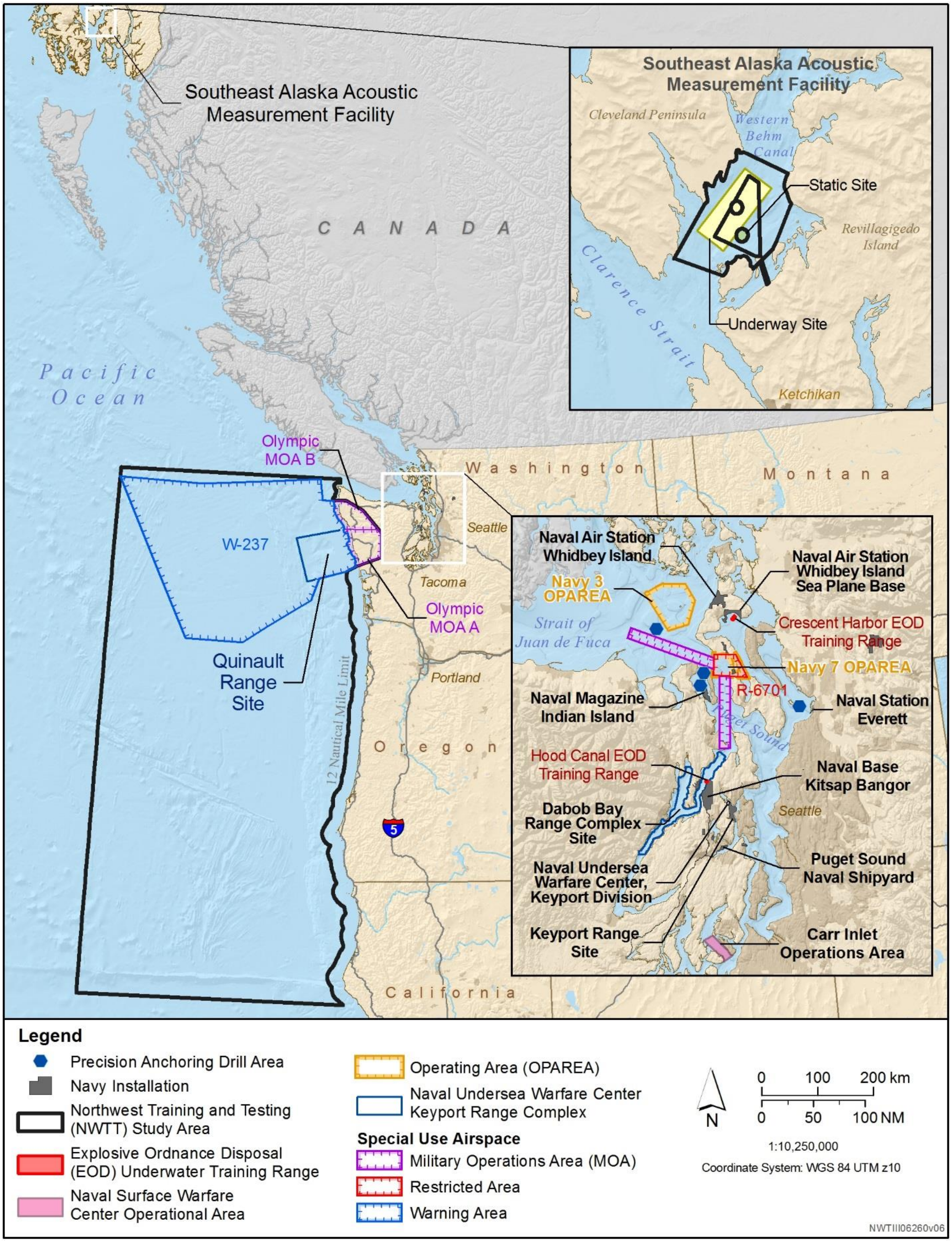

Figure 2.2-1: Northwest Training and Testing Study Area

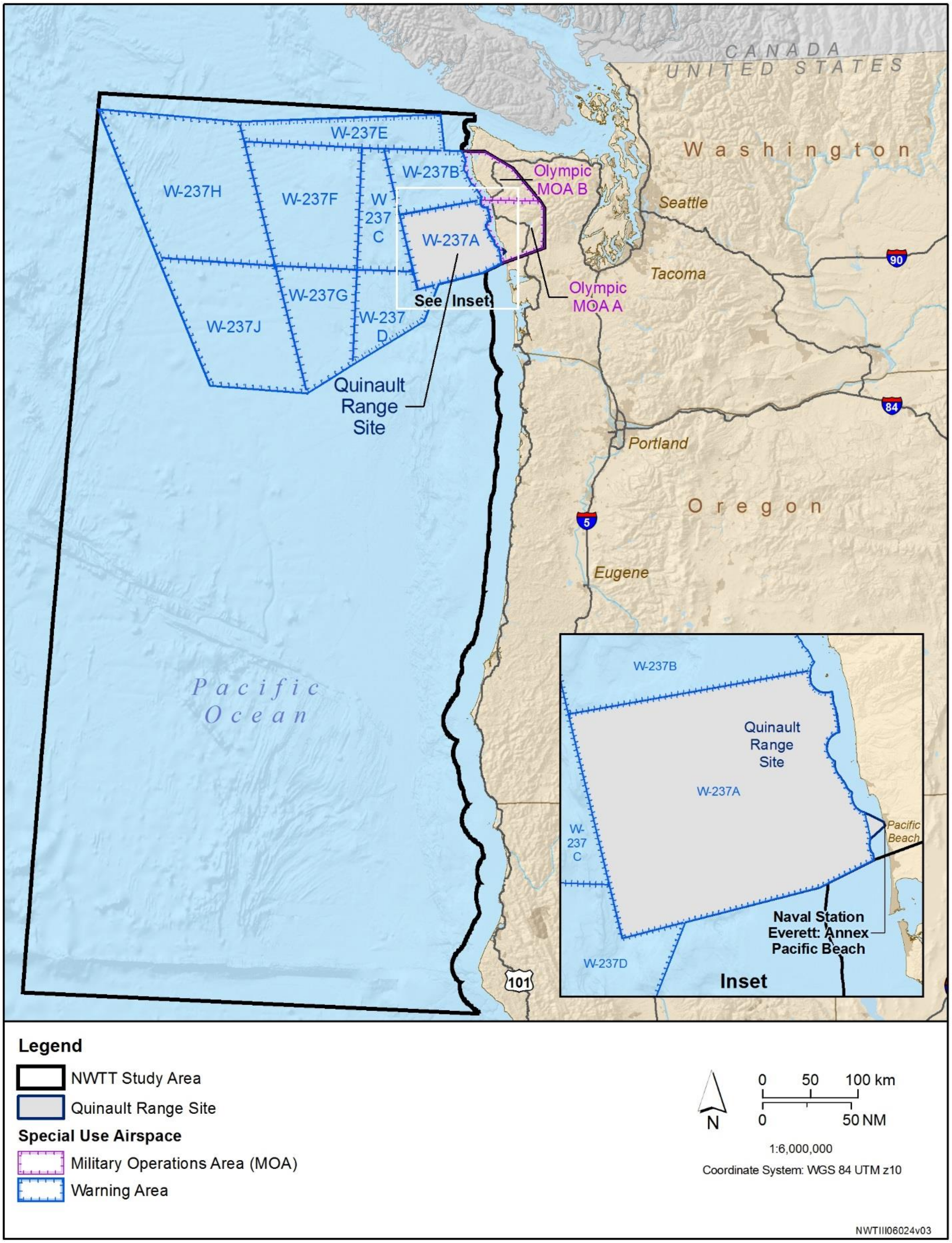

Figure 2.2-2: Offshore Area of the Northwest Training and Testing Study Area

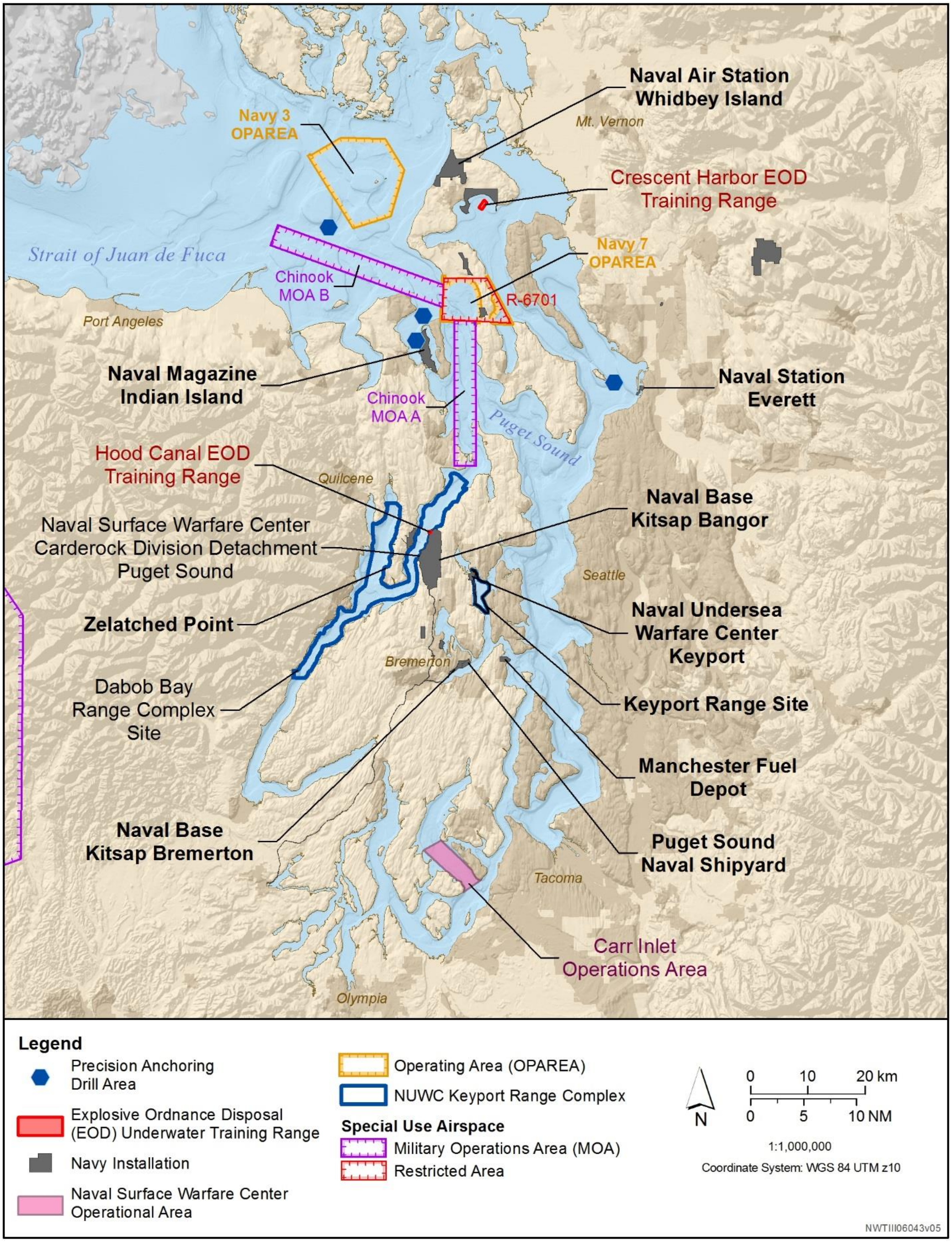

Figure 2.2-3: Range Complexes and Facilities in the Inland Waters of the Northwest Training and Testing Study Area

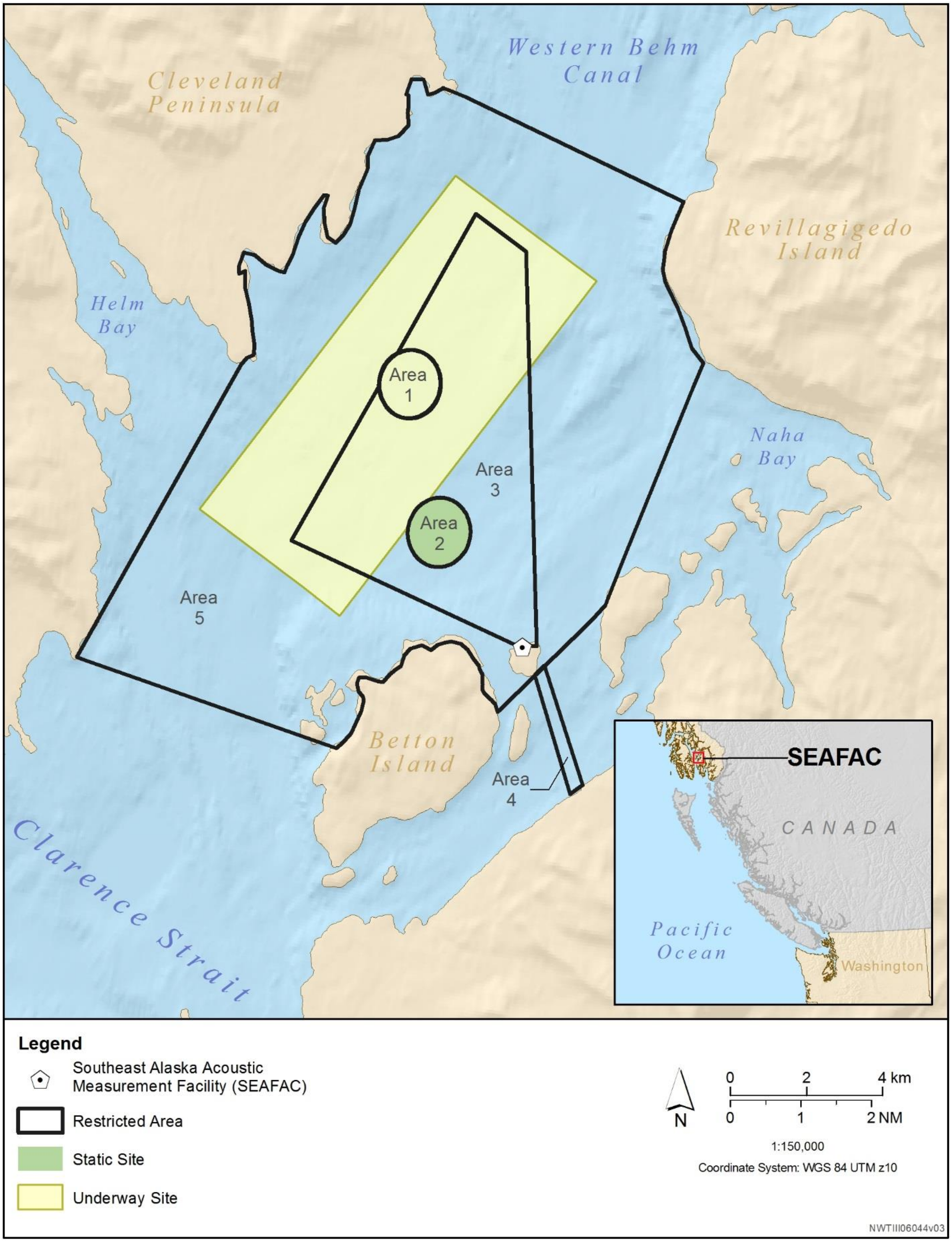

Figure 2.2-4: Western Behm Canal, Alaska and the Southeast Alaska Acoustic Measurement Facility

2.2.1 Air Warfare

The mission of air warfare (named anti-air warfare in the 2015 NWTT Final EIS/OEIS, Section 2.2.1, Anti-Air Warfare, but since changed by the Navy to "Air Warfare") is to destroy or reduce enemy air and missile threats (including unmanned airborne threats) and serves two purposes: to protect U.S. forces from attacks from the air and to gain air superiority. Air warfare provides U.S. forces with adequate attack warnings, while denying hostile forces the ability to gather intelligence about U.S. forces.

Aircraft conduct air warfare through radar search, detection, identification, and engagement of airborne threats. Surface ships conduct air warfare through an array of modern anti-aircraft weapon systems such as aircraft detecting radar, naval guns linked to radar-directed fire-control systems, surface-to-air missile systems, and radar-controlled guns for close-in point defense.

2.2.2 Anti-Submarine Warfare

The mission of anti-submarine warfare (see the 2015 NWTT Final EIS/OEIS, Section 2.2.3, Anti-Submarine Warfare) is to locate, neutralize, and defeat hostile submarine forces that threaten Navy surface forces. Anti-submarine warfare is based on the principle that surveillance and attack aircraft, ships, and submarines all search for hostile submarines. These forces operate together or independently to gain early warning and detection, and to localize, track, target, and attack submarine threats.

Anti-submarine warfare training addresses basic skills such as detection and classification of submarines, as well as evaluating sounds to distinguish between enemy submarines and friendly submarines, ships, and marine life. For a discussion on differentiating sound and noise, see Appendix D, Section D.1.2 (Signal Versus Noise). More advanced training integrates the full spectrum of anti-submarine warfare from detecting and tracking a submarine to attacking a target using either exercise torpedoes (i.e., torpedoes that do not contain a warhead), explosive torpedoes, or simulated weapons. These integrated anti-submarine warfare training exercises are conducted in coordinated, at-sea training events involving submarines, ships, and aircraft.

Testing of anti-submarine warfare systems is conducted to develop new technologies and assess weapon performance and operability with new systems and platforms, such as unmanned systems. Testing uses ships, submarines, and aircraft to demonstrate capabilities of torpedoes, missiles, countermeasure systems, and underwater surveillance and communications systems. Tests may be conducted as part of a large-scale Fleet training event involving submarines, ships, fixed-wing aircraft, and helicopters. These integrated training events offer opportunities to conduct research and acquisition activities and to train aircrew in the use of new or newly enhanced systems during a large-scale, complex exercise.

2.2.3 Electronic Warfare

The mission of electronic warfare (see the 2015 NWTT Final EIS/OEIS, Section 2.2.4, Electronic Warfare) is to degrade the enemy's ability to use electronic systems, such as communication systems and radar, and to confuse or deny them the ability to defend their forces and assets. Electronic warfare is also used to detect enemy threats and counter their attempts to degrade the electronic capabilities of the Navy.

Typical electronic warfare activities include threat avoidance training, signals analysis for intelligence purposes, and use of airborne and surface electronic jamming devices (that block or interfere with other devices) to defeat tracking, navigation, and communications systems.

Testing of electronic warfare systems is conducted to improve the capabilities of systems and ensure compatibility with new systems. Testing involves the use of aircraft, surface ships, and submarine crews to evaluate the effectiveness of electronic systems. Similar to training activities, typical electronic warfare testing activities include the use of airborne and surface electronic jamming devices (see Appendix A, Navy Activities Descriptions, for a description of these devices) to defeat tracking and communications systems.

2.2.4 Mine Warfare

The mission of mine warfare (see the 2015 NWTT Final EIS/OEIS, Section 2.2.5, Mine Warfare) is to detect, classify, and avoid or neutralize (disable) mines to protect Navy ships and submarines and to maintain free access to ports and shipping lanes. Mine warfare also includes offensive mine laying to gain control of or deny the enemy access to sea space. Naval mines can be laid by ships, submarines, Navy divers, or aircraft.

Mine warfare neutralization training includes exercises in which ships, aircraft, submarines, underwater vehicles, unmanned vehicles, or marine mammal detection systems search for mine shapes. Personnel train to destroy or disable mines by attaching underwater explosives to or near the mine or using remotely operated vehicles to destroy the mine.

Testing and development of mine warfare systems is conducted to improve sonar, laser, and magnetic detectors intended to locate, and record the positions of mines for avoidance or subsequent neutralization. Mine warfare testing and development falls into two primary categories: mine detection and classification, and mine countermeasure and neutralization. Mine detection and classification testing involves the use of air, surface, and subsurface vessels and uses sonar, including towed and side-scan sonar, and unmanned vehicles to locate and identify objects underwater. Mine detection and classification systems are sometimes used in conjunction with a mine neutralization system. Mine countermeasure and neutralization testing includes the use of air, surface, and subsurface units to evaluate the effectiveness of tracking devices, countermeasure and neutralization systems, and general purpose bombs to neutralize mine threats. Most neutralization tests use mine shapes, or non-explosive practice mines, to evaluate a new or enhanced capability. For example, during a mine neutralization test, a previously located mine is destroyed or rendered nonfunctional using a helicopter or manned/unmanned surface vehicle based system that may involve the deployment of a towed neutralization system.

A small percentage of mine warfare tests require the use of high-explosive mines to evaluate and confirm the ability of the system to neutralize a high-explosive mine under operational conditions. The majority of mine warfare systems are deployed by ships, helicopters, and unmanned vehicles. Tests may also be conducted in support of scientific research to support these new technologies.

2.2.5 Surface Warfare

The mission of surface warfare (named anti-surface warfare in the 2015 NWTT Final EIS/OEIS, Section 2.2.2, Anti-Surface Warfare, but since changed by the Navy to "Surface Warfare") is to obtain control of sea space from which naval forces may operate, and entails offensive action against other surface, subsurface, and air targets while also defending against enemy forces. In surface warfare, aircraft use guns, air-launched cruise missiles, or other precision-guided munitions; ships employ torpedoes, naval guns, and surface-to-surface missiles; and submarines attack surface ships using torpedoes or submarine-launched, anti-ship cruise missiles.

Surface warfare training includes surface-to-surface gunnery and missile exercises, air-to-surface gunnery and missile exercises, and submarine missile or torpedo launch events, and other munitions against surface targets.

Testing of weapons used in surface warfare is conducted to develop new technologies and to assess weapon performance and operability with new systems and platforms, such as unmanned systems. Tests include various air-to-surface guns and missiles, surface-to-surface guns and missiles, and bombing tests. Testing events may be integrated into training activities to test aircraft or aircraft systems in the delivery of munitions on a surface target. In most cases the tested systems are used in the same manner in which they are used for Fleet training activities.

2.2.6 Other Activities

Other training and testing (see the 2015 NWTT Final EIS/OEIS, Section 2.2.7, Other Training Activities) is conducted in the Study Area that falls outside of the primary mission areas, but supports overall readiness. These include Maritime Security Operations events, including maritime security escorts for Navy vessels such as Fleet Ballistic Missile Submarines; Visit, Board, Search, and Seizure training; Maritime Interdiction Operations training; Force Protection training; Anti-Piracy Operations training; Acoustic Component Testing; Cold Water Support; and Hydrodynamic and maneuverability Testing. Anti-terrorism/Force-protection training will occur as small boat attacks against moored ships at one of the Navy's piers inside Puget Sound. Operator training is also necessary for the maintenance of ship and submarine sonar at piers and at-sea.

2.3 Proposed Activities

The Navy has conducted training and testing activities in the Study Area for decades, with some types of activities dating back to at least the early 1900s. The tempo and types of training and testing activities have fluctuated because of the introduction of new technologies, the evolving nature of international events, advances in warfighting doctrine and procedures, and changes in force structure (organization and basing of ships, submarines, aircraft, and Sailors). Such developments influence the frequency, type, duration, intensity, and location of required training and testing activities. The activities analyzed in this Supplemental are largely a continuation of activities that have been ongoing and were analyzed previously in the 2015 NWTT EIS/OEIS. This Supplemental includes the analysis of those at-sea activities projected to meet readiness requirements beyond 2020 and into the reasonably foreseeable future, includes any changes to those activities previously analyzed, and reflects the most up-to-date compilation of training and testing activities deemed necessary to accomplish military readiness requirements.

2.3.1 Proposed Training Activities

Training activities proposed by the Navy in this Supplemental are described in Table 2.3-1. This table lists the current name of the activity, a brief description of the activity (see Appendix A, Navy Activities Descriptions, for a full description of each), and the activity name from the 2015 NWTT Final EIS/OEIS that corresponds to the current activity. Table 2.5-1 (at the end of this chapter) provides additional information on all training activities, such as location, number of events per year (comparing number of events proposed with the 2015 NWTT Final EIS/OEIS), and ordnance used, if any. More information about each activity can be found in Appendix A (Navy Activities Descriptions) and Appendix B (Activity Stressor Matrices).

2.3.2 Proposed Testing Activities

As described in the 2015 NWTT Final EIS/OEIS, the Navy's research and acquisition community engages in a broad spectrum of testing activities in support of the Fleet. The individual commands within the research and acquisition community included in this Supplemental are the Naval Sea Systems Command and the Naval Air Systems Command.

Testing activities proposed by the Navy in this Supplemental are described in Table 2.3-2 and Table 2.3-3. These tables list the current name of the activity, a brief description of the activity (see Appendix A, Navy Activities Descriptions, for a full description of each), and the activity name from the 2015 NWTT Final EIS/OEIS that corresponds to the current activity. Table 2.5-2 and Table 2.5-3 (at the end of this chapter) provide additional information on all testing activities, such as location, number of events per year, and ordnance used, if any. More information about each activity can be found in Appendix A (Navy Activities Descriptions) and Appendix B (Activity Stressor Matrices).

Table 2.3-1: Training Activities Descriptions

Activity Name	*Activity Description*	*2015 NWTT Final EIS/OEIS Activity Name*
Air Warfare		
Air Combat Maneuver	Fixed-wing aircrews aggressively maneuver against threat aircraft to gain tactical advantage.	Air Combat Maneuver
Gunnery Exercise (Surface-to-Air)	Surface ship crews fire medium- and large-caliber guns at air targets.	Gunnery Exercise (Surface-to-Air)
Missile Exercise (Air-to-Air)	Fixed-wing aircrews fire air-to-air missiles at air targets.	Missile Exercise (Air-to-Air)
Missile Exercise (Surface-to-Air)	Surface ship crews fire surface-to-air missiles at air targets.	Missile Exercise (Surface-to-Air)
Anti-Submarine Warfare		
Torpedo Exercise – Submarine	Submarine crews search for, track, and detect submarines. Event would include one MK-48 torpedo.	*[Previously analyzed in the 2015 NWTT Final EIS/OEIS as part of the Sinking Exercise, which is no longer conducted (Table 2.8-1: Sinking Exercise)]*
Tracking Exercise – Helicopter	Helicopter crews search for, track, and detect submarines.	Tracking Exercise – Helicopter
Tracking Exercise – Maritime Patrol Aircraft	Maritime patrol aircraft crews search for, track, and detect submarines.	Tracking Exercise – Maritime Patrol Aircraft
Tracking Exercise – Ship	Surface ship crews search for, track, and detect submarines.	Tracking Exercise – Ship
Tracking Exercise – Submarine	Submarine crews search for, track, and detect submarines.	Tracking Exercise – Submarine
Electronic Warfare		
Electronic Warfare Training – Aircraft	Aircraft and ship crews control portions of the electromagnetic spectrum used by enemy systems to degrade or deny the enemy's ability to take defensive actions.	Electronic Warfare Operations
Electronic Warfare Training – Ship		
Mine Warfare		
Civilian Port Defense – Homeland Security Anti-Terrorism/Force Protection Exercises	Maritime security personnel train to protect civilian ports and harbors against enemy efforts to interfere with access to those ports.	Maritime Homeland Defense/ Security Mine Countermeasures Integrated Exercises
Mine Neutralization – Explosive Ordnance Disposal Training	Personnel disable threat mines using explosive charges.	Mine Neutralization – Explosive Ordnance Disposal
Surface Warfare		
Bombing Exercise (Air-to-Surface)	Fixed-wing aircrews deliver bombs against surface targets.	Bombing Exercise (Air-to-Surface)

Table 2.3-1: Training Activities Descriptions (continued)

Activity Name	*Activity Description*	*2015 NWTT Final EIS/OEIS Activity Name*
Surface Warfare (continued)		
Missile Exercise (Air-to-Surface)	Fixed-wing aircrews simulate firing precision-guided missiles, using captive air training missiles (CATMs) against surface targets. Some activities include firing a missile with a high-explosive (HE) warhead.	Missile Exercise (Air-to-Surface)
Gunnery Exercise (Surface-to-Surface) – Ship	Surface ship crews fire large-, medium-, and small-caliber guns at surface targets.	Gunnery Exercise (Surface-to-Surface) – Ship
Other Training		
Intelligence, Surveillance, Reconnaissance (ISR)	Maritime patrol aircraft (MPA), unmanned aerial systems, ships, and submarines use all available sensors to collect data on threat vessels.	Intelligence, Surveillance, Reconnaissance (ISR)
Maritime Security Operations	Helicopter, surface ship, and small boat crews conduct a suite of maritime security operations events, including maritime security escorts for Navy vessels such as submarines and aircraft carriers; Visit, Board, Search, and Seizure; Maritime Interdiction Operations; Force Protection; and Anti-Piracy Operations.	Maritime Security Operations
Personnel Insertion/ Extraction – Non-Submersible	Military personnel train for clandestine insertion and extraction into target areas using rotary-wing aircraft, fixed-wing aircraft (insertion only), or small boats.	Personnel Insertion/ Extraction – Non-Submersible
Precision Anchoring	Surface ship crews release and retrieve anchors in designated locations.	Precision Anchoring
Search and Rescue	Helicopter crews train to rescue military personnel at sea.	Search and Rescue
Small Boat Attack Exercise	Small boat crews engage pierside surface targets with small-caliber weapons. Only blank rounds are fired.	Small Boat Attack
Submarine Sonar Maintenance	Maintenance of submarine sonar and other system checks are conducted pierside or at sea.	Submarine Sonar Maintenance
Surface Ship Sonar Maintenance	Maintenance of surface ship sonar and other system checks are conducted pierside or at sea.	Surface Ship Sonar Maintenance
Unmanned Underwater Vehicle Training	Unmanned underwater vehicle certification involves training with unmanned platforms to ensure submarine crew proficiency. Tactical development involves training with various payloads for multiple purposes to ensure that the systems can be employed effectively in an operational environment.	*[Similar activity previously analyzed in the 2015 NWTT Final EIS/OEIS under Testing (Table 2.8-2: Unmanned Underwater Vehicle Testing)]*

Table 2.3-2: Naval Sea Systems Command Testing Activities Descriptions

Activity Name	*Activity Description*	*2015 NWTT Final EIS/OEIS Activity Name*
Anti-Submarine Warfare		
Anti-Submarine Warfare Testing	Ships and their supporting platforms (rotary-wing aircraft and unmanned aerial systems) detect, localize, and prosecute submarines.	Anti-Submarine Warfare Mission Package Testing Anti-Submarine Warfare Testing
At-Sea Sonar Testing	At-sea testing to ensure systems are fully functional in an open ocean environment.	*[Similar activity previously analyzed in the 2015 NWTT Final EIS/OEIS under Training (Table 2.8-1: Tracking Exercise – Surface)]*
Countermeasure Testing	Countermeasure testing involves the testing of systems that will detect, localize, and track incoming weapons, including marine vessel targets. Countermeasures may be systems to obscure the vessel's location or systems to rapidly detect, track, and counter incoming threats. Testing includes surface ship torpedo defense systems and marine vessel stopping payloads.	Countermeasures Testing
Pierside-Sonar Testing	Pierside testing to ensure systems are fully functional in a controlled pierside environment prior to at-sea test activities.	Pierside-Sonar Testing
Submarine Sonar Testing/Maintenance	Pierside, moored, and underway testing of submarine systems occurs periodically following major maintenance periods and for routine maintenance.	Project Operations (POPS)
Torpedo (Explosive) Testing	Air, surface, or submarine crews employ explosive and non-explosive torpedoes against artificial targets.	Torpedo (Explosive) Testing
Torpedo (Non-explosive) Testing	Air, surface, or submarine crews employ non-explosive torpedoes against targets, submarines, or surface vessels.	Torpedo (Non-explosive) Testing
Mine Warfare		
Mine Countermeasure and Neutralization Testing	Air, surface, and subsurface vessels neutralize threat mines and mine-like objects.	*[Not previously analyzed]*
Mine Detection and Classification Testing	Air, surface, and subsurface vessels and systems detect and classify mines and mine-like objects. Vessels also assess their potential susceptibility to mines and mine-like objects.	Side Scan/Multibeam Sonar

Table 2.3-2: Naval Sea Systems Command Testing Activities Descriptions (continued)

Activity Name	*Activity Description*	*2015 NWTT Final EIS/OEIS Activity Name*
Surface Warfare		
Kinetic Energy Weapon Testing	A kinetic energy weapon uses stored energy released in a burst to accelerate a projectile.	*[Not previously analyzed]*
Unmanned Systems		
Unmanned Aerial System Testing	Unmanned aerial systems are remotely piloted or self-piloted (i.e., preprogrammed flight pattern) aircraft that include fixed-wing, rotary-wing, and other vertical takeoff vehicles. They can carry cameras, sensors, communications equipment, or other payloads.	Unmanned Aircraft System
Unmanned Surface Vehicle System Testing	Unmanned surface vehicles are primarily autonomous systems designed to augment current and future platforms to help deter maritime threats. They employ a variety of sensors designed to extend the reach of manned ships.	Unmanned Surface Vehicle Testing
Unmanned Underwater Vehicle Testing	Testing involves the production or upgrade of unmanned underwater vehicles. This may include testing of mission capabilities (e.g., mine detection), evaluating the basic functions of individual platforms, or conducting complex events with multiple vehicles.	Unmanned Underwater Vehicle Testing Unmanned Vehicle Development and Payload Testing Performance Testing at Sea Proof of Concept Testing Development Training and Testing
Vessel Evaluation		
Propulsion Testing	Ship is run at high speeds in various formations and at various depths.	*[Not previously analyzed]*
Undersea Warfare Testing	Ships demonstrate capability of countermeasure systems and underwater surveillance, weapons engagement, and communications systems. This tests ships' ability to detect, track, and engage undersea targets.	*[Not previously analyzed]*
Vessel Signature Evaluation	Surface ship, submarine, and auxiliary system signature assessments. This may include electronic, radar, acoustic, infrared and magnetic signatures.	Electromagnetic Measurement Surface Vessel Acoustic Measurement Testing Underwater Vessel Acoustic Measurement Testing

Table 2.3-2: Naval Sea Systems Command Testing Activities Descriptions (continued)

Activity Name	***Activity Description***	***2015 NWTT Final EIS/OEIS Activity Name***
Other Testing		
Acoustic and Oceanographic Research	Research using active transmissions from sources deployed from ships, aircraft, and unmanned underwater vehicles. Research sources can be used as proxies for current and future Navy systems.	*[Not previously analyzed]*
Acoustic Component Testing	Various surface vessels, moored equipment, and materials are tested to evaluate performance in the marine environment.	Pierside Acoustic Testing Component System Testing
Cold Water Support	Fleet training for divers in a cold water environment, and other diver training related to Navy divers supporting range/test site operations and maintenance.	Cold Water Training
Hydrodynamic and Maneuverability Testing	Submarines maneuver in the submerged operating environment.	Underwater Vessel Hydrodynamic Performance Measurement
Non-Acoustic Component Testing	These tests involve non-acoustic sensors and communication systems. Non-acoustic sensors may also gather other forms of environmental data.	Non-Acoustic Tests
Post-Refit Sea Trial	Following periodic maintenance periods or repairs, sea trials are conducted to evaluate submarine propulsion, sonar systems, and other mechanical tests.	Post-Refit Sea Trial
Radar and Other System Testing	Testing may include use of military or commercial radar, communication systems (or simulators), or high-energy lasers. Testing may occur aboard a ship or a helicopter against drones, small boats, or other targets.	*[High-energy laser testing not previously analyzed]*
Semi-Stationary Equipment Testing	Semi-stationary equipment (e.g., hydrophones) is deployed to determine functionality.	Measurement System Repair and Replacement Target Strength Trial Acoustic Test Facility
Simulant Testing	The capability of surface ship defense systems to detect and protect against chemical and biological attacks are tested.	*[Not previously analyzed]*

Table 2.3-3: Naval Air Systems Command Testing Activities Descriptions

Activity Name	*Activity Description*	*2015 NWTT Final EIS/OEIS Activity Name*
Anti-Submarine Warfare		
Tracking Test – Maritime Patrol Aircraft	The test evaluates the sensors and systems used by maritime patrol aircraft to detect and track submarines and to ensure that aircraft systems used to deploy the tracking systems perform to specifications and meet operational requirements.	Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft (DICASS) Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft (MAC) Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft (HDC) Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft (IEER)
Tracking Test – Maritime Patrol Aircraft (SUS)	This test evaluates the sensors and systems used by maritime patrol aircraft to communicate with submarines using any of the family of signal underwater sound (SUS) sonobuoy systems.	Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft (SUS)
Other Testing		
Intelligence, Surveillance, Reconnaissance (ISR)/Electronic Warfare (EW) Triton Testing	ISR/EW Triton Testing will evaluate the sensors and communication systems on board the MQ-4C Triton unmanned aerial system.	*[Not previously analyzed]*

2.3.3 Standard Operating Procedures

For training and testing to be effective, units must be able to safely use their sensors and weapon systems as they are intended to be used in military missions and combat operations and to their optimum capabilities. Standard operating procedures applicable to training and testing have been developed through years of experience, and their primary purpose is to provide for safety (including public health and safety) and mission success. Because they are essential to safety and mission success, standard operating procedures are part of the Proposed Action and are considered in the Chapter 3 (Affected Environment and Environmental Consequences) environmental analysis for applicable resources.

In many cases, there are benefits to environmental and cultural resources (some of which have high socioeconomic value in the Study Area) resulting from standard operating procedures. Those standard operating procedures that are recognized as providing a benefit to the resources analyzed in this Draft Supplemental are included in Appendix A (Navy Activities Descriptions), as applicable. The following standard operating procedure categories apply to the Proposed Action and are generally consistent with those included in the specified sections in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) of the 2015 NWTT Final EIS/OEIS:

- Section 5.1.1 (General Safety)
- Section 5.1.2 (Vessel Safety)
- Section 5.1.3 (Aircraft Safety)
- Section 5.1.4 (Laser Procedures)
- Section 5.1.5 (Weapons Firing Procedures)
- Section 5.1.7 (Unmanned Aircraft System Procedures)
- Section 5.1.8 (Unmanned Surface Vehicle and Unmanned Underwater Vehicle Procedures)
- Section 5.1.9 (Towed In-Water Device Procedures)
- Section 5.1.10 (Best Management Practices)

Standard operating procedures that apply to the Proposed Action and were not included in, or require a clarification from, the 2015 NWTT Final EIS/OEIS are discussed in the sections below.

2.3.3.1 High-Energy Laser Safety

The Navy operates laser systems approved for fielding by the Laser Safety Review Board or service equivalent. Only properly trained and authorized personnel operate high-energy lasers within designated areas. Designated areas where lasers are used are required to have a Laser Range Safety Certification Report that is updated every three years. Prior to commencing activities involving high-energy lasers, the operator performs a search of the intended impact location to ensure that the area is clear of unauthorized persons. These standard operating procedures benefit public health and safety by reducing the potential for interaction with high-energy lasers.

2.3.3.2 Sea Space and Airspace Deconfliction

The Navy schedules training and testing activities to minimize conflicts with the use of sea space and airspace within ranges and throughout the Study Area to ensure the safety of military personnel, the public, commercial aircraft, commercial and recreational vessels, and military assets. The Navy deconflicts its own use of sea space and airspace to allow for the necessary separation of multiple military units to prevent interference with equipment sensors and to avoid interaction with established commercial air traffic routes and commercial shipping lanes. The Navy also minimizes conflicts within areas used for commercial and recreational fishing, Tribal or subsistence use, and tourism. During applicable seasons, the Navy works collaboratively with local Tribes and communities to deconflict certain sea spaces used for fishing, such as avoiding known fishery infrastructures (e.g., areas used for aquaculture) and usual and accustomed fishing grounds and stations. The Navy provides advanced notification directly to Tribes with treaty resources to deconflict schedules during certain activities conducted in select inland water locations when possible, such as providing training and testing scheduling information (e.g., a weekly schedule of activity and estimated usage time).

In addition, the Navy's Federal Aviation Administration (FAA)-certified approach control deconflicts, through separation of altitude, timing, and distance, a combined air traffic scheme of military, commercial, and general aviation. All of these different types of aviation are arriving and departing from multiple airports located throughout the region. Navy aircraft depart Naval Air Station (NAS) Whidbey Island and are under the control of the Navy's Approach Control and the FAA's control via the Seattle Air Route Traffic Control Center (ARTCC). They enter into the established routes of flight to and from the Olympic Military Operations Areas (MOAs) at altitudes of 12,000 to 18,000 ft. mean sea level (MSL). Aircraft remain under positive FAA control via Seattle ARTCC to and from the Olympic MOAs. Aircraft are visible to both Navy and FAA radar and, once inside the Olympic MOAs airspace, are subject to established FAA and Navy policies of use for the Olympic MOAs. While in the Olympic MOAs, they remain under FAA jurisdiction for airspace separation from commercial, private, and other military aircraft. Within the Olympic MOAs, approximately 95 percent of Navy training flight time occurs at or above 10,000 ft. MSL.

In order to reach the Olympic MOAs, aircraft fly west-southwest from NAS Whidbey Island over the Strait of Juan De Fuca, normally at or above 15,000 ft. MSL from a navigation point identified as MCCUL (20 NM west-southwest of NAS Whidbey Island), and then along a route of flight between MCCUL to a fixed navigation point (65 NM west-southwest of NAS Whidbey Island) where they cross into the boundary of the Olympic MOAs (see Figure 2.3-1). Navy aircraft typically exit the Olympic MOAs following Instrument Flight Rules clearance given by the Seattle ARTCC to the navigation point identified as YETII (30 NM southwest of NAS Whidbey Island). Normally aircraft cross YETII at or above 12,000 ft. MSL and then are directed to enter the arrival pattern to return to NAS Whidbey Island.

These standard operating procedures benefit public health and safety (including persons participating in activities that have subsistence benefits and socioeconomic value, such as recreational or commercial fishing) by reducing the potential for interactions with training and testing activities. Additional information on the Navy's communication and cooperation with Tribes and communities is presented in Section 3.11 (American Indian and Alaska Native Traditional Resources) and Section 3.12 (Socioeconomic Resources).

2.3.3.3 Target Deployment and Retrieval Safety

The standard operating procedures for target deployment and retrieval safety apply to weapons firing activities that involve small boats deploying or retrieving targets. These activities are typically conducted in daylight hours in Beaufort Sea state number 4 conditions or better to ensure safe operating conditions during target deployment and recovery. These standard operating procedures benefit public health and safety, and marine mammals and sea turtles by increasing the effectiveness of visual observations for mitigation, thereby reducing the potential for interactions with the weapons firing activities associated with the use of applicable deployed targets.

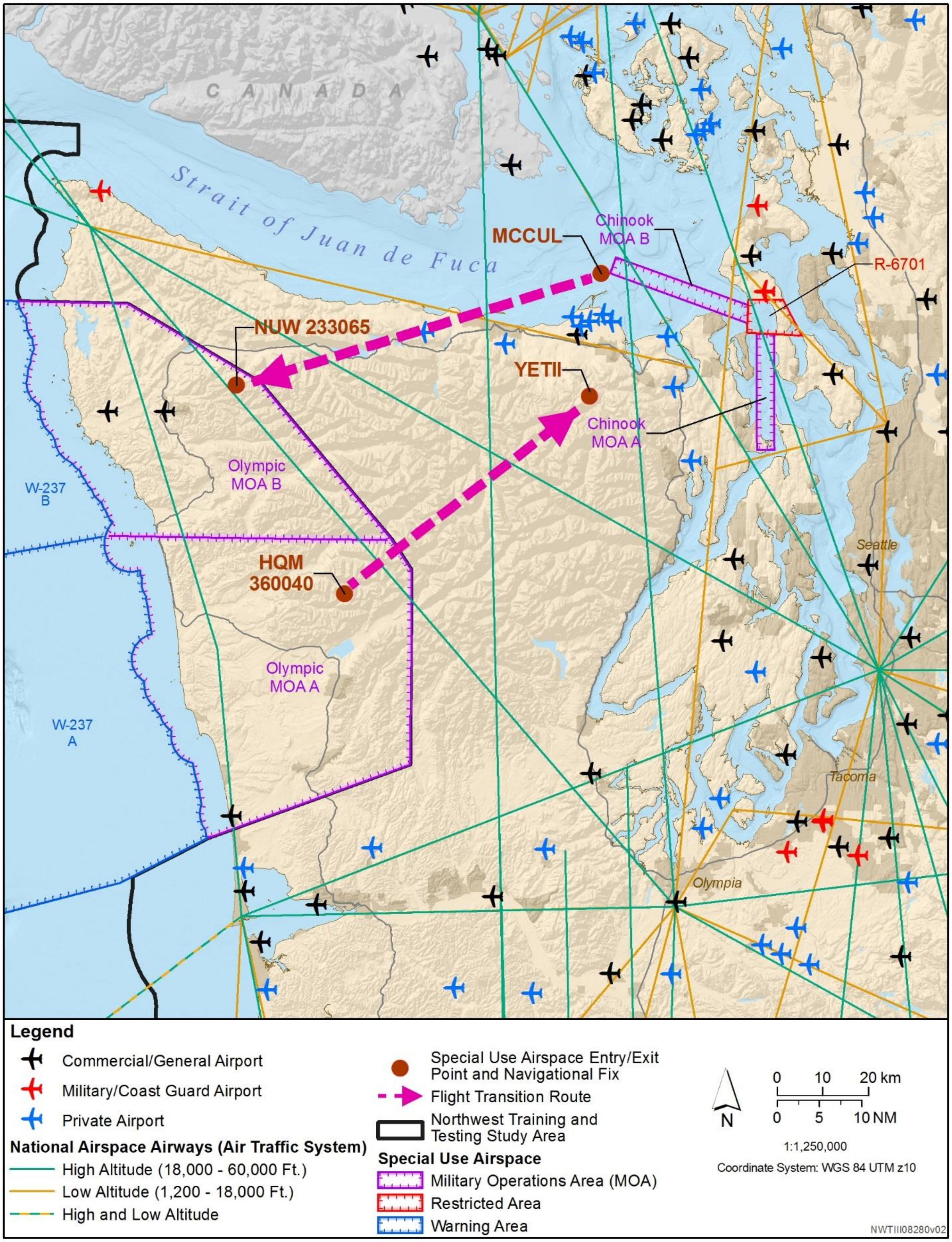

Figure 2.3-1: Aircraft Transit to and from Olympic Military Operations Areas

During activities that involve recoverable targets (e.g., aerial drones), the military recovers the target and any associated decelerators/parachutes to the maximum extent practicable consistent with personnel and equipment safety. Recovery of these items helps minimize the amount of materials that remain, which could potentially alert enemy forces to the presence of military assets during military missions and combat operations. This standard operating procedure benefits biological resources (e.g., marine mammals, sea turtles, fish, marine birds) by reducing the potential for physical disturbance and strike, entanglement, or ingestion of applicable targets and any associated decelerators/parachutes.

2.3.3.4 Pierside Testing Safety

The *U.S. Navy Dive Manual* (U.S. Department of the Navy, 2011) prescribes safe distances for divers from active sonar sources and in-water explosions. Safety distances for the use of electromagnetic energy are specified in Department of Defense Instruction 6055.11 (U.S. Department of Defense, 2009) and Military Standard 464A (U.S. Department of Defense, 2002). These distances are used as the standard safety buffers for in-water energy to protect military divers. If an unauthorized person is detected within the exercise area, the activity will be temporarily halted until the area is again cleared and secured. These standard operating procedures benefit public health and safety (including persons participating in activities that have socioeconomic value, such as commercial or recreational diving) by reducing the potential for interaction with pierside testing activities.

2.3.3.5 Underwater Detonation Safety

Underwater detonation training takes place in designated areas that are located away from popular recreation dive sites, primarily for human safety. Recreational dive sites often include artificial reefs and wrecks. If an unauthorized person (e.g., a recreational diver) or vessel is detected within the exercise area, the activity will be temporarily halted until the area is cleared and secured. Notices to Mariners are issued when the events are scheduled to alert the public to stay clear of the area. These standard operating procedures benefit public health and safety, environmental resources (e.g., artificial reefs and the biological resources that inhabit, shelter in, or feed among them), and cultural resources by reducing the potential for interaction with underwater detonation activities.

2.3.3.6 Sonic Booms

As a general policy, aircraft do not intentionally generate sonic booms below 30,000 feet of altitude unless over water and more than 30 miles from inhabited land areas or islands. Within the Study Area, the Navy uses specifically designated areas to conduct supersonic flights. These designated areas are not located over land or within 30 miles from inhabited land areas or islands. The Navy chose the designated areas to minimize the possibility of human disturbance; therefore, the standard operating procedures for sonic booms benefit public health and safety by reducing the potential for exposure to sonic booms.

2.3.4 Mitigation Measures

The military will implement mitigation measures to avoid or reduce potential impacts from the Proposed Action on environmental and cultural resources. Mitigation measures that the Navy will implement under the Proposed Action are organized into two categories: procedural mitigation and mitigation areas. The Navy will implement procedural mitigation measures whenever and wherever applicable training or testing activities take place within the Study Area. Mitigation areas are geographic locations within the Study Area where the military will implement additional mitigation during all or part of the year.

A list of the activity categories, stressors, and geographic locations that have mitigation measures is provided in Table 2.3-4. Chapter 5 (Mitigation) of this Draft Supplemental provides a full description of each mitigation measure that would be implemented under Alternative 1 and Alternative 2 of the Proposed Action. It also presents a discussion of how the Navy developed and assessed each measure and includes maps of the mitigation area locations. Mitigation developed for the Proposed Action is generally in line with the type and level of mitigation included in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) of the 2015 NWTT Final EIS/OEIS (U.S. Department of the Navy, 2015). The Navy has updated Chapter 5 (Mitigation) of this Draft Supplemental in its entirety based on its ongoing analysis of the best available science and practicality of implementing potential mitigation measures. A full analysis of the mitigation areas that the Navy has considered for the Study Area is provided in Appendix K (Geographic Mitigation Assessment). Relevant mitigation details are also provided throughout Appendix A (Navy Activities Descriptions). The Navy and NMFS Records of Decision, MMPA Regulations and Letters of Authorization, and ESA Biological Opinion will document all mitigation measures that the military will implement under the Proposed Action.

Table 2.3-4: Overview of Mitigation Categories

Mitigation Category	*Chapter 5 (Mitigation) Section*	*Applicable Activity Category, Stressor, or Mitigation Area*
Procedural Mitigation	Section 5.3.2 (Acoustic Stressors)	Active Sonar Weapons Firing Noise
	Section 5.3.3 (Explosive Stressors)	Explosive Sonobuoys Explosive Torpedoes Explosive Medium-Caliber and Large-Caliber Projectiles Explosive Missiles Explosive Bombs Explosive Mine Countermeasure and Neutralization Activities Explosive Mine Neutralization Activities Involving Navy Divers
	Section 5.3.4 (Physical Disturbance and Strike Stressors)	Vessel Movement Towed In-Water Devices Small-, Medium-, and Large-Caliber Non-Explosive Practice Munitions Non-Explosive Missiles Non-Explosive Bombs and Mine Shapes
Mitigation Areas	Section 5.4 (Mitigation Areas to be Implemented)	Areas with Seafloor Resources 50 Nautical Mile Coastal Buffer Mitigation Area 20 Nautical Mile Coastal Buffer Mitigation Area 12 Nautical Mile Coastal Buffer Mitigation Area Olympic Coast National Marine Sanctuary Mitigation Area Stonewall and Heceta Bank Mitigation Area Point St. George Mitigation Area Puget Sound and Strait of Juan de Fuca Mitigation Area Northern Puget Sound Mitigation Area

2.4 Action Alternatives Development

The identification, consideration, and analysis of alternatives are critical components of the National Environmental Policy Act process and contribute to the goal of objective decision-making. The Council on Environmental Quality (CEQ) developed regulations to implement National Environmental Policy Act and these regulations require the decision maker to consider the environmental effects of the proposed action and a range of alternatives (including the No Action Alternative) to the proposed action (40 Code of Federal Regulations [CFR] section 1502.14). CEQ guidance further provides that an EIS must rigorously and objectively explore all reasonable alternatives for implementing the proposed action and, for alternatives eliminated from detailed study, briefly discuss the reasons for having been eliminated. To be reasonable, an alternative, except for the no action alternative, must meet the stated purpose of and need for the proposed action.

The action alternatives, and in particular the mitigation measures that are incorporated in the action alternatives, were developed to meet both the Navy's purpose and need to train and test, and NMFS's independent purpose and need to evaluate the potential impacts of the Navy's activities, determine whether incidental take resulting from the Navy's activities would have a negligible impact on affected marine mammal species and stocks, and to prescribe measures to effect the least practicable adverse impact on species or stocks and their habitat, as well as monitoring and reporting requirements.

The Navy developed the alternatives considered in this Supplemental after careful assessment by subject matter experts, including military commands that utilize the ranges, military range management professionals, and Navy environmental managers and scientists.

For example, the Optimized Fleet Response Plan, discussed in Section 1.4.2 (Optimized Fleet Response Training), changed how the Navy meets its readiness requirements. The data developed from the Optimized Fleet Response Plan informs the level of training, including the use of sonar sources and explosives, required by the Navy to meet its Title 10 responsibilities, which includes to maintain, train, and equip combat ready forces.

Through the analysis of several years of classified sonar use data, cross referenced with training requirements of the same period, the Navy produced a more refined estimate for the amount of sonar use anticipated to meet future training requirements, which supports the development of action alternatives.

With regards to testing activities, as previously stated, the level of activity in any given year is highly variable and is dependent on technological advancements, emergent requirements identified during operations, and fiscal fluctuations. Therefore, the environmental analysis must consider all testing activities that could possibly occur to ensure that the analysis fully captures the potential environmental effects. These factors were considered in alternatives carried forward for consideration and analyses as described in Section 2.4.2 (Alternatives Carried Forward).

2.4.1 Alternatives Eliminated from Further Consideration

This Supplemental serves as an update to the 2015 NWTT Final EIS/OEIS; therefore, alternatives eliminated from consideration in the 2015 NWTT Final EIS/OEIS were evaluated to determine if they should be reconsidered for this Supplemental and are discussed below. In response to the comments received during the public scoping period, the Navy also considered developing an alternative that included geographic mitigation. Alternatives eliminated from further consideration are described below. The Navy determined that these alternatives did not meet the purpose of and need for the Proposed Action after a thorough consideration of each. Alternatives considered but not carried forward are discussed below.

2.4.1.1 Alternative Training and Testing Locations

As described in Section 2.5.1.1 (Alternative Locations) in the 2015 NWTT Final EIS/OEIS, there is no other set of integrated ranges in the Pacific Northwest that affords this level of operational support for local range users. The Navy reevaluated the availability of other suitable locations that can support the training and testing requirements in the Pacific Northwest. The Navy determined that the attributes listed in the 2015 NWTT Final EIS/OEIS are all still required, and that there are no other locations with those attributes. As a result, this alternative has been eliminated from further consideration in this Supplemental because it does not meet the purpose of and need for the Proposed Action.

2.4.1.2 Reduced Training and Testing

As described in Section 2.5.1.2 (Reduced Training and Testing) in the 2015 NWTT Final EIS/OEIS, a reduction or cessation of training and testing would prevent the Navy from meeting its statutory requirements and adequately preparing naval forces for operations at sea ranging from disaster relief to armed conflict. Therefore, this alternative has been eliminated from further consideration in this Supplemental because it does not meet the purpose of and need for the Proposed Action.

2.4.1.3 Alternatives Including Geographic Mitigation Measures Within the Study Area

The Navy considered developing an alternative based solely on geographic mitigation that would impose time/area restrictions on an expanded list of specific areas in the NWTT Study Area associated with the presence of specific species. However, such an alternative would present a patchwork of areas and time periods in which the Navy could conduct required training and testing, preventing the Navy from conducting the full scope of activities necessary to fulfill its Title 10 responsibilities and running counter to the purpose and need of the Proposed Action. Thus, such an alternative would not be reasonable. Further, regulations governing the National Environmental Policy Act allow agencies to "Include appropriate mitigation measures not already included in the proposed action or alternatives" (40 CFR 1502.14[f]). Under both action alternatives carried forward, the Navy would implement limited geographic mitigation areas that are biologically supported and practical to implement. Such areas are more fully described in Appendix K (Geographic Mitigation Assessment). Therefore, appropriate mitigation protective of impacted species would be implemented regardless of the alternative selected.

2.4.1.4 Simulated Training and Testing Only

Since the 2015 NWTT Final EIS/OEIS, new simulation technology has been made available to the EA-18Gs. In order to prepare and qualify military aircrews for their missions to provide for national defense, live flight training is an absolute necessity and can never be replaced. However, live training can be optimized and augmented through the use of Live, Virtual, Constructive (LVC) training. LVC training involves simulations and advances in technologies that improve the effectiveness of simulations and reduce flight time.

There are many increasing demands that go along with efforts to maintain aircrew readiness, including: extending the life of aircraft, reducing costs, supplementing training range inadequacies, security considerations, rising systems costs, personnel and equipment limitations, and reducing effects on the human environment.

In an effort to address these demands, aircraft squadrons based at NAS Whidbey Island are already implementing measures that are resulting in minimizing flights in assigned airspace areas. Specifically, the use of synthetic inject training during live training events is being used to replicate the use of actual aircraft.

With this technology, computer generated aircraft (synthetic targets) are injected into the onboard systems of EA-18G aircraft during live training events with the result of fewer real aircraft being present in the airspace during training. Normally in a typical air combat training event, multiple aircraft are used, with one or more aircraft taking the role of an aggressor while the other aircraft take the defending role. With the synthetic interjection, a virtual aircraft, becomes one side of the engagement instead of actual aircraft.

2.4.1.5 Training and Testing Without the Use of Active Sonar

In order to detect and counter submerged mines and potentially hostile submarines, the Navy uses both passive and active sonar. Sonar proficiency is a complex and perishable skill that requires regular, hands-on training in realistic and diverse conditions. Training and testing with active sonar is needed to find and counter newer-generation submarines around the world, which are growing in number, as are torpedoes and underwater mines, which are true threats to global commerce, national security, and the safety of military personnel. As a result, defense against enemy submarines is a top priority for the Navy. The detection and countering of submarines is paramount to national security. Naval forces cannot counter this threat without the use of active sonar. Because the Navy is statutorily responsible to provide combat-ready forces to operational Commanders, it must train in a manner in which it will be utilized in military operations. Accordingly, training and testing without active sonar is not a reasonable alternative and will not be carried forward.

2.4.2 Alternatives Carried Forward

The Navy's anticipated level of training and testing activity evolves over time based on numerous factors. Over the past several years, the Navy's ongoing sonar reporting program has gathered classified data regarding the number of hull-mounted mid-frequency active sonar hours used to meet anti-submarine warfare requirements. These data allow for a more accurate projection of the number of active sonar hours required to meet anti-submarine warfare training requirements into the reasonably foreseeable future. As previously discussed, in addition to meeting the Navy's purpose and need to train and test, the action alternatives, and in particular the mitigation measures that are incorporated in the action alternatives, were developed to meet NMFS's independent purpose and need to evaluate the potential impacts of the Navy's activities, determine whether incidental take resulting from the Navy's activities would have a negligible impact on affected marine mammal species and stocks, and prescribe measures to effect the least practicable adverse impact on species or stocks and their habitat, as well as monitoring and reporting requirements.

2.4.2.1 No Action Alternative

As mentioned in Section 2.4 (Action Alternatives Development), the CEQ implementing regulations require that a range of alternatives to the proposed action, including a No Action Alternative, be analyzed to provide a clear basis for choice among options by the decision maker and the public (40 CFR 1502.14). CEQ guidance identifies two approaches in developing the No Action Alternative (46 *Federal Register* 18026). One approach is applicable to ongoing, continuing actions as the present course of action under the current management direction or intensity. For example, the continuation of training and testing activities conducted at levels analyzed in the 2015 NWTT Final EIS/OEIS could be a viable No Action Alternative, even if separate legal authorizations under the MMPA and ESA are required to continue the activities. Under this approach, which was used in the 2015 NWTT Final EIS/OEIS, the analysis compares the effects of continuing current activity levels (i.e., the "status quo") with the effects of the Proposed Action. The second approach depicts a scenario where no authorizations or permits are issued, in which the proposed action does not take place, and the resulting environmental effects from taking no action are compared with the effects of implementing the proposed action. The Navy applied the second approach in this Supplemental as it further supports NMFS' regulatory process by presenting the scenario where no authorization will be issued. Additionally, the second approach responds to comments submitted at various stages regarding the 2015 NWTT Final EIS/OEIS and during the scoping process of this Supplemental.

Under the No Action Alternative analyzed in this Supplemental, the Navy would not conduct the proposed training and testing activities in the NWTT Study Area. Consequently, the No Action Alternative of not conducting the proposed live, at-sea training and testing activities in the Study Area is inherently unreasonable in that it does not meet the purpose and need (see Section 1.4, Purpose and Need) for the reasons noted below. However, the analysis associated with the No Action Alternative is carried forward in order to compare the magnitude of the potential environmental effects of the Proposed Actions with the conditions that would occur if the Proposed Action did not occur (see Section 3.0.1, Overall Approach to Analysis).

From NMFS' perspective, pursuant to its obligation to grant or deny permit applications under the MMPA, the No Action Alternative involves NMFS denying Navy's application for an incidental take authorization under Section 101(a)(5)(A) of the MMPA. If NMFS were to deny the Navy's application, the Navy would not be authorized to incidentally take marine mammals and the Navy would not conduct the proposed training and testing activities in the NWTT Study Area.

Cessation of proposed Navy at-sea training and testing activities would mean that the Navy would be unable to (1) meet its statutory requirements, (2) adequately prepare to defend itself and the United States from enemy forces, (3) successfully detect enemy submarines, and (4) effectively use its weapons systems or defensive countermeasures due to a lack of training of forces and testing of systems that replicate the conditions to which Naval forces must operate while executing the range of military operations required to further national security objectives. Navy personnel would essentially not be taught how to use Navy systems in any realistic scenario in the Study Area. For example, sonar proficiency, which is a complex and perishable skill, requires regular, hands-on training in realistic and diverse conditions. In order to detect and counter hostile submarines, the Navy uses both passive and active sonar. Inability to train with active sonar would result in greatly diminished anti-submarine warfare capability.

Additionally, without proper training, individual Sailors and Marines serving onboard Navy vessels would not be taught how to properly operate complex equipment in inherently dynamic and dangerous environments. Even with high levels of training, injuries, and sometimes even death occur. Therefore, without proper training, it is likely that there would be an increase in the number of mishaps, potentially resulting in the death or serious injury of Sailors and Marines. Failing to allow our Sailors and Marines to achieve and maintain the skills necessary to defend the United States and its interests will result in an unacceptable increase in the danger they willingly face.

Finally, the lack of live training and testing would require a higher reliance on simulated training and testing. While the Navy continues to research new ways to provide realistic training through simulation, there are limits to the realism that technology provides. While simulators are used for the basic training of sonar technicians, they are of limited utility beyond basic training. A simulator cannot match the dynamic nature of the environment, such as bathymetry and sound propagation properties, or the training activities involving several units with multiple crews interacting in a variety of acoustic environments. Sole reliance on simulation would deny Sailors the ability to develop battle-ready required proficiency in the employment of active sonar during military operations (Section 2.4.1.4, Simulated Training and Testing Only).

2.4.2.2 Alternative 1 (Preferred Alternative)

Alternative 1 is the Preferred Alternative. Alternative 1 reflects a representative year of training and testing to account for the natural fluctuation of training cycles, testing programs, and deployment schedules that generally limit the maximum level of training and testing from occurring for the reasonably foreseeable future.

2.4.2.2.1 Training

Under this alternative, the Navy proposes to conduct military readiness activities into the reasonably foreseeable future, as necessary to meet current and future readiness requirements. These military readiness activities include new activities as well as activities subject to previous analysis that are currently ongoing and have historically occurred in the Study Area. The requirements for the types of activities to be conducted, as well as the intensity at which they need to occur, have been validated by senior Navy leadership. Specifically, training activities are based on the requirements of the Optimized Fleet Response Plan (Section 1.4.2, Optimized Fleet Response Training) and on changing world events, advances in technology, and Navy tactical and strategic priorities. These activities account for force structure changes and include training with new aircraft, vessels, unmanned/autonomous systems, and weapon systems that will be introduced to the Fleets after November 2020. The numbers and locations of all proposed training activities are provided in Table 2.5-1.

Using a representative level of activity rather than a maximum tempo of training activity in every year has reduced the amount of hull-mounted mid-frequency active sonar estimated to be necessary to meet training requirements. Under Alternative 1, the Navy assumes that some unit-level training would be conducted using synthetic means (e.g., simulators). Additionally, this alternative assumes that some unit-level active sonar training will be completed through other training exercises. By using a representative level of training activity rather than a maximum level of training activity in every year, this alternative accepts a degree of risk that if global events necessitated a rapid expansion of military training that the Navy would not have sufficient capacity in its MMPA and ESA authorizations to carry out those training requirements.

The Optimized Fleet Response Plan and various training plans identify the number and duration of training cycles that could occur. Alternative 1 considers fluctuations in training cycles and deployment schedules that do not follow a traditional annual calendar but instead are influenced by in-theater demands and other external factors. This alternative takes a similar approach to estimating unit-level training.

2.4.2.2.2 Testing

Under Alternative 1, the Navy proposes an annual level of testing that reflects the fluctuations in testing programs by recognizing that the maximum level of testing will not be conducted each year. This alternative includes the testing of new platforms, systems, and related equipment that will be introduced after November 2020. The majority of testing activities that would be conducted under this alternative are the same as or similar to those conducted currently or in the past. This alternative includes the testing of some new systems using new technologies and takes into account inherent uncertainties in this type of testing. The numbers and locations of all proposed testing activities are listed in Table 2.5-2 and Table 2.5-3.

2.4.2.2.3 Mitigation Measures

The Navy's entire suite of mitigation measures was applied to Alternative 1 to ensure that: (1) the benefit of mitigation measures to environmental and cultural resources was considered during the applicable environmental analyses, and (2) Navy Senior Leadership approved each mitigation measure included in this Draft Supplemental under Alternative 1. Navy Senior Leadership reviewed relevant supporting information to make a fully informed decision, including the benefit of mitigation measures to environmental and cultural resources, and the impacts that implementing mitigation will have on training and testing activities under Alternative 1. As discussed in Chapter 5 (Mitigation) and Appendix K (Geographic Mitigation Assessment), the final suite of mitigation measures that will be included in the Final Supplemental will represent the maximum level of mitigation that is practicable for the Navy to implement when balanced against impacts to safety, sustainability, and the ability to continue meeting its mission requirements.

2.4.2.3 Alternative 2

2.4.2.3.1 Training

Alternative 2 reflects the maximum number of training activities that could occur within a given year and assumes that the maximum level of activity would occur every year for the reasonably foreseeable future. As under Alternative 1, this alternative includes new and ongoing activities. Under Alternative 2, training activities are based on requirements established by the Optimized Fleet Response Plan. Under this alternative, the Navy would be enabled to meet the highest levels of required military readiness in order to respond to a direct challenge from a naval opponent that possesses, or will soon possess, near-peer capabilities. This allows for the greatest flexibility for the Navy to maintain readiness when considering potential changes in the national security environment, fluctuations in training and deployment schedules, and anticipated in-theater demands. The numbers and locations of all proposed training activities are provided in Table 2.5-1.

2.4.2.3.2 Testing

Alternative 2 assumes that the maximum annual testing efforts predicted for each individual system or program could occur concurrently in any given year. Like Alternative 1, Alternative 2 entails a level of testing activities to be conducted into the reasonably foreseeable future and includes the testing of new platforms, systems, and related equipment that will be introduced after November 2020. The majority of testing activities that would be conducted under this alternative are the same as or similar to those conducted currently or in the past.

Alternative 2 would include the testing of some new systems using new technologies, taking into account the potential for delayed or accelerated testing schedules, variations in funding availability, and innovations in technology development. To account for these inherent uncertainties in testing, this alternative assumes a higher annual level of testing than Alternative 1. This alternative also includes the contingency for augmenting some weapon systems tests in response to potential increased world conflicts and changing Navy leadership priorities as the result of a direct challenge from a naval opponent that possesses near-peer capabilities. Therefore, this alternative includes the provision for higher levels of vessel evaluations, annual testing of certain anti-submarine warfare systems and unmanned systems to support expedited delivery of these systems to the Fleet, and increases in other testing activities. All proposed testing activities are listed in Table 2.5-2 and Table 2.5-3.

2.4.2.3.3 Mitigation Measures

The Navy's entire suite of mitigation measures was applied to Alternative 2 to ensure that: (1) the benefit of mitigation measures to environmental and cultural resources was considered during the applicable environmental analyses, and (2) Navy Senior Leadership approved each mitigation measure included in this Draft Supplemental under Alternative 2. Navy Senior Leadership reviewed relevant supporting information to make a fully informed decision, including the benefit of mitigation measures to environmental and cultural resources, and the impacts that implementing mitigation will have on training and testing activities under Alternative 2. As discussed in Chapter 5 (Mitigation) and Appendix K (Geographic Mitigation Assessment), the final suite of mitigation measures that will be included in the Final Supplemental will represent the maximum level of mitigation that is practical for the Navy to implement when balanced against impacts to safety, sustainability, and the ability to continue meeting its mission requirements.

2.5 Comparison of Alternatives

For a comparison of acoustic and explosive stressors associated with the proposed activities, refer to Table 3.0-2 and Table 3.0-7. These tables reflect changes in proposed explosive and acoustic source requirements, as the Navy's training and testing needs have changed since the 2015 NWTT Final EIS/OEIS.

The following tables compare the proposed Supplemental action alternatives (Alternative 1 and Alternative 2) with the current training and testing activities described under Alternative 1 in the 2015 NWTT Final EIS/OEIS. Each table describes the activities in terms of the activity name and where in the Study Area the Navy proposes to conduct it (first two columns). The next two columns show the annual occurrence and ordnance or other expended items (if any) involved in the activity as is currently ongoing (under the heading "2015 NWTT EIS/OEIS Ongoing Activities"). The final two pairs of columns present the same information (annual occurrence and ordnance/items) as the activities are analyzed in this Supplemental for Alternative 1 and Alternative 2, respectively.

Table 2.5-1 is the table of training activities, Table 2.5-2 is the table of Naval Sea Systems Command testing activities, and Table 2.5-3 is the table of Naval Air Systems Command testing activities.

Table 2.5-1: Current and Proposed Training Activities

Range Activity	*Location*	*2015 NWTT EIS/OEIS Ongoing Activities*		*Supplemental*			
				Alternative 1 (Preferred)		*Alternative 2*	
		No. of events (annual)	*Ordnance (Number per year)*	*No. of events [1] (annual)*	*Ordnance (Number per year)*	*No. of events [1] (annual)*	*Ordnance (Number per year)*
Air Warfare							
Air Combat Maneuver (ACM)	Offshore Area (W-237)	550[2]	None	126[2]	None	126[2]	None
	Offshore Area (Olympic MOA)			574[2]	None	574[2]	None
Gunnery Exercise (Surface-to-Air) (GUNEX [S-A])	Offshore Area (W-237)	160	Large-caliber rounds (230 explosive, 80 NEPM) Medium-caliber rounds (6,320 explosive, 9,672 NEPM)	125	Large-caliber rounds (60 explosive, 6,670 NEPM) Medium-caliber rounds (300 explosive, 9,660 NEPM)	160	Large-caliber rounds (230 explosive, 6,670 NEPM) Medium-caliber rounds (6,240 explosive, 9,680 NEPM)
Missile Exercise (Air-to-Air) (MISSILEX [A-A])	Offshore Area (W-237)	24	AIM-7/9/120 (15 explosive warheads, 15 NEPM warheads)	0–4	AIM-7/9/120 (4 explosive warheads, 4 NEPM warheads)	24	AIM-7/9/120 (15 explosive warheads, 15 NEPM warheads)
Missile Exercise (Surface-to-Air) (MISSILEX [S-A])	Offshore Area (W-237)	4	RIM-7/116 (8 explosive warheads)	0–4	RIM-7/116 (8 explosive warheads)	4	RIM-7/116 (8 explosive warheads)
Anti-Submarine Warfare							
Torpedo Exercise – Submarine (TORPEX - Sub)	Offshore Area	Not Analyzed[3]	Not Analyzed	0–2	2 MK-48 Torpedoes (non-explosive)	2	2 MK-48 Torpedoes (HE)
Tracking Exercise – Helicopter (TRACKEX – Helo)	Offshore Area	4	None	0–2	None	4	None

Table 2.5-1: Current and Proposed Training Activities (continued)

Range Activity	***Location***	***2015 NWTT EIS/OEIS Ongoing Activities***		***Supplemental***			
				Alternative 1 (Preferred)		***Alternative 2***	
		No. of events (annual)	***Ordnance (Number per year)***	***No. of events [1] (annual)***	***Ordnance (Number per year)***	***No. of events [1] (annual)***	***Ordnance (Number per year)***
Anti-Submarine Warfare (continued)							
Tracking Exercise – Maritime Patrol Aircraft (TRACKEX – MPA)	Offshore Area	324	None	373	16 Torpedoes (non-explosive)	373	16 Torpedoes (non-explosive)
Tracking Exercise – Ship (TRACKEX – Ship)	Offshore Area	65	None	62	None	65	None
Tracking Exercise – Submarine (TRACKEX – Sub)	Offshore Area	100	None	75-100	None	100	None
Electronic Warfare							
Electronic Warfare Training – Aircraft (EW Training)	Offshore Area (W-237)	1,062 [4]	None	1,062 [4]	None	1,062 [4]	None
	Offshore Area (Olympic MOA)	3,938 [4]		3,938 [4]	None	3,938 [4]	None
Electronic Warfare Training – Ship (EW Training)	Offshore Area (W-237), Inland Waters	275	None	220	None	275	None
Mine Warfare							
Civilian Port Defense – Homeland Security Anti-Terrorism/Force Protection Exercises	Inland Waters	Every other year (three in 5 years)	None	0–1	None	1	None

Table 2.5-1: Current and Proposed Training Activities (continued)

Range Activity	Location	2015 NWTT EIS/OEIS Ongoing Activities		Supplemental Alternative 1 (Preferred)		Supplemental Alternative 2	
		No. of events (annual)	Ordnance (Number per year)	No. of events [1] (annual)	Ordnance (Number per year)	No. of events [1] (annual)	Ordnance (Number per year)
Mine Warfare (continued)							
Mine Neutralization – Explosive Ordnance Disposal (EOD) Training	Crescent Harbor EOD Training Range	3	Three 2.5 lb. charges	3	Three 2.5 lb. charges	5	Five 2.5 lb. charges
		3	Eighteen 1 oz. charges	3	Eighteen 1 oz. charges	5	Thirty 1 oz. charges
	Hood Canal EOD Training Range	3	Three 2.5 lb. charges	3	Three 2.5 lb. charges	5	Five 2.5 lb. charges
		3	Eighteen 1 oz. charges	3	Eighteen 1 oz. charges	5	Thirty 1 oz. charges
Submarine Mine Exercise	Offshore Area	8	None	Discontinued		Discontinued	
Surface Warfare							
Bombing Exercise (Air-to-Surface) (BOMBEX [A-S])	Offshore Area (W-237)	30	BDU-45, MK-84 bombs (10 explosive, 110 NEPM)	0–28	BDU-45 series bombs (84 NEPM)	30	BDU-45 series bombs (110 NEPM)
				0–2	MK-80 series bombs (2 explosive)	2	MK-80 series bombs (10 explosive)
Gunnery Exercise (Surface-to-Surface) – Ship (GUNEX [S-S] – Ship)	Offshore Area	200	Small-caliber rounds (121,200 NEPM) Medium-caliber rounds (48 explosive, 33,492 NEPM) Large-caliber rounds (160 explosive, 2,720 NEPM)	100–200	Small-caliber rounds (121,000 NEPM) Medium-caliber rounds (250 explosive, 16,750 NEPM) Large-caliber rounds (112 explosive, 2,720 NEPM)	200	Small-caliber rounds (121,000 NEPM) Medium-caliber rounds (250 explosive, 33,492 NEPM) Large-caliber rounds (160 explosive, 2,720 NEPM)

Table 2.5-1: Current and Proposed Training Activities (continued)

Range Activity	*Location*	*2015 NWTT EIS/OEIS Ongoing Activities*		*Supplemental*			
				Alternative 1 (Preferred)		*Alternative 2*	
		No. of events (annual)	*Ordnance (Number per year)*	*No. of events [1] (annual)*	*Ordnance (Number per year)*	*No. of events [1] (annual)*	*Ordnance (Number per year)*
Surface Warfare (continued)							
Missile Exercise (Air-to-Surface) (MISSILEX [A-S])	Offshore Area (W-237)	4	AGM-84 (4 explosive missiles)	0–2	AGM-84 (2 explosive missiles)	4	AGM-84 (4 explosive missiles)
Other Training							
Intelligence, Surveillance, Reconnaissance (ISR)	Offshore Area	200	None	No Change		No Change	
Maritime Security Operations	Inland Waters	286	1,320 small-caliber rounds (all blanks)	220	1,320 small-caliber rounds (all blanks)	286	1,320 small-caliber rounds (all blanks)
Personnel Insertion/ Extraction – Non-Submersible	Inland Waters	10	None	6	None	10	None
Personnel Insertion/ Extraction – Submersible	Inland Waters	35	None	0 [5]	None	0 [5]	None
Precision Anchoring	Inland Waters	10	None	30–40	None	40	None
Search and Rescue	Inland Waters	100	None	80	None	100	None
Small Boat Attack Exercise	NS Everett NBK Bangor NBK Bremerton	1	None	1	None	2	None
Submarine Sonar Maintenance	NBK Bangor, NBK Bremerton, and Offshore Area	22	None	26	None	26	None

Table 2.5-1: Current and Proposed Training Activities (continued)

Range Activity	Location	2015 NWTT EIS/OEIS Ongoing Activities		Supplemental Alternative 1 (Preferred)		Supplemental Alternative 2	
		No. of events (annual)	Ordnance (Number per year)	No. of events [1] (annual)	Ordnance (Number per year)	No. of events [1] (annual)	Ordnance (Number per year)
Other Training (continued)							
Surface Ship Sonar Maintenance	NBK Bremerton, NS Everett, and Offshore Area	13	None	25	None	25	None
Unmanned Underwater Vehicle Training	Inland Waters Offshore Area (QRS)	Not previously analyzed as a training activity [6]	None	60	None	75	None

[1] For activities where the maximum number of events varies between years, a range is provided to indicate the "representative–maximum" number of events. For activities where no variation is anticipated, only the maximum number of events within a single year is provided.
[2] These events typically involve two aircraft; however, based upon the training requirement, events may involve multiple aircraft.
[3] The TORPEX – SUB activity was analyzed in 2010 as part of the Sinking Exercise. The Sinking Exercise is no longer conducted in the NWTT Study Area and the TORPEX – SUB activity is now a separate activity.
[4] Multiple Air Combat Maneuver and Electronic Warfare aircraft events occur during a single aircraft training flight (sortie). On average, two events occur per sortie.
[5] This activity is covered under a separate analysis (2018 Final Environmental Assessment for Naval Special Operations in Western Washington State)
[6] Unmanned underwater vehicles were analyzed in 2015 as a testing activity.
Notes: NEPM = Non-Explosive Practice Munitions, MOA = Military Operations Area, NS = Naval Station, NBK = Naval Base Kitsap, EOD = Explosive Ordnance Disposal, QRS = Quinault Range Site

Table 2.5-2: Current and Proposed Naval Sea Systems Command Testing Activities

Range Activity	Location [1]	2015 NWTT EIS/OEIS Ongoing Activities		Supplemental			
				Alternative 1 (Preferred)		Alternative 2	
		No. of events (annual)	Ordnance (Number per year)	No. of events [2] (annual)	Ordnance (Number per year)	No. of events [2] (annual)	Ordnance (Number per year)
Anti-Submarine Warfare							
Anti-Submarine Warfare Testing	Offshore Area	13	16 NEPM torpedoes	44	8 NEPM torpedoes	44	8 NEPM torpedoes
At-Sea Sonar Testing	Offshore Area	Not previously analyzed as a testing activity	None	5	None	7	None
	Inland Waters (DBRC)		Not previously analyzed	5–7	16-24 NEPM torpedoes	9	32 NEPM torpedoes
Countermeasure Testing	Offshore Area (QRS)	14	123 NEPM torpedoes	14	12 NEPM torpedoes	14	12 NEPM torpedoes
	Inland Waters (DBRC, Keyport Range Site)	74	21 NEPM torpedoes	29	None	29	None
	Western Behm Canal, AK	4	None	1	None	1	None
Pierside-Sonar Testing	Inland Waters (NS Everett, NBK Bangor, NBK Bremerton)	67	None	88–99	None	174	None
Submarine Sonar Testing/Maintenance	Western Behm Canal, AK	3	None	1–2	None	3	None
Torpedo (Explosive) Testing	Offshore Area	3	6 explosive torpedoes 6 NEPM torpedoes	4	8 explosive torpedoes 16 NEPM torpedoes	4	8 explosive torpedoes 16 NEPM torpedoes
Torpedo (Non-explosive) Testing	Offshore Area	23	119 NEPM torpedoes	22	146 NEPM torpedoes	22	146 NEPM torpedoes
	Inland Waters (DBRC)	41	189 NEPM torpedoes	61	358 NEPM torpedoes	61	358 NEPM torpedoes

Table 2.5-2: Current and Proposed Naval Sea Systems Command Testing Activities (continued)

Range Activity	***Location [1]***	***2015 NWTT EIS/OEIS Ongoing Activities***		***Supplemental***			
				Alternative 1 (Preferred)		***Alternative 2***	
		No. of events (annual)	***Ordnance (Number per year)***	***No. of events [2] (annual)***	***Ordnance (Number per year)***	***No. of events [2] (annual)***	***Ordnance (Number per year)***
Mine Warfare							
Mine Countermeasure and Neutralization Testing	Offshore Area	Not previously analyzed	None	3	Mine explosive–5 Mine Neutralizer–36	3	Mine explosive–5 Mine Neutralizer–36
	Inland Waters		None	3	None	3	None
Mine Detection and Classification Testing	Offshore Area (QRS)	Not previously analyzed	None	1	None	2	None
	Inland Waters (DBRC, Keyport Range Site)	54	None	42	None	44	None
Surface Warfare							
Kinetic Energy Weapon Testing	Offshore Area	Not previously analyzed	Not previously analyzed	4	Kinetic energy explosive – 80	4	Kinetic energy explosive – 80
Unmanned Systems							
Unmanned Aerial System Testing	Offshore Area (QRS)	20	None	2	None	2	None
	Inland Waters (DBRC, Keyport Range Site, R6701)	20	None	20	None	20	None

Table 2.5-2: Current and Proposed Naval Sea Systems Command Testing Activities (continued)

Range Activity	Location [1]	2015 NWTT EIS/OEIS Ongoing Activities		Supplemental Alternative 1 (Preferred)		Supplemental Alternative 2	
		No. of events (annual)	Ordnance (Number per year)	No. of events [2] (annual)	Ordnance (Number per year)	No. of events [2] (annual)	Ordnance (Number per year)
Unmanned Systems (continued)							
Unmanned Surface Vehicle System Testing	Offshore Area (QRS)	20	None	4	None	4	None
	Inland Waters (DBRC, Keyport Range Site)	20	None	20	None	20	None
Unmanned Underwater Vehicle Testing	Offshore Area (QRS)	28	27 NEPM torpedoes	38–39	12–24 NEPM torpedoes	39	24 NEPM torpedoes
	Inland Waters (DBRC, Keyport Range Site, Carr Inlet)	253	107 NEPM torpedoes	371–379	48–72 NEPM torpedoes	400	72 NEPM torpedoes
Vessel Evaluation							
Propulsion Testing	Offshore Area	Not previously analyzed	Not previously analyzed	8–10	None	13	None
Undersea Warfare Testing	Offshore Area	Not previously analyzed	Not previously analyzed	1–12	23–55 NEPM torpedoes	18	78 NEPM torpedoes
Vessel Signature Evaluation	Inland Waters (DBRC)	Not previously analyzed	None	1	None	1	None
	Western Behm Canal, AK	43	None	25–37	None	48	None

Table 2.5-2: Current and Proposed Naval Sea Systems Command Testing Activities (continued)

Range Activity	*Location [1]*	*2015 NWTT EIS/OEIS Ongoing Activities*		*Supplemental*			
				Alternative 1 (Preferred)		*Alternative 2*	
		No. of events (annual)	*Ordnance (Number per year)*	*No. of events [2] (annual)*	*Ordnance (Number per year)*	*No. of events [2] (annual)*	*Ordnance (Number per year)*
Other Testing							
Acoustic and Oceanographic Research	Offshore Area (QRS)	Not previously analyzed	Not previously analyzed	1	None	1	None
	Inland Waters (DBRC, Keyport Range Site)	Not previously analyzed	Not previously analyzed	3	None	3	None
Acoustic Component Testing	Inland Waters (Indian Island, NS Everett, NBK Bangor, NBK Bremerton)	60	None	45	None	45	None
	Western Behm Canal, AK	4	None	13–18	None	18	None
Cold Water Support	Offshore Area (QRS)	20	None	0	None	0	None
	Inland Waters (Keyport Range Site, DBRC, Carr Inlet)	65	None	4	None	5	None
	Western Behm Canal, AK	1	None	1	None	1	None
Hydrodynamic and Maneuverability Testing	Western Behm Canal, AK	3	None	1	None	3	None

Table 2.5-2: Current and Proposed Naval Sea Systems Command Testing Activities (continued)

Range Activity	*Location* [1]	*2015 NWTT EIS/OEIS Ongoing Activities*		*Supplemental*			
				Alternative 1 (Preferred)		*Alternative 2*	
		No. of events (annual)	*Ordnance (Number per year)*	*No. of events* [2] *(annual)*	*Ordnance (Number per year)*	*No. of events* [2] *(annual)*	*Ordnance (Number per year)*
Other Testing (continued)							
Non-Acoustic Component Testing	Offshore Area	6	None	7–8	None	8	None
	Inland Waters (DBRC, Keyport Range Site, NBK Bangor)	74	None	75	None	75	None
Post-Refit Sea Trial	Inland Waters (DBRC)	32	None	30	None	39	None
Radar and Other System Testing	Offshore Area	Not previously analyzed	Not previously analyzed	54	None	54	None
Semi-Stationary Equipment Testing	Inland Waters (DBRC, Keyport Range Site)	176	None	120	None	120	None
	Western Behm Canal, AK	2	None	2–3	None	3	None
Simulant Testing	Offshore Area	Not previously analyzed	Not previously analyzed	50	None	50	None

[1] Locations given are areas where activities typically occur. However, activities could be conducted in other locations within the Study Area.
[2] For activities where the maximum number of events varies between years, a range is provided to indicate the "representative–maximum" number of events. For activities where no variation is anticipated, only the maximum number of events within a single year is provided.
Notes: NEPM = Non-Explosive Practice Munitions, NS = Naval Station, NBK = Naval Base Kitsap, DBRC = Dabob Bay Range Complex, QRS = Quinault Range Site, EOD = Explosive Ordnance Disposal

Table 2.5-3: Current and Proposed Naval Air Systems Command Testing Activities

Range Activity	Location	2015 NWTT EIS/OEIS Ongoing Activities		Supplemental Alternative 1 (Preferred)		Supplemental Alternative 2	
		No. of events (annual)	Ordnance (Number per year)	No. of events (annual)	Ordnance (Number per year)	No. of events (annual)	Ordnance (Number per year)
Anti-Submarine Warfare							
Tracking Test – Maritime Patrol Aircraft	Offshore Area	43	None	4	None	4	None
		6	70 IEER sonobuoy				
Tracking Test – Maritime Patrol Aircraft (SUS)	Offshore Area	5	72 Impulsive SUS buoys (e.g., MK-61, MK-64, MK-82)	4	80 Impulsive SUS buoys (e.g., MK-61, MK-64, MK-82)	4	80 Impulsive SUS buoys (e.g., MK-61, MK-64, MK-82)
Electronic Warfare (EW)							
Flare Test	Offshore Area	10	600 flares	0	None	0	None
Other Testing							
Intelligence, Surveillance, Reconnaissance (ISR)/Electronic Warfare (EW) Triton Testing	Offshore Area	0	None	20	None	20	None

Notes: SUS = Signal Underwater Sound, IEER = Improved Extended Echo Ranging

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3 Affected Environment and Environmental Consequences

This chapter describes the United States (U.S.) Department of the Navy's (Navy's) approach to analysis, existing environmental conditions in the Northwest Training and Testing (NWTT) Study Area, and the analysis of resources potentially impacted by the Proposed Action described in Chapter 2 (Description of Proposed Action and Alternatives). The Study Area is described in Section 2.1 (Description of the Northwest Training and Testing Study Area) and depicted in Figure 2.1-1.

3.0 Introduction

This section describes the approach the Navy has taken to analyze the potential environmental impacts resulting from activities described in this Supplemental.

In October 2015, the Navy released the NWTT Final Environmental Impact Statement (EIS)/OEIS (U.S. Department of the Navy, 2015), hereafter referred to as the 2015 NWTT Final EIS/OEIS, for which a Record of Decision was released (U.S. Department of the Navy, 2016a). The Navy applied the Navy Acoustics Effects Model for the 2015 NWTT Final EIS/OEIS to quantitatively analyze potential acoustic effects from Navy training and testing activities. For this Supplemental, the Navy refined the Navy Acoustics Effects Model (U.S. Department of the Navy, 2018) and updated marine mammal density estimates (U.S. Department of the Navy, 2019), as well as the criteria and activity data inputs used in the acoustic model (U.S. Department of the Navy, 2017b).

The following subsections are included in the remainder of Section 3.0:

- Section 3.0.1 (Overall Approach to Analysis) identifies the methodology used in this Supplemental to assess resource impacts associated with the Proposed Action.
- Section 3.0.2 (Regulatory Framework) presents the regulatory framework on which this Supplemental is based. It identifies applicable laws, regulations, executive orders, and directives used to develop the analyses.
- Section 3.0.3 (Identification of Stressors for Analysis) discusses the stressors used in the analysis of impacts to resources.

3.0.1 Overall Approach to Analysis

The methods used in this Supplemental to assess resource impacts associated with the Proposed Action include the procedural steps outlined below:

- Review the existing 2015 NWTT Final EIS/OEIS and Record of Decision.
- Determine if information about the affected environment has changed.
- Identify new activities and proposed changes to existing activities.
- Identify the stressors associated with the updated list of activities.
- Review existing and identify new federal and state regulations and standards relevant to resource-specific management or protection and determine if there has been any change since the 2015 NWTT Final EIS/OEIS.
- Review and apply new literature, including science, surveys, and information on how resources could be affected by stressors.
- Determine if there is a new method of analysis for those activities.
- Review and consider comments received from members of the public and other stakeholders during the scoping period.

- Identify past, present, and reasonably foreseeable future actions to analyze the cumulative impacts.
- Consider mitigation measures to reduce identified potential impacts.

3.0.1.1 Navy Compiled and Generated Data

While preparing this document, the Navy used the best available data, science, and information accepted by the relevant and appropriate regulatory and scientific communities to establish a baseline in the environmental analyses for all resources in accordance with National Environmental Policy Act (NEPA), the Administrative Procedure Act (5 United States Code sections 551–596), and Executive Order 12114.

In support of the environmental baseline and environmental consequences sections for this and other environmental documents, the Navy has sponsored and supported both internal and independent research and monitoring efforts. The Navy's research and monitoring programs, as described below, are largely focused on filling data gaps and obtaining the most up-to-date science.

3.0.1.1.1 Marine Species Monitoring and Research Programs

The Navy has been conducting marine species monitoring for compliance with the Marine Mammal Protection Act (MMPA) and Endangered Species Act (ESA) since 2006, both in association with training and testing events and independently. In addition to monitoring activities associated with regulatory compliance, two other U.S. Navy research programs provide extensive investments in basic and applied research: the Office of Naval Research Marine Mammals & Biology program, and the Living Marine Resources program. In fact, the U.S. Navy is one of the largest sources of funding for marine mammal research in the world. A survey of federally funded marine mammal research and conservation conducted by the Marine Mammal Commission found that the Navy was the second-largest source of funding for marine mammal activities (direct project expenditures, as well as associated indirect or support costs) in the United States in 2014, second only to National Oceanic and Atmospheric Administration Fisheries (Purdy, 2016).

The monitoring program has historically focused on collecting baseline data that supports analysis of marine mammal occurrence, distribution, abundance, and habitat use preferences in and around ocean areas in the Atlantic and Pacific where the Navy conducts training and testing. More recently, the priority has begun to shift towards assessing the potential response of individual species to training and testing activities. Data collected through the monitoring program serves to inform the analysis of impacts on marine mammals with respect to species distribution, habitat use, and potential responses to training and testing activities. Monitoring is performed using various methods, including visual surveys from surface vessels and aircraft, passive acoustics, and tagging. Additional information on the program is available on the U.S. Navy Marine Species Monitoring Program website (https://www.navymarinespeciesmonitoring.us/), which serves as a public online portal for information on the background, history, and progress of the program and also provides access to reports, documentation, data, and updates on current monitoring projects and initiatives.

The two other Navy programs previously mentioned invest in research on the potential effects of sound on marine species and develop scientific information and analytic tools that support preparation of environmental impact statements and associated regulatory processes under the MMPA and ESA, as well as support development of improved monitoring and detection technology and advance overall knowledge about marine species. These programs support coordinated science, technology, research, and development focused on understanding the effects of sound on marine mammals and other marine species, including physiological, behavioral, ecological, and population-level effects. Additional information on these programs and other ocean resources-oriented initiatives can be found at the U.S. Navy Green Fleet – Energy, Environment, and Climate Change website.

3.0.1.2 Navy's Quantitative Analysis to Determine Impacts to Sea Turtles and Marine Mammals

If proposed Navy activities introduce sound or explosive energy into the marine environment, an analysis of potential impacts on marine species is conducted. Data on the density of animals (number of animals per unit area) of each species and stock is needed, along with criteria and thresholds defining the levels of sound and energy that may cause certain types of impacts. The Navy's acoustic effects model takes the density and the criteria and thresholds as inputs and analyzes Navy training and testing activities. Finally, mitigation and animal avoidance behaviors are considered to determine the number of impacts that could occur. The inputs and process are described below. A detailed explanation of this analysis is provided in the technical report titled *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2018).

3.0.1.2.1 Marine Species Density Database

A quantitative analysis of impacts on a species requires data on their abundance and distribution in the potentially impacted area. The most appropriate metric for this type of analysis is density, which is the number of animals present per unit area. Estimating marine species density requires substantial surveys and effort to collect and analyze data to produce a usable estimate. The National Marine Fisheries Service (NMFS) is the primary agency responsible for estimating marine mammal and sea turtle density within the U.S. Exclusive Economic Zone. Other agencies and independent researchers often publish density data for species in specific areas of interest, including areas outside the U.S. Exclusive Economic Zone. In areas where surveys have not produced adequate data to allow robust density estimates, methods such as model extrapolation from surveyed areas, Relative Environmental Suitability models, or expert opinion are used to estimate occurrence. These density estimation methods rely on information such as animal sightings from adjacent locations, amount of survey effort, and the associated environmental variables (e.g., depth, sea surface temperature).

There is no single source of density data for every area of the world, species, and season because of the fiscal limitations, resources, effort involved in providing survey coverage to sufficiently estimate density, and practical limitations. Therefore, to characterize marine species density for large areas, such as the NWTT Study Area, the Navy compiled data from multiple sources and developed a protocol to select the best available density estimates based on species, area, and time (i.e., season). When multiple data sources were available, the Navy ranked density estimates based on a hierarchal approach to ensure that the most accurate estimates were selected. The highest tier included peer-reviewed published studies of density estimates from spatial models, since these provide spatially explicit density estimates with relatively low uncertainty. Other preferred sources included peer-reviewed published studies of density estimates derived from systematic line-transect survey data, the method typically used for the NMFS marine mammal stock assessment reports. In the absence of survey data, information on species occurrence and known or inferred habitat associations have been used to predict densities using model-based approaches, including Relative Environmental Suitability models. Because these estimates inherently include a high degree of uncertainty, they were considered the least preferred data source. In cases where a preferred data source was not available, density estimates were selected based on expert opinion from scientists.

The resulting Geographic Information System database includes seasonal density values for every marine mammal and sea turtle species present within the Study Area. This database is described in the technical report titled *U.S. Navy Marine Species Density Database Phase III for the Northwest Training and Testing Study Area* (U.S. Department of the Navy, 2019), hereafter referred to as the Density Technical Report. These data were used as an input into the Navy Acoustic Effects Model.

The Density Technical Report describes the models that were utilized in detail and provides detailed explanations of the models applied to each species density estimate. The list below describes models in order of preference.

1. Spatial density models are preferred and used when available because they provide an estimate with the least amount of uncertainty by deriving estimates for divided segments of the sampling area. These models (see Becker et al., 2016; Forney et al., 2015) predict spatial variability of animal presence as a function of habitat variables (e.g., sea surface temperature, seafloor depth). This model is developed for areas, species, and, when available, specific timeframes (months or seasons) with sufficient survey data.
2. Stratified design-based density estimates use line-transect survey data with the sampling area divided (stratified) into sub-regions, and a density is predicted for each sub-region (Barlow, 2016; Becker et al., 2016; Bradford et al., 2017; Campbell et al., 2015; Jefferson et al., 2014). While geographically stratified density estimates provide a good indication of a species' distribution within the Study Area, the uncertainty is typically high because each sub-region estimate is based on a smaller stratified segment of the overall survey effort.
3. Design-based density estimations use line-transect survey data from land and aerial surveys designed to cover a specific geographic area (see Carretta et al., 2015). These estimates use the same survey data as stratified design-based estimates, but they are not segmented into sub-regions and instead provide one estimate for a large surveyed area.
4. Although relative environmental suitability models provide estimates for areas of the oceans that have not been surveyed, using information on species occurrence and inferred habitat associations, and have been used in past density databases, these models were not used in the current quantitative analysis.

When interpreting the results of the quantitative analysis, as described in the Density Technical Report, it is important to consider that "each model is limited to the variables and assumptions considered by the original data source provider. No mathematical model representation of any biological population is perfect, and with regards to marine mammal biodiversity, any single model will not completely explain the results" (U.S. Department of the Navy, 2019). These factors and others described in the Density Technical Report should be considered when examining the estimated impact numbers in comparison to current population abundance information for any given species or stock.

3.0.1.2.2 Developing Acoustic and Explosive Criteria and Thresholds

Information about the numerical sound and energy levels that are likely to elicit certain types of physiological and behavioral reactions is needed to analyze potential impacts on marine species. Revised Phase III criteria and thresholds for quantitative modeling of impacts use the best available existing data from scientific journals, technical reports, and monitoring reports to develop thresholds and functions for estimating impacts on marine species. Working with NMFS, the Navy has developed updated criteria for marine mammals and sea turtles. Criteria for estimating impacts on marine fishes are also used in this analysis, which largely follows *Sound Exposure Guidelines for Fishes and Sea Turtles* (Popper et al., 2014).

Since the release of the *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effect Analysis* in 2012 (U.S. Department of the Navy, 2012b), recent and emerging science has necessitated an update to these criteria and thresholds for assessing potential impacts on marine mammals and sea turtles. A detailed description of the Phase III acoustic and explosive criteria and threshold development is included in the supporting technical report *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Impact to Marine Mammals and Sea Turtles* (U.S. Department of the Navy, 2017b), and details are provided in each resource section. A series of behavioral studies, largely funded by the U.S. Navy, has led to a new understanding of how some species of marine mammals react to military sonar. This understanding resulted in developing new behavioral response functions for estimating alterations in behavior. Additional information on auditory weighting functions has also emerged [e.g., (Mulsow et al., 2015)], leading to the development of a new methodology to predict auditory weighting functions for each hearing group along with the accompanying hearing loss thresholds. These criteria for predicting hearing loss in marine mammals were largely adopted by NMFS for species within their purview (National Marine Fisheries Service, 2016).

The Navy also uses criteria for estimating effects to fishes and the ranges to which those effects are likely to occur. A working group of experts generated a technical report that provides numerical criteria and relative likelihood of effects to fish within different hearing groups (i.e., fishes with no swim bladder versus fishes with a swim bladder involved in hearing) (Popper et al., 2014). Where applicable, thresholds and relative risk factors presented in the technical report were used to assist in the analysis of effects to fishes from Navy activities. Details on criteria used to estimate impacts on marine fishes are contained within the appropriate stressor section (e.g., sonar and other transducers, explosives) within Section 3.9 (Fishes). This panel of experts also estimated parametric criteria for the effects of sea turtle exposure to sources located at “near,” “intermediate,” and “far” distances, assigning “low,” “medium,” and “high” probability to specific categories of behavioral impacts (Popper et al., 2014).

3.0.1.2.3 The Navy’s Acoustic Effects Model

The Navy’s Acoustic Effects Model calculates sound energy propagation from sonar and other transducers, air guns, and explosives during naval activities and the energy or sound received by animat dosimeters. Animat dosimeters are virtual representations of marine mammals or sea turtles distributed in the area around the modeled naval activity; each animat records its individual sound “dose.” The model bases the distribution of animats over the Study Area on the density values in the Navy Marine Species Density Database and distributes animats in the water column proportional to the known time that species spend at varying depths.

The model accounts for environmental variability of sound propagation in both distance and depth when computing the received sound level on the animats. The model conducts a statistical analysis based on multiple model runs to compute the estimated effects on animals. The number of animats that exceed the received threshold for an effect is tallied to provide an estimate of the number of marine mammals or sea turtles that could be affected.

Assumptions in the Navy model intentionally err on the side of overestimation when there are unknowns:

- Naval activities are modeled as though they would occur regardless of proximity to marine mammals or sea turtles (i.e., mitigation and implementation of standard operating procedures that employ protective measures are not modeled) and without any avoidance of the activity by the animal. The final step of the quantitative analysis of acoustic effects is to consider the implementation of mitigation. For sonar and other transducers, the possibility that marine mammals or sea turtles would avoid continued or repeated sound exposures is also considered.

- Many explosions from munitions such as bombs and missiles actually occur upon impact with above-water targets and at the water's surface. However, for this analysis, sources such as these were modeled as exploding underwater. This modeling overestimates the amount of explosive and acoustic energy entering the water.

The model estimates the impacts caused by individual training and testing activities. During any individual modeled event, impacts on individual animats are considered over 24-hour periods. The animats do not represent actual animals, but rather allow for a statistical analysis of the number of instances that marine mammals or sea turtles may be exposed to sound levels resulting in an effect. Therefore, the model estimates the number of instances in which an effect threshold was exceeded over the course of a year, but it does not estimate the number of individual marine mammals or sea turtles that may be impacted over a year (i.e., some marine mammals or sea turtles could be impacted several times, while others would not experience any impact). A detailed explanation of the Navy's Acoustic Effects Model is provided in the technical report *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2018).

3.0.1.2.4 Accounting for Mitigation

3.0.1.2.4.1 Sonar and Other Transducers

The Navy implements mitigation measures (described in Section 5.3.2, Acoustic Stressors) including the power-down or shut-down (i.e., power-off) of sonar when a marine mammal is observed in the mitigation zone, during activities that use sonar and other transducers. The mitigation zones encompass the estimated ranges to injury (including permanent threshold shift [PTS]) for a given sonar exposure. Therefore, the impact analysis quantifies the potential for mitigation to reduce the risk of PTS. Two factors are considered when quantifying the effectiveness of mitigation: (1) the extent to which the type of mitigation proposed for a sound-producing activity (e.g., active sonar) allows for observation of the mitigation zone prior to and during the activity; and (2) the sightability of each species that may be present in the mitigation zone, which is determined by species-specific characteristics and the viewing platform. A detailed explanation of the analysis is provided in the technical report *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2018).

In the quantitative analysis, consideration of mitigation measures means that, for activities where mitigation is feasible, some model-estimated PTS is considered mitigated to the level of temporary threshold shift (TTS). The quantitative 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 marine mammals or 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 group size or surface active behavior). The behaviors and characteristics of some species may make them easier to detect. For example, based on small boat surveys between 2000 and 2012 in the Hawaiian Islands, pantropical spotted dolphins and striped dolphins were frequently observed leaping out of the water, and Cuvier's beaked whales (Baird, 2013) and Blainville's beaked whales (HDR, 2012) were occasionally observed breaching. These behaviors are visible from a great distance and likely increase sighting distances and detections of these species. Environmental conditions under which the training or testing activity could take place are also considered, such as the sea surface conditions, weather (e.g., fog or rain), and day versus night.

3.0.1.2.4.2 Explosions

The Navy implements mitigation measures (described in Section 5.3.3, Explosive Stressors) during explosive activities, including delaying detonations when a marine mammal or sea turtle is observed in the mitigation zone. The mitigation zones encompass the estimated ranges to mortality for a given explosive. Therefore, the impact analysis quantifies the potential for mitigation to reduce the risk of mortality due to exposure to explosives. Two factors are considered when quantifying the effectiveness of mitigation: (1) the extent to which the type of mitigation proposed for a sound-producing activity (e.g., gunnery exercise) allows for observation of the mitigation zone prior to and during the activity; and (2) the sightability of each species that may be present in the mitigation zone, which is determined by species-specific characteristics and the viewing platform. A detailed explanation of the analysis is provided in the technical report *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2018).

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

3.0.1.2.5 Marine Mammal Avoidance of Sonar and other Transducers

Because a marine mammal is assumed to initiate avoidance behavior (tens of meters away for most species groups) after an initial startle reaction when exposed to relatively high received levels of sound, a marine mammal could reduce its cumulative sound energy exposure over a sonar event with multiple pings. This would reduce risk of both PTS and TTS, although the quantitative analysis conservatively only considers the potential to reduce instances of PTS by accounting for marine mammals swimming away to avoid repeated high-level sound exposures. All reductions in PTS impacts from likely avoidance behaviors are instead considered TTS impacts.

3.0.2 Regulatory Framework

In accordance with the Council on Environmental Quality regulations for implementing the requirements of the NEPA, other planning and environmental review procedures are integrated in this Supplemental to the fullest extent possible. The federal statutes and executive orders described in the 2015 NWTT Final EIS/OEIS have not changed.

Chapter 6 (Additional Regulatory Considerations) provides a status of compliance with the applicable environmental laws, regulations, and executive orders that were considered in preparing this Supplemental (including those that may be secondary considerations in the resource evaluations).

3.0.3 Identification of Stressors for Analysis

As in the 2015 NWTT Final EIS/OEIS, Navy activities are assessed in this Supplemental by evaluating the impacts of the various stressors associated with the activities. The Navy has updated the list of stressors for all of its at-sea planning documents to provide more consistency between documents and to better reflect that certain types of activities affect the environment in the same way. In addition, a few new stressors are being considered. The updated list of stressors considered in this Supplemental and their equivalents considered in the 2015 NWTT Final EIS/OEIS are shown in Table 3.0-1. Although the names of some stressors have changed, the analysis conducted on that stressor did not change. Where useful, an explanation of the change is provided in italics. In the subsections that follow, stressors are further defined and the Navy activities generating each stressor are tabulated. These tables of activities will be referred to during the resource analyses in the remainder of Chapter 3 (Affected Environment and Environmental Consequences). Appendix B (Activity Stressor Matrices) includes matrices that identify the stressors associated with each activity and that show the stressors that can affect each resource.

Table 3.0-1: Comparison of Stressors Analyzed

2015 NWTT FINAL EIS/OEIS	Supplemental
Components and Stressors for Physical Resources	
Sediments and Water Quality Stressors	
• Explosives and explosives byproducts • Metals • Chemicals other than explosives • Other materials	• Explosives • Metals • Chemicals • Other materials
Air Quality Stressors	
• Criteria pollutants • Hazardous air pollutants	• Criteria pollutants • Hazardous air pollutants
Components and Stressors for Biological Resources	
Acoustic Stressors	
• Sonar and other active acoustic sources • Underwater explosives • Swimmer defense airguns • Weapons firing, launch, and impact noise • Vessel noise • Aircraft noise	• Sonar and other transducers • *("Underwater explosives" is moved to "Explosives Stressors" and renamed "In-water explosives")* • *(Swimmer defense airguns are not proposed or analyzed in this Supplemental)* • Weapons noise • Vessel noise • Aircraft noise
Explosives Stressors	
(*In the 2015 NWTT Final EIS/OEIS, Explosives were included under Acoustic Stressors*)	• In-air explosives • In-water explosives
Energy Stressors	
• Electromagnetic devices • Lasers	• In-air electromagnetic devices (*previously included under Electromagnetic Devices*) • In-water electromagnetic devices (*previously included under Electromagnetic Devices*) • Lasers

Table 3.0-1: Comparison of Stressors Analyzed (continued)

2015 NWTT FINAL EIS/OEIS	Supplemental
Physical Disturbance and Strike Stressors	
• Aircraft and aerial targets • Vessels • In-water devices • Military expended materials • Seafloor devices	• Aircraft and aerial targets • Vessels and in-water devices • Military expended materials • Seafloor devices
Entanglement Stressors	
• Fiber optic cables and guidance wires • Decelerators/parachutes	• Wires and cables (*includes all cables and wires analyzed previously*) • Decelerators/parachutes • Biodegradable polymer (*new stressor*)
Ingestion Stressors	
• Military expended materials from munitions • Military expended materials other than munitions	• Military expended materials from munitions • Military expended materials other than munitions
Secondary Stressors	
• Habitat • Prey availability	• Impacts on habitat • Impacts on prey availability
Components and Stressors for Human Resources	
Cultural Resources	
• Acoustic • Physical disturbance and strike	• Explosives (*previously referred to as Acoustic*) • Physical disturbance and strike
American Indian and Alaska Native Traditional Resources	
• Access • Availability of marine resources or habitat • Loss or damage to Tribal fishing gear	• Access • Availability of marine resources or habitat • Loss or damage to Tribal fishing gear
Socioeconomic Resources Stressors	
• Accessibility • Airborne acoustics • Physical disturbance and strike • Secondary impacts from availability of resources	• Accessibility • Airborne acoustics • Physical disturbance and strike • Secondary impacts from availability of resources
Public Health and Safety Stressors	
• Underwater energy • In-air energy • Physical interactions • Secondary stressors (sediments and water quality)	• Underwater energy • In-air energy • Physical interactions • Secondary stressors (sediments and water quality)

Notes: Comments in italics point to modifications in how stressors are characterized or analyzed in this Supplemental as compared to the 2015 NWTT Final EIS/OEIS. Where no comment is included, the stressor is characterized the same as previously, though specific quantities of the stressor may be changed to reflect the updated level of activities.

3.0.3.1 Acoustic Stressors

This section describes the characteristics of sounds produced during naval training and testing and the relative magnitude and location of these sound-producing activities. This section provides the basis for analysis of acoustic impacts on resources in the remainder of Chapter 3 (Affected Environment and Environmental Consequences). Explanations of the terminology and metrics used when describing sound in this Supplemental are in Appendix D (Acoustic and Explosive Concepts).

Acoustic stressors include acoustic signals emitted into the water from a specific source such as sonar and other transducers (devices that convert energy from one form to another – in this case, to sound waves), as well as incidental sources of broadband sound produced as a byproduct of vessel movement; aircraft transits; and use of weapons or other deployed objects. Explosives also produce broadband sound but are characterized separately from other acoustic sources due to their unique hazardous characteristics (Section 3.0.3.2, Explosive Stressors). Characteristics of each of these sound sources are described in the following sections.

In order to better organize and facilitate the analysis of approximately 300 sources of underwater sound used for testing and training by the Navy including sonars, other transducers, and explosives, a series of source classifications, or source bins, were developed. The source classification bins do not include the broadband noise produced incidental to vessel and aircraft transits and weapons firing.

The use of source classification bins provides the following benefits:

- Provides the ability for new sensors or munitions to be covered under existing authorizations, as long as those sources fall within the parameters of a "bin"
- Improves efficiency of source utilization data collection and reporting requirements anticipated under the MMPA authorizations
- Ensures a conservative approach to all impact estimates, as all sources within a given class are modeled as the most impactful source (highest source level, longest duty cycle [i.e., the proportion of time signals are emitted in a given period of time], or largest net explosive weight) within that bin
- Allows analyses to be conducted in a more efficient manner, without any compromise of analytical results
- Provides a framework to support the reallocation of source usage (hours/explosives) between different source bins, as long as the total numbers of takes remain within the overall analyzed and authorized limits. This flexibility is required to support evolving Navy training and testing requirements, which are linked to military missions and combat operations

3.0.3.1.1 Sonar and Other Transducers

Active sonar and other transducers emit non-impulsive sound waves into the water to detect objects, safely navigate, and communicate. Passive sonars differ from active sound sources in that they do not emit acoustic signals; rather, they only receive acoustic information about the environment, or listen. In this Supplemental, the terms sonar and other transducers will be used to indicate active sound sources unless otherwise specified.

The Navy employs a variety of sonars and other transducers to obtain and transmit information about the undersea environment. Some examples are mid-frequency hull-mounted sonars used to find and track potential enemy submarines; high-frequency small object detection sonars used to detect mines; high-frequency underwater modems used to transfer data over short ranges; and extremely high frequency (greater than 200 kilohertz [kHz]) Doppler sonars used for navigation, like those used on commercial and private vessels. The characteristics of these sonars and other transducers, such as source level, beam width, directivity, and frequency, depend on the purpose of the source. Higher frequencies can carry or provide more information about objects off which they reflect, but attenuate more rapidly. Lower frequencies attenuate less rapidly, so may detect objects over a longer distance, but with less detail.

Propagation of sound produced underwater is highly dependent on environmental characteristics such as bathymetry, bottom type, water depth, temperature, and salinity. The sound received at a particular location will be different than near the source due to the interaction of many factors, including: propagation loss; how the sound is reflected, refracted, or scattered; the potential for reverberation; and interference due to multi-path propagation. In addition, absorption greatly affects the distance over which higher-frequency sounds propagate. The effects of these factors are explained in Appendix D (Acoustic and Explosive Concepts). Because of the complexity of analyzing sound propagation in the ocean environment, the Navy relies on acoustic models in its environmental analyses that consider sound source characteristics and varying ocean conditions across the Study Area.

The sound sources and platforms typically used in naval activities analyzed in this Supplemental are described in Appendix A (Navy Activities Descriptions). Sonars and other transducers used to obtain and transmit information underwater during Navy training and testing activities generally fall into several categories of use described below.

Anti-Submarine Warfare

Sonar used during anti-submarine warfare would impart the greatest amount of acoustic energy of any category of sonar and other transducers analyzed in this Supplemental. Types of sonars used to detect potential enemy vessels include hull-mounted, towed, line array, sonobuoy, helicopter dipping, and torpedo sonars. In addition, acoustic targets and decoys (countermeasures) may be deployed to emulate the sound signatures of vessels or repeat received signals.

Most anti-submarine warfare sonars are mid-frequency (1–10 kilohertz [kHz]) because mid-frequency sound balances sufficient resolution to identify targets with distance over which threats can be identified. However, some sources may use higher or lower frequencies. Duty cycles can vary widely, from rarely used to continuously active. Anti -submarine warfare sonars can be wide-angle in a search mode or highly directional in a track mode.

Most anti-submarine warfare activities involving submarines or submarine targets would occur in waters greater than 600 feet (ft.) deep due to safety concerns about running aground at shallower depths. Sonars used for anti-submarine warfare activities would typically be used beyond 12 nautical miles (NM) from shore. Exceptions include use of dipping sonar by helicopters, pierside testing and maintenance of systems while in port, and system checks while transiting to or from port.

Mine Warfare, Small Object Detection, and Imaging

Sonars used to locate mines and other small objects, as well as those used in imaging (e.g., for hull inspections or imaging of the seafloor), are typically high frequency or very high frequency. Higher frequencies allow for greater resolution and, due to their greater attenuation, are most effective over shorter distances. Mine detection sonar can be deployed (towed or vessel hull-mounted) at variable depths on moving platforms (ships, helicopters, or unmanned vehicles) to sweep a suspected mined area. Hull-mounted anti-submarine sonars can also be used in an object detection mode known as "Kingfisher" mode. Sonars used for imaging are usually used in close proximity to the area of interest, such as pointing downward near the seafloor.

Mine detection sonar use would be concentrated in areas where practice mines are deployed, typically in water depths less than 200 ft., at established training minefields or temporary minefields close to strategic ports and harbors, or at targets of opportunity such as navigation buoys. Kingfisher mode on vessels is most likely to be used when transiting to and from port. Sound sources used for imaging could be used throughout the Study Area.

Navigation and Safety

Similar to commercial and private vessels, Navy vessels employ navigational acoustic devices including speed logs, Doppler sonars for ship positioning, and fathometers. These may be in use at any time for safe vessel operation. These sources are typically highly directional to obtain specific navigational data.

Communication

Sound sources used to transmit data (such as underwater modems), provide location (pingers), or send a single brief release signal to bottom-mounted devices (acoustic release) may be used throughout the Study Area. These sources typically have low duty cycles and are usually only used when it is desirable to send a detectable acoustic message.

Classification of Sonar and Other Transducers

Sonars and other transducers are grouped into classes that share an attribute, such as frequency range or purpose of use. As detailed below, classes are further sorted by bins based on the frequency or bandwidth; source level; and, when warranted, the application in which the source would be used. Unless stated otherwise, a reference distance of 1 meter is used for sonar and other transducers.

- Frequency of the non-impulsive acoustic source:
  - low-frequency sources operate below 1 kHz
  - mid-frequency sources operate at and above 1 kHz, up to and including 10 kHz
  - high-frequency sources operate above 10 kHz, up to and including 100 kHz
  - very high-frequency sources operate above 100 kHz but below 200 kHz
- Sound pressure level:
  - greater than 160 decibels (dB) referenced to (re) 1 micropascal (dB re 1µPa), but less than 180 dB re 1 µPa
  - equal to 180 dB re 1 µPa and up to and including 200 dB re 1 µPa
  - greater than 200 dB re 1 µPa
- Application in which the source would be used:
  - sources with similar functions that have similar characteristics, such as pulse duration, beam pattern, and duty cycle

The bins used for classifying active sonars and transducers that are quantitatively analyzed in the Study Area are shown in Table 3.0-2. While general parameters or source characteristics are shown in the table, actual source parameters are classified.

Table 3.0-2 also shows the bin use that could occur in any year under each action alternative for training and testing activities; Phase II amounts are included for comparison. A range of annual bin use indicates that use of that bin is anticipated to vary annually, consistent with the variation in the number of annual activities described in Chapter 2 (Description of Proposed Action and Alternatives).

Table 3.0-2: Sonar and Transducer Sources Quantitatively Analyzed

Source Class Category	*Bin*	*Description*	*Unit*[1]	*Training*			*Testing*		
				2015 Final EIS/OEIS (annual)	*Alternative 1 (annual)*	*Alternative 2 (annual)*	*2015 Final EIS/OEIS (annual)*	*Alternative 1 (annual)*	*Alternative 2 (annual)*
Low-Frequency (LF): Sources that produce signals less than 1 kHz	LF4	LF sources equal to 180 dB and up to 200 dB	H	0	0	0	110	177	177
	LF5	LF sources less than 180 dB	H	0	1	1	71	0–18	18
Mid-Frequency (MF): Tactical and nontactical sources that produce signals at or above 1 kHz up to and including 10 kHz	MF1	Hull-mounted surface ship sonars (e.g., AN/SQS-53C and AN/SQS-60)	H	166	164	164	32	20–169	253
	MF1K	Kingfisher mode associated with MF1 sonars	H	0	0	0	0	48	48
	MF2[2]	Hull-mounted surface ship sonars (e.g., AN/SQS-56)	H	0	0	0	0	32	32
	MF3	Hull-mounted submarine sonars (e.g., AN/BQQ-10)	H	70	70	82	145	34–36	44
	MF4	Helicopter-deployed dipping sonars (e.g., AN/AQS-22)	H	4	0-1	1	10	53–74	80
	MF5	Active acoustic sonobuoys (e.g., DICASS)	C	896	918–926	934	273	308–689	1,025
	MF6	Active underwater sound signal devices (e.g., MK 84)	C	0	0	0	12	60–232	392
	MF8	Active sources (greater than 200 dB) not otherwise binned	H	0	0	0	40	0	0
	MF9	Active sources (equal to 180 dB and up to 200 dB) not otherwise binned	H	0	0	0	1,183	644–959	1,170

Table 3.0-2: Sonar and Transducer Sources Quantitatively Analyzed (continued)

Source Class Category	*Bin*	*Description*	*Unit*[1]	*Training*			*Testing*		
				2015 Final EIS/OEIS (annual)	*Alternative 1 (annual)*	*Alternative 2 (annual)*	*2015 Final EIS/OEIS (annual)*	*Alternative 1 (annual)*	*Alternative 2 (annual)*
Mid-Frequency (MF): Tactical and nontactical sources that produce signals at or above 1 kHz up to and including 10 kHz	MF10	Active sources (greater than 160 dB, but less than 180 dB) not otherwise binned	H	0	0	0	1,156	886	1,053
	MF11	Hull-mounted surface ship sonars with an active duty cycle greater than 80%	H	16	16	16	34	48	48
	MF12	Towed array surface ship sonars with an active duty cycle greater than 80%	H	0	0	0	24	100	100
High-Frequency (HF): Tactical and non-tactical sources that produce signals greater than 10 kHz up to and including 100 kHz	HF1	Hull-mounted submarine sonars (e.g., AN/BQQ-10)	H	48	48	60	161	10	12
	HF3	Other hull-mounted submarine sonars (classified)	H	0	0	0	145	1–19	19
	HF4	Mine detection, classification, and neutralization sonar (e.g., AN/SQS-20)	H	384	0–65	65	0	1,860–1,868	1,868
	HF5	Active sources (greater than 200 dB) not otherwise binned	H	0	0	0	360	352–400	448
	HF6	Active sources (equal to 180 dB and up to 200 dB) not otherwise binned	H	192	0	0	2,099	1,705–1,865	2,047
	HF8	Hull-mounted surface ship sonars (e.g., AN/SQS-61)	H	0	0	0	0	24	24
	HF9	Weapon-emulating sonar source	H	0	0	0	0	257	274

Table 3.0-2: Sonar and Transducer Sources Quantitatively Analyzed (continued)

Source Class Category	*Bin*	*Description*	*Unit*[1]	*Training*			*Testing*		
				2015 Final EIS/OEIS (annual)	*Alternative 1 (annual)*	*Alternative 2 (annual)*	*2015 Final EIS/OEIS (annual)*	*Alternative 1 (annual)*	*Alternative 2 (annual)*
Very High-Frequency (VHF): Tactical and non-tactical sources that produce signals greater than 100 kHz but less than 200 kHz	VHF1	Active sources greater than 200 dB	H	0	0	0	0	320	320
	VHF2	Active sources with a source level less than 200 dB	H	0	0	0	35	135	135
Anti-Submarine Warfare (ASW): Tactical sources (e.g., active sonobuoys and acoustic countermeasures systems) used during ASW training and testing activities	ASW1	MF systems operating above 200 dB	H	0	0	0	16	80	80
	ASW2	MF Multistatic Active Coherent sonobuoy (e.g., AN/SSQ-125)	H	0	0	0	64	0	0
			C	720	350	350	170	240	240
	ASW3	MF towed active acoustic countermeasure systems (e.g., AN/SLQ-25)	H	78	86	86	444	487–1,015	1,543
	ASW4	MF expendable active acoustic device countermeasures (e.g., MK3)	C	0	0	0	1,182	1,349–1,389	1,429
	ASW5[2]	MF sonobuoys with high duty cycles	H	0	50	50	0	80	80
Torpedoes (TORP): Source classes associated with the active acoustic signals produced by torpedoes	TORP1	Lightweight torpedo (e.g., MK 46, MK 54, or Anti-Torpedo Torpedo)	C	0	16	16	315	298–360	371
	TORP2	Heavyweight torpedo (e.g., MK 48)	C	0	0–2	0	299	332–372	412
	TORP3	Heavyweight torpedo (e.g., MK 48)	C	0	0	0	0	6	6

Table 3.0-2: Sonar and Transducer Sources Quantitatively Analyzed (continued)

Source Class Category	*Bin*	*Description*	*Unit*[1]	*Training*			*Testing*		
				2015 Final EIS/OEIS (annual)	*Alternative 1 (annual)*	*Alternative 2 (annual)*	*2015 Final EIS/OEIS (annual)*	*Alternative 1 (annual)*	*Alternative 2 (annual)*
Forward Looking Sonar (FLS): Forward or upward looking object avoidance sonars used for vessel navigation and safety	FLS2	HF sources with short pulse lengths, narrow beam widths, and focused beam patterns	H	0	240	300	0	24	24
Acoustic Modems (M): Systems used to transmit data through the water	M3	MF acoustic modems (greater than 190 dB)	H	0	30	38	1,519	1,088	1,328
Synthetic Aperture Sonars (SAS): Sonars in which active acoustic signals are post-processed to form high-resolution images of the seafloor	SAS2	HF SAS systems	H	0	0–561	561	798	1,312	1,312
Broadband Sound Sources (BB): Sonar systems with large frequency spectra, used for various purposes	BB1	MF to HF mine countermeasure sonar	H	0	0	0	0	48	48
	BB2	HF to VHF mine countermeasure sonar	H	0	0	0	0	48	48
Swimmer Detection Sonar (SD): Used to detect divers and submerged swimmers	SD1	HF and VHF sources with short pulse lengths, used for the detection of swimmers and other objects for the purpose of port security	H	0	0	0	757	0	0

[1] H = hours; C = count (e.g., number of individual pings or individual sonobuoys)
[2] Formerly ASW2 (H) in 2015 NWTT Final EIS/OEIS.
Notes: dB = decibel(s), kHz = kilohertz

There are in-water active acoustic sources with narrow beam widths, downward directed transmissions, short pulse lengths, frequencies above known hearing ranges, low source levels, or combinations of these factors, which are not anticipated to result in takes of protected species. These sources are categorized as *de minimis* sources and are qualitatively analyzed to determine the appropriate determinations under NEPA in the appropriate resource impact analyses, as well as under the MMPA and the ESA. When used during routine training and testing activities, and in a typical environment, *de minimis* sources fall into one or more of the following categories:

- Transmit primarily above 200 kHz: Sources above 200 kHz are above the hearing range of the most sensitive marine mammals and far above the hearing range of other protected species in the Study Area.
- Source levels of 160 dB re 1 µPa or less: Low-powered sources with source levels at or less than 160 dB re 1 µPa are typically hand-held sonars, range pingers, transponders, and acoustic communication devices. Assuming spherical spreading for a 160 dB re 1 µPa source, the sound will attenuate to less than 140 dB re 1 µPa within 10 m and less than 120 dB re 1 µPa within 100 m of the source. Ranges would be even shorter for a source less than 160 dB re 1 µPa source level.
- Acoustic source classes listed in Table 3.0-3: Sources with operational characteristics, such as short pulse length, narrow beam width, downward-directed beam, low energy release, or manner of system operation that excludes the possibility of any significant impact on a protected species (actual source parameters are classified). Even if there is a possibility that some species may be exposed to and detect some of these sources, any response is expected to be short-term and inconsequential.

Table 3.0-3: Sonar and Transducers Qualitatively Analyzed

Source Class Category	*Bin*	*Characteristics*
Doppler Sonar/Speed Logs (DS): High-frequency/very high-frequency navigation transducers	DS3–DS4	*Required for safe navigation* • downward focused • narrow beam width • very short pulse lengths
Fathometers (FA): High-frequency sources used to determine water depth	FA1–FA4	*Required for safe navigation* • downward focused directly below the vessel • narrow beam width (typically much less than 30°) • short pulse lengths (less than 10 milliseconds)
Imaging Sonar (IMS): Sonars with high or very high frequencies used to obtain images of objects underwater	IMS2–IMS3	• High-frequency or very high-frequency • downward directed • narrow beam width • very short pulse lengths (typically 20 milliseconds)
High-Frequency Acoustic Modems (M): Systems that send data underwater **Tracking Pingers (P):** Devices that send a ping to identify an object location	M1, M2, M4 P1–P4	• low duty cycles (single pings in some cases) • short pulse lengths (typically 20 milliseconds) • low source levels

Table 3.0-3: Sonar and Transducers Qualitatively Analyzed (continued)

Source Class Category	Bin	Characteristics
Acoustic Releases (R): Systems that ping to release a bottom-mounted object from its housing in order to retrieve the device at the surface	R2	• typically emit only several pings to send release order
Side-Scan Sonars (SSS): Sonars that use active acoustic signals to produce high-resolution images of the seafloor	SSS1–SSS2	• downward-directed beam • short pulse lengths (less than 20 milliseconds)

Notes: ° = degree(s)

3.0.3.1.2 Vessel Noise

Vessel noise, in particular commercial shipping, is a major contributor to underwater anthropogenic noise in the ocean within the Study Area. Naval vessels (e.g., ships and small craft) and civilian vessels (e.g., commercial ships, tugs, work boats, pleasure craft) produce low-frequency, broadband underwater sound, though the exact level of noise produced varies by vessel type. Frisk (2012) reported that between 1950 and 2007 ocean noise in the 25–50 Hertz (Hz) frequency range increased 3.3 decibels (dB) per decade, resulting in a cumulative increase of approximately 19 dB over a baseline of 52 dB. The increase in noise is associated with an increase in commercial shipping, which correlates with global economic growth (Frisk, 2012). Within the Study Area, Navy vessels represent a small amount of overall vessel traffic and an even smaller amount of overall vessel traffic noise (Mintz & Filadelfo, 2011; Mintz, 2012).

The Center for Naval Analyses conducted studies to determine traffic patterns of Navy and non-Navy vessels (Mintz & Parker, 2006; Mintz & Filadelfo, 2011; Mintz, 2012; Mintz, 2016). The most recent analysis covered the period 2011–2015 (Mintz, 2016) and included U.S. Navy surface ship traffic and non-military vessels such as cargo vessels, bulk carriers, commercial fishing vessels, oil tankers, passenger vessels, tugs, and research vessels. Caveats to this analysis include that only vessels over 65 ft. in length are reported, so smaller Navy vessels and civilian craft are not included, and vessel position records are much more frequent for Navy vessels than for commercial vessels. Therefore, the Navy is likely overrepresented in the data, and the reported fraction of total energy is likely the upper limit of its contribution (Mintz & Filadelfo, 2011; Mintz, 2012).

Although the aforementioned studies did not include analysis of vessel traffic and associated vessel noise in the Study Area, the conclusions of the studies are relevant to vessel noise in the Study Area. Overall, the contribution of Navy vessel traffic to broadband noise levels was relatively small compared with the contribution from commercial vessel traffic.

The 2015 NWTT Final EIS/OEIS (Section 3.0.5.3.1.4, Vessel Noise) provides detailed information regarding vessel noise characteristics and production, and timing and duration of vessel activity.

3.0.3.1.3 Aircraft Noise

Fixed-wing, tiltrotor, and rotary-wing aircraft are used for a variety of training and testing activities within the Study Area, contributing both airborne and underwater sound to the ocean environment. Sounds in air are often measured using A-weighting, which adjusts received sound levels based on human hearing abilities (see Appendix D, Acoustic and Explosive Concepts). Aircraft used in training and testing generally have turboprop, or jet engines. Motors, propellers, and rotors produce the most noise, with some noise contributed by aerodynamic turbulence. Aircraft sounds have more energy at lower frequencies. Aircraft may transit to or from vessels at sea within the Study Area and from established air stations on land. Aircraft noise generated in and around air stations in the Northwest is outside the Study Area and scope of this document, but it has been addressed in other Navy NEPA analyses (U.S. Department of the Navy, 2014b, 2016b). Takeoffs and landings occur at established airfields as well as on vessels at sea across the Study Area. Takeoffs and landings from Navy vessels produce in-water noise at a given location for a brief period as the aircraft climbs to cruising altitude. Military activities involving aircraft are dispersed over large expanses of open ocean, as well as designated special use airspace over land, and preplanned transit routes to and from training areas. In addition, the Navy conducted an airborne noise study by modeling aircraft training activities conducted in the Olympic Military Operations Areas (MOAs) and within the Warning Areas W-237A and W-237B, which is discussed further in Appendix J (Airspace Noise Analysis for the Olympic Military Operations Areas). Table 3.0-4 provides source levels for some typical aircraft used during training and testing in the Study Area and depicts comparable airborne source levels for the F-35A, EA-18G, and F/A-18C/D during takeoff.

Table 3.0-4: Representative Aircraft Sound Characteristics

Noise Source	***Sound Pressure Level***
In-Water Noise Level	
F/A-18 Subsonic at 1,000 ft. (300 m) Altitude	152 dB re 1 µPa at 2 m below water surface[1]
F/A-18 Subsonic at 10,000 ft. (3,000 m) Altitude	128 dB re 1 µPa at 2 m below water surface[1]
H-60 Helicopter Hovering at 82 ft. (25 m) Altitude	Approximately 125 dB re 1 µPa at 1 m below water surface, estimate based on in-air level[2]
Airborne Noise Level	
F/A-18C/D Under Military Power	143 dBA re 20 µPa at 13 m from source[3]
F/A-18C/D Under Afterburner	146 dBA re 20 µPa at 13 m from source[3]
F35-A Under Military Power	145 dBA re 20 µPa at 13 m from source[3]
F-35-A Under Afterburner	148 dBA re 20 µPa at 13 m from source[3]
H-60 Helicopter Hovering at 82 ft. (25 m) Altitude	113 dBA re 20 µPa at 25 m from source[2]
F-35A Takeoff Through 1,000 ft. (300 m) Altitude	119 dBA re 20 $\mu Pa^2 s$[4] (per second of duration), based on average sound exposure level
EA-18G Takeoff Through 1,622 ft. (500 m) Altitude	115 dBA re 20 $\mu Pa^2 s$ [5] (per second of duration), based on average sound exposure level

* estimate based on in-air level
**average sound exposure level
Notes: dB re 1 µPa = decibel(s) referenced to 1 micropascal, dBA re 20 µPa = A-weighted decibel(s) referenced to 20 micropascals, m = meter(s), ft. = feet, dBA re 20 µPa s[4] = A-weighted decibel(s) referenced to 20 micropascals squared seconds
Sources: [1]Eller and Cavanagh (2000), [2]Bousman and Kufeld (2005), [3]U.S. Naval Research Advisory Committee (2009), [4]U.S. Department of the Air Force (2016), [5]U.S. Department of the Navy (2012a).

3.0.3.1.3.1 Navigation and Safety

The National Airspace around the country, including the Pacific Northwest, is regulated and controlled by the Federal Aviation Administration (FAA). Like commercial and private aircraft, Navy aircraft employ safe air navigational maneuvers to enter and depart the National Airspace, avoiding obstacles and to the extent possible noise-sensitive areas. For the efficient management of regional airspace, the FAA and the Navy jointly established stereotyped flight plans and preplanned routes for military aircraft to transit to and from the training areas of the Olympic MOAs and Warning Area 237, while deconflicting with commercial air routes and avoiding major population density areas.

Navy aircraft depart Naval Air Station (NAS) Whidbey and are under the control of the FAA into the established routes of flight to the Olympic MOAs at altitudes of 12,000 to 18,000 feet above mean sea level (MSL) and remain under positive FAA control by Seattle Air Route Traffic Control Center. Aircraft are visible to FAA radar and once inside the Olympic MOAs airspace, aircraft are subject to established FAA and Navy policies of use of the Olympic MOAs, and remain under FAA jurisdiction for airspace separation from non-participating commercial, private and other military aircraft. Approximately 95 percent of the training flights within the Olympic MOAs occur at or above 10,000 ft. MSL.

In order to reach the Olympic MOAs, aircraft must fly west-southwest from NAS Whidbey Island over the Strait of Juan De Fuca normally at or above 15,000 ft. MSL from a navigation point named MCCUL (20 NM west-southwest of NAS Whidbey Island) along a route of flight between NAS Whidbey Island to a fixed navigation point (65 NM west-southwest of NAS Whidbey Island) at the boundary of the Olympic MOAs (Figure 3.0-1). Navy aircraft typically enter the Olympic MOAs at this access navigational fix in the northern portion of the MOAs and exit the Olympic MOAs per their Instrument Flight Rules clearance given by the Seattle Air Route Traffic Control Center to the navigation point named YETII (30 NM southwest of NAS Whidbey Island). Aircraft cross YETII normally at or above 12,000 ft. MSL and then enter the arrival pattern to return to NAS Whidbey Island.

For the preferred alternative, Alternative 1, it is anticipated the Fleet Replacement Squadron EA-18Gs would make more transits for training than would the Fleet Squadron EA-18Gs, as the Pacific Northwest Electronic Warfare Range was specifically put into place to support the Fleet Replacement Squadron class syllabus. As a result, there is an anticipated slight increase in EA-18G traffic transiting to and from the Olympic MOAs. The three-year average from 2015 to 2017 shows about 2,224 EA-18Gs per year transiting to and from the Olympic MOAs. The analysis for Alternative 1 shows an increase of 300 aircraft to 2,524 EA-18Gs per year transiting to and from the Olympic MOAs, which is less than 1 additional EA-18G sortie per day based on a 365-day year.

Per the Airspace Noise Analysis for the Olympic Military Operations Areas (Appendix J), visitors to the national park, national forests, and wilderness areas may be affected by and respond to individual flyover events. At the highest peaks and ridgelines along the flight transit routes between NAS Whidbey Island and the Olympic MOAs (ground elevations of about 4,500 to 8,000 feet) the maximum noise levels at flyover event at 14,000–15,000 ft. MSL would be about 69 dBA (see Appendix J). Flyover event noise levels would be lower at locations below the highest peaks and ridgelines. At ground level (ground elevations of about 300 ft. to 3,500 ft. MSL) the flyover noise levels would be about 57 dBA (see Appendix J). Night or weekend visitors to the western side of the Olympic Peninsula, under the Olympic MOAs, or to the national park would rarely hear an EA-18G as the EA-18Gs normally fly during the day Monday through Friday. For overall noise from the EA-18G while training within the Olympic MOAs, the Appendix J noise analysis shows an increase of 11 dBA for a total of 37 dBA estimated for the preferred Alternative 1.

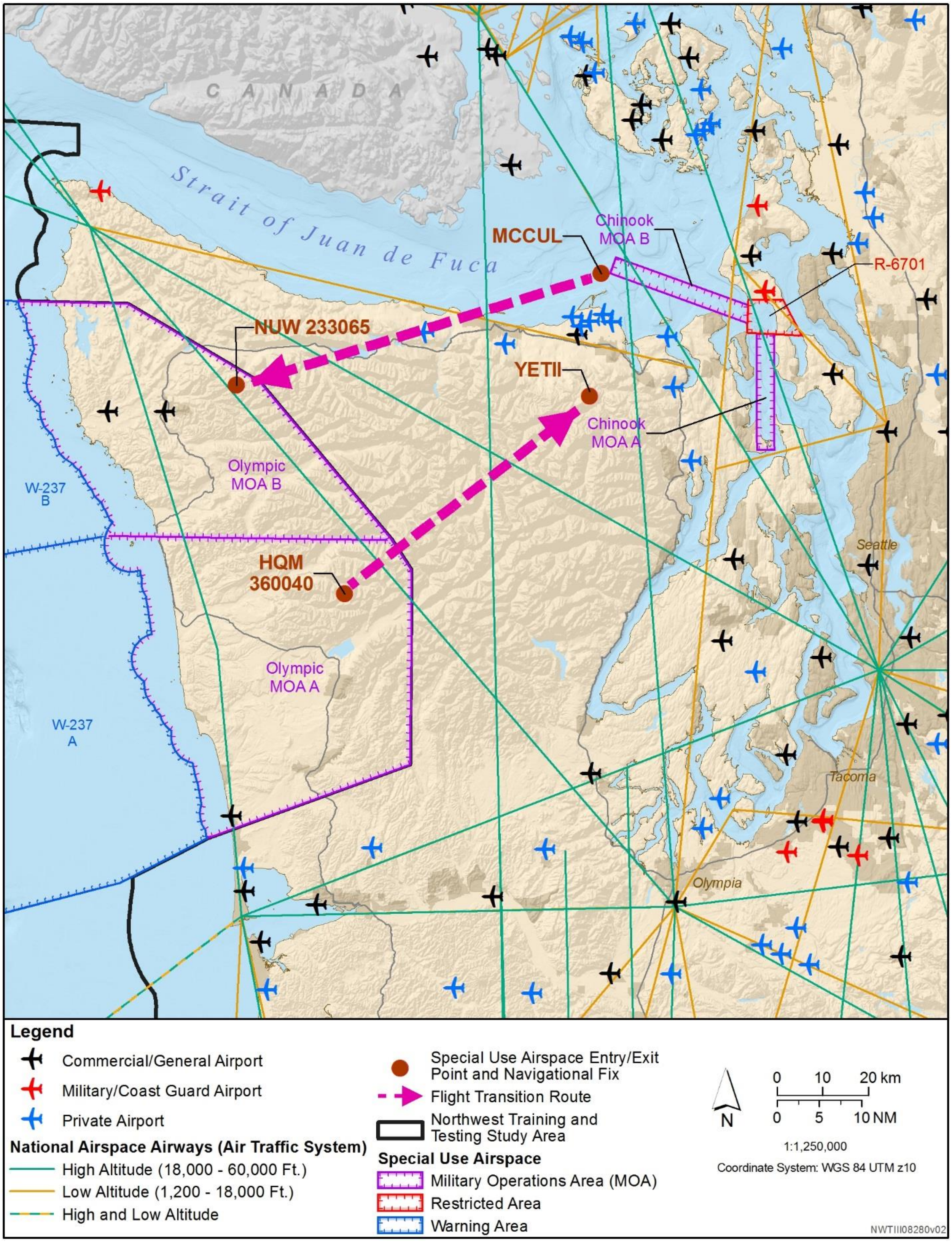

Figure 3.0-1: Aircraft Transit to and from Olympic Military Operations Areas

Although the flyover event noise levels during transit would be higher than average background noise levels in the national park and wilderness areas, they are not substantially above the range of noise levels that can occur under natural conditions. For example, leaves or tall grass rustling in a moderate wind can generate sustained noise levels of 55 dBA. Strong winds can generate relatively sustained noise levels above 65 dBA, with peak nose levels being even higher (Cowan, 1994).

3.0.3.1.3.2 Underwater Transmission of Aircraft Noise

The 2015 NWTT Final EIS/OEIS (Section 3.0.5.3.1.5, Aircraft Noise) describes underwater transmission of aircraft noise. Since information regarding underwater transmission of aircraft noise has not changed, this Supplemental will not further analyze underwater transmission of aircraft noise.

3.0.3.1.3.3 Helicopters

The 2015 NWTT Final EIS/OEIS (Section 3.0.5.3.1.5, Aircraft Noise) describes characteristics and production of noise from helicopters. Since information regarding characteristics and production of noise from helicopters has not changed, this Supplemental will not further analyze characteristics and production of noise from helicopters.

3.0.3.1.3.4 Sonic Booms

An intense but infrequent type of aircraft noise is the sonic boom, produced when an aircraft exceeds the speed of sound. Per Navy Instruction *Naval Air Training and Operating Procedures General Flight and Operating Instructions Manual, Commander Naval Air Forces Manual-3710.7* (U.S. Department of the Navy, 2017a), it is incumbent on every pilot flying aircraft capable of generating sonic booms to reduce such disturbances and damage to the absolute minimum dictated by operational/training requirements. Supersonic flight operations shall be strictly controlled and supervised by operational commanders. Supersonic flight over land or within 30 miles (mi.) offshore shall be conducted in specifically designated areas. Such areas must be chosen to ensure minimum possibility of disturbance. As a general policy, sonic booms shall not be intentionally generated below 30,000 ft. of altitude unless over water and more than 30 mi. from inhabited land areas or islands. Deviations from the foregoing general policy may be authorized only under one of the following conditions:

- tactical missions that require supersonic speeds;
- phases of formal training syllabus flights requiring supersonic speeds;
- research, test, and operational suitability test flights requiring supersonic speeds; or
- when specifically authorized by the Chief of Naval Operations for flight demonstration purposes.

Several factors that influence sonic booms include weight, size, and shape of aircraft or vehicle; altitude; flight paths; and atmospheric conditions. A larger and heavier aircraft must displace more air and create more lift to sustain flight, compared with small, light aircraft. Therefore, larger aircraft create sonic booms that are stronger than those of smaller, lighter aircraft. Consequently, the larger and heavier the aircraft, the stronger the shock waves (U.S. Department of the Navy & Department of Defense, 2007). Aircraft maneuvers that result in changes to acceleration, flight path angle, or heading can also affect the strength of a boom. In general, an increase in flight path angle (lifting the aircraft's noise) will diffuse a boom while a decrease (lowering the aircraft's nose) will focus it. In addition, acceleration will focus a boom while deceleration will weaken it. Any change in horizontal direction will focus a boom, causing two or more wave fronts that originated from the aircraft at different times to coincide exactly (U.S. Department of the Navy, 2001). Atmospheric conditions such as wind speed and direction and air temperature and pressure can also influence the sound propagation of a sonic boom.

Of all the factors influencing sonic booms, increasing altitude is the most effective method of reducing sonic boom intensity. The width of the boom "carpet" or area exposed to sonic boom beneath an aircraft is about 1 mi. for each 1,000 ft. of altitude. For example, an aircraft flying supersonic, straight and level at 50,000 ft. can produce a sonic boom carpet about 50 mi. wide. The sonic boom, however, would not be uniform, and its intensity at the water surface would decrease with greater aircraft altitude. Maximum intensity is directly beneath the aircraft and decreases as the lateral distance from the flight path increases until shock waves refract away from the ground or water surface and the sonic boom attenuates. The lateral spreading of the sonic boom depends only on altitude, speed, and the atmosphere and is independent of the vehicle's shape, size, and weight. The ratio of the aircraft length to maximum cross-sectional area also influences the intensity of the sonic boom. The longer and more slender the aircraft, the weaker the shock waves. The wider and more blunt the aircraft, the stronger the shock waves can be (U.S. Department of the Navy & Department of Defense, 2007).

In air, the energy from a sonic boom is concentrated in the frequency range from 0.1 to 100 Hz. The underwater sound field due to transmitted sonic boom waveforms is primarily composed of low-frequency components (Sparrow, 2002), and frequencies greater than 20 Hz have been found to be difficult to observe at depths greater than 33 ft. (10 m) (Sohn et al., 2000). F/A-18 Hornet supersonic flight was modeled to obtain peak sound pressure levels (SPLs) and energy flux density at the water surface and at depth (U.S. Department of the Air Force, 2000). These results are shown in Table 3.0-5.

Table 3.0-5: Sonic Boom Underwater Sound Levels Modeled for F/A-18 Hornet Supersonic Flight

*Mach Number**	*Aircraft Altitude (km)*	*Peak SPL (dB re 1 µPa)*			*Energy Flux Density (dB re 1 µPa²-s)*[1]		
		At surface	*50 m Depth*	*100 m Depth*	*At surface*	*50 m Depth*	*100 m Depth*
1.2	1	176	138	126	160	131	122
	5	164	132	121	150	126	117
	10	158	130	119	144	124	115
2	1	178	146	134	161	137	128
	5	166	139	128	150	131	122
	10	159	135	124	144	127	119

[1] Equivalent to SEL for a plane wave.
* Mach number equals aircraft speed divided by the speed of sound.
Notes: SPL = sound pressure level, dB re 1 µPa = decibel(s) referenced to 1 micropascal, dB re 1 µPa²-s = decibel(s) referenced to 1 micropascal squared seconds, m = meter(s)

3.0.3.1.4 Weapons Noise

The Navy trains and tests using a variety of weapons, as described in Appendix A (Navy Activities Descriptions). Depending on the weapon, incidental (unintentional) noise may be produced at launch or firing, while in flight, or upon impact. Not all weapons utilize explosives, either by design or because they are non-explosive practice munitions. Noise produced by explosives, both in air and water, is discussed in Section 3.0.3.2 (Explosive Stressors).

Small- to medium-caliber rounds up to but not including the 57 mm non-explosive round could be used 12 NM or more from shore. Large-caliber non-explosive rounds could be used 20 NM or more from shore. Medium- and large-caliber explosive rounds could be used 50 NM or more from shore.

Examples of some types of weapons noise are shown in Table 3.0-6. Examples of launch noise are provided in the table. Noise produced by other weapons and devices is described further below.

Table 3.0-6: Example Weapons Noise

Noise Source	***Sound Level***
In-Water Noise Level	
Naval Gunfire Muzzle Blast (5-inch)	Approximately 200 dB re 1 µPa peak directly under gun muzzle at 1.5 m below the water surface[1]
Airborne Noise Level	
Naval Gunfire Muzzle Blast (5-inch)	178 dB re 20 µPa peak directly below the gun muzzle above the water surface[1]
Hellfire Missile Launch from Aircraft	149 dB re 20 µPa at 4.5 m[2]
Advanced Gun System Missile (115-millimeter)	133-143 dBA re 20 µPa between 12 and 22 m from the launcher on shore[3]
RIM 116 Surface-to-Air Missile	122-135 dBA re 20 µPa between 2 and 4 m from the launcher on shore[3]
Tactical Tomahawk Cruise Missile	92 dBA re 20 µPa 529 m from the launcher on shore[3]

Notes: dB re 1 µPa = decibel(s) referenced to 1 micropascal, dB re 20 µPa = decibel(s) referenced to 20 micropascals, dBA re 20 µPa = A-weighted decibel(s) referenced to 20 micropascals, m = meter(s)
Sources: [1]Yagla and Stiegler (2003); [2]U.S. Department of the Army (1999); [3]U.S. Department of the Navy (2013)

Muzzle Blast from Naval Gunfire

The 2015 NWTT Final EIS/OEIS (Section 3.0.5.3.1.3, Weapons Firing, Launch, and Impact Noise) describes the characteristics of the 5-inch (in.) large caliber naval gun, which is the most prevalent large weapon fired. Since information regarding characteristics of muzzle blast from naval gunfire has not changed, this Supplemental will not further analyze muzzle blast from naval gunfire. Examples of noise measurements from naval gunfire muzzle blast are provided in Table 3.0-6.

Supersonic Projectile Bow Shock Wave

Supersonic projectiles, such as a fired gun shell or kinetic energy weapon, create a bow shock wave along the line of fire. A bow shock wave is an impulsive sound caused by a projectile exceeding the speed of sound (for more explanation, see Appendix D, Acoustic and Explosive Concepts). The bow shock wave itself travels at the speed of sound in air. The projectile bow shock wave created in air by a shell in flight at supersonic speeds propagates in a cone (generally about 65°) behind the projectile in the direction of fire (U.S. Department of the Navy, 1981). Exposure to the bow shock wave is very brief.

Projectiles from a 5 in./54 caliber gun would travel at approximately 2,600 ft./second, and the associated bow shock wave is subjectively described as a “crack” noise (U.S. Department of the Navy, 1981). Measurements of a 5 in. projectile shock wave ranged from 140 to 147 dB re 20 µPa SPL peak taken at the ground surface at 0.59 NM distance from the firing location and 10° off the line of fire for safety (approximately 190 m from the shell's trajectory) (U.S. Department of the Navy, 1981).

Hyperkinetic projectiles may travel up to and exceeding approximately six times the speed of sound in air, or about 6,500 ft./second (U.S. Department of the Navy, 2014a). For a hyperkinetic projectile sized similar to the 5 in. shell, peak pressures would be expected to be several dB higher than those described for the 5 in. projectile above, following the model in U.S. Department of the Navy (1981).

Like sound from the gun muzzle blast, sound waves from a projectile in flight could only enter the water in a narrow cone beneath the sound source, with in-air sound being totally reflected from the water surface outside of the cone. The region of underwater sound influence from a single traveling shell would be relatively narrow and the duration of sound influence would be brief at any location.

Launch Noise

The 2015 NWTT Final EIS/OEIS (Section 3.0.5.3.1.3, Weapons Firing, Launch, and Impact Noise) describes launch noise. Since information regarding launch noise has not changed, this Supplemental will not further analyze launch noise. Examples of launch noise measurements are provided in Table 3.0-6.

Impact Noise (Non-Explosive)

The 2015 NWTT Final EIS/OEIS (Section 3.0.5.3.1.3, Weapons Firing, Launch, and Impact Noise) describes characteristics and production of non-explosive impact noise. Since information regarding non-explosive impact noise has not changed, this Supplemental will not further analyze non-explosive impact noise.

Long Range Acoustic Device

The Long Range Acoustic Device is a communication device that can be used to warn vessels against continuing towards a high value asset by emitting loud sounds in air. Although not a weapon, the Long Range Acoustic Device (and other hailing and deterring devices) is considered along with in-air sounds produced by Navy sources. The system would typically be used in training activities nearshore, and use would be intermittent during these activities. Source levels at 1 m range between 137 A-weighted decibels (dBA) re 1 µPa for small portable systems and 153 dBA re 1 µPa for large systems. Sound would be directed within a 30–60° wide zone and would be directed over open water.

3.0.3.2 Explosive Stressors

This section describes the characteristics of explosions during naval training and testing. The activities analyzed in this Supplemental that use explosives are described in Appendix A (Navy Activities Descriptions). This section provides the basis for analysis of explosive impacts on resources in the remainder of Chapter 3 (Affected Environment and Environmental Consequences). Explanations of the terminology and metrics used when describing explosives in this Supplemental are in Appendix D (Acoustic and Explosive Concepts).

The near-instantaneous rise from ambient to an extremely high peak pressure is what makes an explosive shock wave potentially damaging. Farther from an explosive, the peak pressures decay and the explosive waves propagate as an impulsive, broadband sound. Several parameters influence the effect of an explosive: the weight of the explosive warhead, the type of explosive material, the boundaries and characteristics of the propagation medium, and, in water, the detonation depth. The net explosive weight, the explosive power of a charge expressed as the equivalent weight of trinitrotoluene (TNT), accounts for the first two parameters. The effects of these factors are explained in Appendix D (Acoustic and Explosive Concepts).

3.0.3.2.1 Explosions in Water

Explosive detonations during training and testing activities are associated with high-explosive munitions, including, but not limited to, bombs, missiles, rockets, naval gun shells, torpedoes, mines, demolition charges, and explosive sonobuoys. Explosive detonations during training and testing involving the use of high-explosive munitions, including bombs, missiles, and naval gun shells, could occur in the air or near the water's surface. Explosive detonations associated with torpedoes and explosive sonobuoys would occur in the water column; mines and demolition charges could be detonated in the water column or on the ocean bottom. Detonations would typically occur in waters greater than 200 ft. in depth, and greater than 50 NM from shore, with the exception of mine countermeasure and neutralization testing proposed in the Offshore Area, and existing mine warfare areas in Inland Waters (i.e., Crescent Harbor and Hood Canal Explosive Ordnance Disposal Training Ranges). Section 5.3.3 (Explosive Stressors) outlines the procedural mitigation measures for explosive stressors to reduce potential impacts on biological resources.

In order to better organize and facilitate the analysis of Navy training and testing activities using explosives that could detonate in water or at the water surface, explosive classification bins were developed. The use of explosive classification bins provides the same benefits as described for acoustic source classification bins in Section 3.0.3.1 (Acoustic Stressors).

Explosives detonated in water are binned by net explosive weight. The bins of explosives that are proposed for use in the Study Area are shown in Table 3.0-7. This table shows the number of explosive items that could be used in any year under each action alternative for training and testing activities. A range of annual bin use indicates that use of that bin is anticipated to vary annually, consistent with the variation in the number of annual activities described in Chapter 2 (Description of Proposed Action and Alternatives).

In addition to the explosives quantitatively analyzed for impacts on protected species shown in Table 3.0-7, the Navy uses some very small impulsive sources (less than 0.1 lb. net explosive weight), categorized in bin E0, that are not anticipated to result in takes of protected species. Quantitative modeling in multiple locations has validated that these sources have a very small zone of influence. These E0 charges, therefore, are categorized as *de minimis* sources and are qualitatively analyzed to determine the appropriate determinations under NEPA in the appropriate resource impact analyses, as well as under the MMPA and the ESA.

Propagation of explosive pressure waves in water is highly dependent on environmental characteristics such as bathymetry, bottom type, water depth, temperature, and salinity, which affect how the pressure waves are reflected, refracted, or scattered; the potential for reverberation; and interference due to multi-path propagation. In addition, absorption greatly affects the distance over which higher frequency components of explosive broadband noise can propagate. Appendix D (Acoustic and Explosive Concepts) explains the characteristics of explosive detonations and how the above factors affect the propagation of explosive energy in the water. Because of the complexity of analyzing sound propagation in the ocean environment, the Navy relies on acoustic models in its environmental analyses that consider sound source characteristics and varying ocean conditions across the Study Area.

Table 3.0-7: Explosive Sources Quantitatively Analyzed that Could Be Used Underwater or at the Water Surface

Bin	*Net Explosive Weight[1] (lb.)*	*Example Explosive Source*	*Training*			*Testing*		
			2015 Final EIS/OEIS (annual)	*Alternative 1 (annual)*	*Alternative 2 (annual)*	*2015 Final EIS/OEIS (annual)*	*Alternative 1 (annual)*	*Alternative 2 (annual)*
E1	0.1–0.25	Medium-caliber projectiles	48	60–120	120	0	8	8
E2	> 0.25–0.5	Medium-caliber projectiles	0	65–130	130	0	0	0
E3	> 0.5–2.5	Explosive Ordnance Disposal Mine Neutralization Training	6	6	10	72	72	72
E4	>2.5–5	Mine Countermeasure and Neutralization	0	0	0	70	36	36
E5	> 5–10	Large-caliber projectile	80	56–112	160	0	0	0
E7	> 20– 60	Mine Countermeasure and Neutralization	0	0	0	0	5	5
E8	> 60– 100	Lightweight torpedo	0	0	0	3	4	4
E10	> 250– 500	1,000 lb. bomb	4	0–4	6	0	0	0
E11	> 500–650	Heavyweight torpedo	0	0	2	3	4	4
E12	> 650–1,000	2,000 lb. bomb	10	0	0	0	0	0

[1] Net Explosive Weight refers to the equivalent amount of TNT; the actual weight of a munition may be larger due to other components.
Note: lb. = pound(s). Bins E6 and E9 are not applicable to activities within the NWTT Study Area.

3.0.3.2.1.1 Explosions in Air

Explosions in air include detonations of projectiles and missiles during surface-to-air gunnery and air-to-air missile exercises conducted during air warfare. These explosions typically occur far above the water surface in special use airspace. Some typical types of explosive munitions that would be detonated in air during Navy activities are shown in Table 3.0-8. Various missiles, rockets, and medium- and large-caliber projectiles may be explosive or non-explosive, depending on the objective of the training or testing activity in which they are used. Quantities of explosive and non-explosive missiles, rockets, and projectiles proposed for use during Navy training and testing are provided in the tables below.

Table 3.0-8: Typical Air Explosive Munitions During Navy Activities

Weapon Type[1]	*Net Explosive Weight (lb.)*	*Typical Altitude of Detonation (ft.)*
Surface-to-Air Missile		
RIM-66 SM-2 Standard Missile	80	> 15,000
RIM-116 Rolling Airframe Missile	39	< 3,000
RIM-7 Sea Sparrow	36	> 15,000 (can be used on low targets)
FIM-92 Stinger	7	< 3,000
Air-to-Air Missile		
AIM-9 Sidewinder	38	> 15,000
AIM-7 Sparrow	36	> 15,000
AIM-120 AMRAAM	17	> 15,000
Air-to-Surface Missile		
AGM-88 HARM	45	< 100
Projectile - Large Caliber[2]		
5"/54 caliber HE-ET	7	< 100
5"/54 caliber Other	8	< 3,000

[1] Mission Design Series and popular name shown for missiles.
[2] Most medium and large caliber projectiles used during Navy training and testing activities do not contain high explosives.
Notes: AMRAAM = Advanced Medium-Range Air-to-Air Missile; HARM = High-Speed Anti-Radiation Missile; HE-ET = High Explosive-Electronic Time, lb. = pound(s), ft. = foot/feet

Bombs and projectiles that detonate at or near the water surface, which are considered for underwater impacts (see Table 3.0-7), would also release some explosive energy into the air. Appendix A (Navy Activities Descriptions) describes where activities with these stressors typically occur.

The explosive energy released by detonations in air has been well-studied (see Appendix D, Acoustic and Explosive Concepts) and basic methods are available to estimate the explosive energy exposure with distance from the detonation (U.S. Department of the Navy, 1975). In air, the propagation of impulsive noise from an explosion is highly influenced by atmospheric conditions, including temperature and wind. While basic estimation methods do not consider the unique environmental conditions that may be present on a given day, they allow for approximation of explosive energy propagation under neutral atmospheric conditions. Explosions that occur during air warfare would typically be at a sufficient altitude that a large portion of the sound refracts upward due to cooling temperatures with increased altitude.

Missiles, rockets, projectiles, and other cased weapons will produce casing fragments upon detonation. These fragments may be of variable size and are ejected at supersonic speed from the detonation. The casing fragments will be ejected at velocities much greater than debris from any target due to the proximity of the casing to the explosive material. Unlike detonations on land targets, in-air detonations during Navy training and testing would not result in other propelled materials such as crater debris.

3.0.3.3 Energy Stressors

Energy stressors are discussed in the 2015 NWTT Final EIS/OEIS. Changes to energy stressors analyzed in this Supplemental are described below.

3.0.3.3.1 Electromagnetic Devices

As described in the 2015 NWTT Final EIS/OEIS (Section 3.0.5.3.2.1, Electromagnetic), electromagnetic energy originates from several sources that are analyzed for impacts in this document: airborne energy primarily from ships and aircraft, and in-water energy from mine neutralization systems.

3.0.3.3.1.1 In-Air Electromagnetic Devices

In-air electromagnetic devices were described as Airborne Electromagnetic Energy in Section 3.0.5.3.2.1 (Electromagnetic) of the 2015 NWTT Final EIS/OEIS. The following information supplements the discussion from that section.

Sources of electromagnetic energy in the air include communications transmitters, radars, and electronic countermeasures transmitters. Electromagnetic devices on Navy platforms operate across a wide range of frequencies and power. On a single ship the source frequencies may range from 2 megahertz (MHz) to 14,500 MHz, and transmitter maximum average power may range from 0.25 watts to 1,280,00 watts.

The term radar was originally coined by the Navy to refer to Radio Detection And Ranging. A radar system is an electromagnetic device that emits radio waves to detect and locate objects. In most cases, basic radar systems operate by generating pulses of radio frequency energy and transmitting these pulses via directional antennae into space (Courbis & Timmel, 2008). Some of this energy is reflected by the target back to the antenna, and the signal is processed to provide useful information to the operator.

Radars come in a variety of sizes and power, ranging from wide-band milliwatt systems to very-high-power systems that are used primarily for long-range search and surveillance (Courbis & Timmel, 2008). In general, radars operate at radio frequencies that range between 300 MHz and 300 gigahertz, and are often classified according to their frequency range. Navy vessels commonly operate radar systems that include S-band and X-band electronically steered radar. S-band radar serves as the primary search and acquisition sensor capable of tracking and collecting data on a large number of objects, while X-band radar can provide high-resolution data on particular objects of interest and discrimination for weapons systems. Both systems employ a variety of waveforms and bandwidths to provide high-quality data collection and operational flexibility (Baird et al., 2016).

It is assumed that most Navy platforms associated with the Proposed Action will be transmitting from a variety of in-air electromagnetic devices at all times that they are underway, with very limited exceptions. Low-power transmissions are used routinely for communications, navigation, and safety. High-power settings are used for a small number of activities, including ballistic missile defense training, missile and rocket testing, radar and other system testing, and signature analysis operations. The number of Navy vessels or aircraft in the Study Area at any given time varies and is dependent on local training or testing requirements. Therefore, in-air electromagnetic energy as part of the Proposed Action would be widely dispersed throughout the Study Area, but more concentrated in portions of the Study Area near ports, naval installations, and range complexes. Because these stressors are operated at power levels, altitudes, and distances from people and animals to ensure that energy received is well below levels that could disrupt behavior or cause injury, and because most in-air electromagnetic energy is reflected by water, in-air electromagnetic energy is not analyzed further except for potential impacts to birds.

The kinetic energy weapon (commonly referred to as the rail gun) will be tested aboard surface vessels, firing explosive and non-explosive projectiles at air- or sea-based targets. The system uses stored electrical energy to accelerate the projectiles, which are fired at supersonic speeds over great distances. The system charges for two minutes and fires in less than one second; therefore, the release of any electromagnetic energy would occur over a very short period. Also, the system is shielded so as not to affect shipboard controls and systems. The amount of electromagnetic energy released from this system is low and contained on the surface vessel. Therefore, this device is not expected to result in any electromagnetic impacts and will not be further analyzed for biological resources in this document.

3.0.3.3.1.2 In-Water Electromagnetic Devices

In-water electromagnetic devices were described in Section 3.0.5.3.2.1 (Electromagnetic) of the 2015 NWTT Final EIS/OEIS.

Table 3.0-9 shows the number of ongoing events (from the 2015 NWTT Final EIS/OEIS) and the number of events proposed in this Supplemental that include the use of in-water electromagnetic devices.

Table 3.0-9: Annual Number and Location of Events Including In-Water Electromagnetic Devices

Activity Area	Training			Testing		
	2015 Final EIS/OEIS	Alternative 1	Alternative 2	*2015 Final EIS/OEIS*	Alternative 1	Alternative 2
Inland Waters	Note 1	Note 1	Note 1	0	0	0

Note 1: The only exercise with in-water electromagnetic devices would occur once every two years. In years of occurrence, the activity has four separate events in which the in-water electromagnetic devices would be used.

3.0.3.3.2 Lasers

Laser devices can be organized into two categories: (1) low-energy lasers and (2) high-energy lasers.

3.0.3.3.2.1 Low-Energy Lasers

Low-energy lasers are proposed to be used as described in Section 3.0.5.3.2.2 (Lasers) in the 2015 NWTT Final EIS/OEIS. The parameters of low-energy lasers and behavior and life histories of major biological groups have not changed since the Phase II analysis. Therefore, the conclusion of low potential to affect biological resources as found in U.S. Department of the Navy (2010) remains valid, and low-energy lasers will not be further analyzed for impacts on biological resources in this Supplemental.

3.0.3.3.2.2 High-Energy Lasers

While high-energy lasers were not proposed to be used in the 2015 NWTT Final EIS/OEIS, they are now proposed for use as part of the Proposed Action in this Supplemental. High-energy laser weapons testing would involve the use of directed energy as a weapon against small surface and airborne targets. High-energy lasers would be employed from surface ships or helicopters and are designed to create small but critical failures in potential targets. The high-energy laser is expected to be used at short ranges (i.e., line-of-sight). Marine life at or near the ocean surface, and birds, could be susceptible to injury by high-energy lasers. Table 3.0-10 shows the number of ongoing events (from the 2015 NWTT Final EIS/OEIS) and the number of events proposed in this Supplemental that include the use of high-energy lasers.

Table 3.0-10: Annual Number and Location of Events Including High-Energy Lasers

Activity Area	Training			Testing		
	2015 Final EIS/OEIS	Alternative 1	Alternative 2	*2015 Final EIS/OEIS*	Alternative 1	Alternative 2
Offshore Area	0	0	0	0	54	54

3.0.3.4 Physical Disturbance and Strike Stressors

As described in the 2015 NWTT Final EIS/OEIS, physical disturbance and strike stressors can result from the Navy's use of aircraft and aerial targets, vessels, in-water devices, military expended materials, and seafloor devices.

3.0.3.4.1 Aircraft and Aerial Targets

Aircraft (both manned and unmanned) and aerial targets were described in Section 3.0.5.3.3.5 (Aircraft Strikes) in the 2015 NWTT Final EIS/OEIS. Table 3.0-11 shows the number of ongoing events (from the 2015 NWTT Final EIS/OEIS) and the number of events proposed in this Supplemental that include the use of aircraft.

Table 3.0-11: Annual Number and Location of Events Including Aircraft Movement

Activity Area	Training			Testing		
	2015 Final EIS/OEIS	Alternative 1	Alternative 2	*2015 Final EIS/OEIS*	Alternative 1	Alternative 2
Offshore Area	6,311	7,047	7,147	113	260	264
Inland Waters	100	143	165	456	61	61
Western Behm Canal	0	0	0	4	4	4
Total	**6,411**	**7,190**	**7,312**	**573**	**325**	**329**

Note: Includes drones, decoys, and other unmanned aircraft.

3.0.3.4.2 Vessels

Vessels were described in Section 3.0.5.3.3.1 (Vessels) in the 2015 NWTT Final EIS/OEIS. Table 3.0-12 shows the number of ongoing events (from the 2015 NWTT Final EIS/OEIS) and the number of events proposed in this Supplemental that include the use of vessels.

Table 3.0-12: Annual Number and Location of Events Including Vessel Movement

Activity Area	Training			Testing		
	2015 Final EIS/OEIS	Alternative 1	Alternative 2	*2015 Final EIS/OEIS*	Alternative 1	Alternative 2
Offshore Area	1,156	1,144	1,249	181	283	295
Inland Waters	368	327	409	916	918	1,028
Western Behm Canal	0	0	0	60	63	77
Total	**1,524**	**1,471**	**1,658**	**1,157**	**1,264**	**1,400**

3.0.3.4.3 In-Water Devices

In-water devices were described in Section 3.0.5.3.3.2 (In-Water Devices) in the 2015 NWTT Final EIS/OEIS. Table 3.0-13 shows the number of ongoing events (from the 2015 NWTT Final EIS/OEIS) and the number of events proposed in this Supplemental that include the use of in-water devices.

Table 3.0-13: Annual Number and Location of Events Including In-Water Devices

Activity Area	Training			Testing		
	2015 Final EIS/OEIS	Alternative 1	Alternative 2	*2015 Final EIS/OEIS*	Alternative 1	Alternative 2
Offshore Area	495	541	547	156	215	224
Inland Waters	1 (Note 1)	59	73	576	664	689
Western Behm Canal	0	0	0	8	19	19
Total	**496**	**600**	**620**	**740**	**898**	**932**

Note 1: This ongoing event occurs once every two years.

3.0.3.4.4 Military Expended Materials

Military expended materials were described in Section 3.0.5.3.3.3 (Military Expended Material) in the 2015 NWTT Final EIS/OEIS. Table 3.0-14 shows the number of non-explosive practice munitions analyzed in the 2015 NWTT Final EIS/OEIS and the number of events proposed in this Supplemental. Other military expended materials are listed in Table 3.0-15, explosive munitions in Table 3.0-16, and targets in Table 3.0-17.

Table 3.0-14: Annual Number and Location of Expended Non-Explosive Practice Munitions

Activity Area	Training			Testing		
	2015 Final EIS/OEIS	Alternative 1	Alternative 2	*2015 Final EIS/OEIS*	Alternative 1	Alternative 2
Bombs						
Offshore Area	110	84	90	0	0	0
Missiles						
Offshore Area	15	4	15	0	0	0
Sabot – Kinetic Energy Rounds						
Offshore Area	0	0	0	0	80	80
Large-Caliber Projectiles						
Offshore Area	3,190	9,390	9,520	0	160	160
Medium-Caliber Projectiles						
Offshore Area	43,172	26,660	43,112	0	0	0
Small-Caliber Projectiles						
Offshore Area	121,200	121,000	121,000	0	0	0
Small-Caliber Projectile Casings						
Inland Waters	3,036	3,036	6,057	0	0	0
Sonobuoys (includes Buoys, Bathythermograph Buoys, and Signal Underwater Sound buoys)						
Offshore Area	8,928	9,338	9,378	1,000	4,281	6,647
Inland Waters	0	0	0	6	48	48
Marine Markers						
Offshore Area	334	230	232	190	0	0
Inland Waters	0	40	40	0	0	0
Anti-Torpedo Torpedo						
Offshore Area	0	0	0	123	58	58
Inland Waters	0	0	0	81	176	184

Table 3.0-15: Annual Number and Location of Other Expended or Recovered Items

Activity Area	Training			Testing		
	2015 Final EIS/OEIS	Alternative 1	Alternative 2	*2015 Final EIS/OEIS*	Alternative 1	Alternative 2
Acoustic Countermeasures (Recovered)						
Western Behm Canal	0	0	0	20	5	5
Acoustic Countermeasures (Expended)						
Offshore Area	0	0	0	663	751	791
Inland Waters	0	0	0	1,837	721	721
Western Behm Canal	0	0	0	4	1	1
Anchors (Expended)						
Inland Waters	0	0	0	884	720	720
Anchors (Recovered)						
Offshore Area	0	0	0	180	445	445
Inland Waters	0	0	0	2,462	2,527	3,107
Western Behm Canal	0	0	0	20	20	20
Canisters – Miscellaneous (Expended)						
Offshore Area	170	170	164	0	0	0
Western Behm Canal	0	0	0	0	4	4
Heavyweight Torpedoes (Recovered)						
Offshore Area	0	2	0	220	148	188
Inland Waters	0	0	0	189	230	230
Lightweight Torpedoes (Recovered)						
Offshore Area	0	16	16	41	78	81
Inland Waters	0	0	0	62	48	48
Illumination Flares (Expended)						
Offshore Area	24	4	24	0	0	0

Table 3.0-16: Annual Number and Location of Explosive Munitions that May Result in Fragments

Activity Area	Training			Testing		
	2015 Final EIS/OEIS	Alternative 1	Alternative 2	*2015 Final EIS/OEIS*	Alternative 1	Alternative 2
Torpedoes						
Offshore Area	0	0	2	6	8	8
Neutralizers						
Offshore Area	0	0	0	0	36	36
Explosive Mines						
Offshore Area	0	0	0	0	5	5
Sonobuoys and Buoys						
Offshore Area	0	0	0	142	80	80
Bombs						
Offshore Area	10	2	2	0	0	0
Missiles						
Offshore Area	27	14	27	0	0	0
Large-Caliber Projectiles						
Offshore Area	390	172	390	0	80	80
Medium-Caliber Projectiles (includes Grenades)						
Offshore Area	6,368	550	6,490	0	0	0
Explosive Ordnance Disposal Underwater Detonations						
Inland Waters	42	42	70	0	0	0

Table 3.0-17: Annual Number and Location of Expended and Recovered[1] Targets

Activity Area	Training			Testing		
	2015 Final EIS/OEIS	Alternative 1	Alternative 2	*2015 Final EIS/OEIS[2]*	Alternative 1	Alternative 2
Sub-surface Targets (Mobile)						
Offshore Area	393	469	480	23	185	188
Inland Waters	0	0	0	768	1,127	1,159
Sub-surface Targets (Stationary)						
Offshore Area	0	0	0	7	3,335	3,335
Inland Waters	0	0	0	5,422	7,317	7,317
Surface Targets (Mobile)						
Offshore Area	0	0	0	0	162	162
Surface Targets (Stationary)						
Offshore Area	372	374	370	22	253	253
Inland Waters	0	0	0	407	542	542
Air Targets						
Offshore Area	188	133	188	0	162	162
Mine Shapes (Non-Explosive) - Recovered						
Offshore Area	112	0	0	36	181	181
Inland Waters	42	112	120	12,982	3,776	5,266
Western Behm Canal	0	0	0	20	20	20
Mine Shapes (Non-Explosive) - Expended						
Offshore Area	0	0	0	0	280	280
Inland Waters	0	0	0	0	336	336

[1] Unless specified as “expended,” the Navy makes best effort to recover all targets.
[2] In some cases the 2015 numbers have been adjusted to conform to current definitions of targets.

3.0.3.4.5 Seafloor Devices

Seafloor devices were described in Section 3.0.5.3.3.4 (Seafloor Devices) in the 2015 NWTT Final EIS/OEIS. Table 3.0-18 shows the number of ongoing events (from the 2015 NWTT Final EIS/OEIS) and the number of events proposed in this Supplemental that include the use of seafloor devices.

Table 3.0-18: Annual Number and Location of Events Including Seafloor Devices

Activity Area	Training			Testing		
	2015 Final EIS/OEIS	Alternative 1	Alternative 2	*2015 Final EIS/OEIS*	Alternative 1	Alternative 2
Anchors						
Offshore Area	0	0	0	91	70	71
Inland Waters	10	40	40	433	512	536
Western Behm Canal	0	0	0	1	1	1
Bottom-Placed Instruments						
Inland Waters	0	0	0	74	75	75
Mine Shapes						
Offshore Area	0	0	0	62	54	55
Inland Waters	13	13	21	446	454	478
Western Behm Canal	0	0	0	5	2	2
All Seafloor Devices (Anchors, Bottom-Placed Instruments, and Mine Shapes combined)[1]						
Offshore Area	0	0	0	111	92	93
Inland Waters	23	53	61	581	616	640
Western Behm Canal	0	0	0	5	2	2

[1]Because some activities include the use of more than one type of seafloor device, the number of events including anchors, bottom-placed instruments, or mine shapes may be less than the sum of each of those categories.

3.0.3.5 Entanglement Stressors

As described in the 2015 NWTT Final EIS/OEIS (Section 3.0.5.3.4, Entanglement Stressors), entanglement stressors can result from the Navy's use of fiber optic cables, guidance wires, and decelerators/parachutes. In addition, sonobuoy wires can be entanglement stressors and are included in this Supplemental for analysis. A new entanglement stressor is also proposed for use in this Supplemental that has not previously been used in the NWTT Study Area: biodegradable polymer, described below in Section 3.0.3.5.3.

3.0.3.5.1 Wires and Cables

Wires and cables were described in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires) in the 2015 NWTT Final EIS/OEIS. Table 3.0-19 shows the number of fiber optic cables, guidance wires, and sonobuoy wires analyzed in the 2015 NWTT Final EIS/OEIS and the number of events proposed in this Supplemental.

3.0.3.5.1.1 Fiber Optic Cables

Although a portion may be recovered, some fiber optic cables used during Navy training and testing activities would be expended. The length of the expended tactical fiber would vary depending on the activity. Tactical fiber has a silica core and acylate coating, and looks and feels like thin monofilament fishing line. Tensile strength and cable diameter may vary depending on the type of tactical fiber used, however, tactical fibers are generally 242 µm (0.24 mm) in diameter, have a 12 lb. tensile strength, and a 3.4 mm bend radius (Corning Incorporated, 2005; Raytheon Company, 2015). Tactical fiber is relatively brittle; it readily breaks if knotted, kinked, or abraded against a sharp object. Deployed tactical fiber will break if looped beyond its bend radius, or if it exceeds its tensile strength. If the fiber becomes looped around an underwater object or marine animal, it will not tighten unless it is under tension. Such an event would be unlikely based on its method of deployment and its resistance to looping after it is expended. The tactical fibers are often designed with controlled buoyancy to minimize the fiber's effect on vehicle movement. The tactical fiber would be suspended within the water column during the activity, and then be expended and sink to the seafloor (effective sink rate of 1.45 cm/second or greater (Raytheon Company, 2015)), where it would be susceptible to abrasion and burial by sedimentation.

3.0.3.5.1.2 Guidance Wires

Guidance wires are used during heavy-weight torpedo firings to help the firing platform control and steer the torpedo. They trail behind the torpedo as it moves through the water. Finally, the guidance wire is released from both the firing platform and the torpedo and sinks to the ocean floor. See Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires) in the 2015 NWTT Final EIS/OEIS for a full description of guidance wires.

3.0.3.5.1.3 Sonobuoy and Bathythermograph Wires

Sonobuoys consist of a surface antenna and float unit and a subsurface hydrophone assembly unit. The two units are attached through a thin-gauge, dual-conductor, and hard-draw copper strand wire, which is then wrapped by a hollow rubber tubing or bungee in a spiral configuration. The tensile breaking strength of the wire and rubber tubing is no more than 40 lb. The length of the wire is housed in a plastic canister dispenser, which remains attached upon deployment. The length of wire that extends out is no more than 1,500 ft. and is dependent on the water depth and type of sonobuoy. Attached to the wire is a kite-drogue and damper disk stabilizing system made of non-woven nylon fabric. The nylon fabric is very thin and can be broken by hand. The wire runs through the stabilizing system and leads to the hydrophone components. The hydrophone components may be covered by thin plastic netting depending on type of sonobuoy but pose no entanglement risk. Each sonobuoy has a saltwater activated polyurethane float that inflates when the sonobuoy is submerged and keeps the sonobuoy components floating vertically in the water column below it. Sonobuoys remain suspended in the water column for no more than 30 hours, after which they sink to the seafloor.

Bathythermographs are similar to sonobuoys in that they consist of a subsurface unit (to measure temperature of the water column, in the case of the bathythermograph) that is connected by wire to the float unit (for air-deployed bathythermographs) or directly to the ship (for ship-deployed bathythermographs). The bathythermograph wire is similar to the sonobuoy wire as described above.

Table 3.0-19: Annual Number and Location of Expended Wires and Cables

Activity Area	Training			Testing		
	2015 Final EIS/OEIS	Alternative 1	Alternative 2	*2015 Final EIS/OEIS*	Alternative 1	Alternative 2
Fiber Optic Cables						
Offshore Area	0	0	0	20	36	36
Inland Waters	0	0	0	122	197	197
Guidance Wires						
Offshore Area	0	2	2	92	152	192
Inland Waters	0	0	0	155	230	230
Sonobuoy Wires (includes Bathythermograph Buoys)						
Offshore Area	8,928	9,338	9,378	1,000	4,049	6,255
Inland Waters	0	0	0	6	48	48

3.0.3.5.2 Decelerators/Parachutes

Decelerators/parachutes were described in Section 3.0.5.3.4.2 (Decelerators/Parachutes) in the 2015 NWTT Final EIS/OEIS. Table 3.0-20 shows the number of decelerators/parachutes analyzed in the 2015 NWTT Final EIS/OEIS and the number proposed in this Supplemental.

Table 3.0-20: Annual Number and Location of Expended Decelerators/Parachutes

Activity Area	Training			Testing		
	2015 Final EIS/OEIS	Alternative 1	Alternative 2	*2015 Final EIS/OEIS*	Alternative 1	Alternative 2
Small Decelerators/Parachutes						
Offshore Area	8,928	9,354	9,394	1,068	1,759	1,759
Inland Waters	0	0	0	113	224	232
Medium Decelerators/Parachutes						
Offshore Area	24	4	24	0	0	0
Large Parachutes						
Offshore Area	145	98	145	0	0	0

3.0.3.5.3 Biodegradable Polymer

Marine Vessel Stopping proposed activities include the use of biodegradable polymers. The biodegradable polymers that the Navy uses are designed to temporarily interact with the propeller(s) of a target craft, rendering it ineffective. Some of the polymer constituents would dissolve within two hours of immersion. Based on the constituents of the biodegradable polymer the Navy proposes to use, it is anticipated that the material will break down into small pieces within a few days to weeks. These pieces will break down further and dissolve into the water column within weeks to a few months. Degradation and dispersal timelines are influenced by water temperature, currents, and other oceanographic features. Overall, the longer the polymer remains in the water, the weaker it becomes, making it more brittle and likely to break.

Table 3.0-21 shows the number of events proposed in this Supplemental that include the use of biodegradable polymer.

Table 3.0-21: Annual Number and Location of Events Including Biodegradable Polymer

Activity Area	Training			Testing		
	2015 Final EIS/OEIS	Alternative 1	Alternative 2	*2015 Final EIS/OEIS*	Alternative 1	Alternative 2
Inland Waters	0	0	0	0	4	4

3.0.3.6 Ingestion Stressors

As described in the 2015 NWTT Final EIS/OEIS, ingestion stressors can result from the Navy's proposed use of non-explosive practice munitions (small- and medium-caliber), fragments from explosives, fragments from targets, chaff, flare casings (including plastic end caps and pistons), and decelerator/parachutes. In addition, biodegradable polymer has been analyzed in this Supplemental as an ingestion stressor. The annual number of non-explosive practice munitions expended is shown in Table 3.0-14, the number of explosive munitions that could fragment is shown in Table 3.0-16, the number of targets that could fragment is shown in Table 3.0-17, the number of decelerator/parachutes is shown in Table 3.0-20, the number of events including the use of biodegradable polymer is shown in Table 3.0-21, and the number of chaff and flares is shown in Table 3.0-22.

Table 3.0-22: Annual Number and Location of Expended Chaff and Flares

Activity Area	Training			Testing		
	2015 Final EIS/OEIS	Alternative 1	Alternative 2	*2015 Final EIS/OEIS*	Alternative 1	Alternative 2
Chaff						
Offshore Area	5,000	5,000	5,000	0	0	0
Flares						
Offshore Area	500	700	700	600	0	0
Compression Pad or Plastic Piston						
Offshore Area	500	700	700	600	0	0
Endcap – Chaff and Flare						
Offshore Area	5,500	5,700	5,700	600	0	0
Flare O-Ring						
Offshore Area	504	704	724	600	0	0

3.0.3.7 Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities

This conceptual framework describes the potential effects from exposure to acoustic and explosive activities and the accompanying short-term costs to the animal (e.g., expended energy or missed feeding opportunity). It then outlines the conditions that may lead to long-term consequences for the individual if the animal cannot fully recover from the short-term costs and how these in turn may affect the population. Within each biological resource section (e.g., marine mammals, birds, and fishes) the detailed methods to predict effects on specific taxa are derived from this conceptual framework.

An animal is considered "exposed" to a sound if the received sound level at the animal's location is above the background ambient noise level within a similar frequency band. A variety of effects may result from exposure to acoustic and explosive activities.

The categories of potential effects are:

- ***Injury*** *- Injury to organs or tissues of an animal.*
- ***Hearing loss*** *- A noise-induced decrease in hearing sensitivity which can be either temporary or permanent and may be limited to a narrow frequency range of hearing.*
- ***Masking*** *- When the perception of a biologically important sound (i.e., signal) is interfered with by a second sound (i.e., noise).*
- ***Physiological stress*** *- An adaptive process that helps an animal cope with changing conditions; although, too much stress can result in physiological problems.*
- ***Behavioral response*** *- A reaction ranging from very minor and brief changes in attentional focus, changes in biologically important behaviors, and avoidance of a sound source or area, to aggression or prolonged flight.*

Figure 3.0-2 is a flowchart that diagrams the process used to evaluate the potential effects to marine animals exposed to sound-producing activities. The shape and color of each box on the flowchart represents either a decision point in the analysis (green diamonds); specific processes such as responses, costs, or recovery (blue rectangles); external factors to consider (purple parallelograms); and final outcomes for the individual or population (orange ovals and rectangles). Each box is labeled for reference throughout the following sections. For simplicity, sound is used here to include not only sound waves but also blast waves generated from explosive sources. Box A1, the Sound-Producing Activity, is the source of this stimuli and therefore the starting point in the analysis.

The first step in predicting whether an activity is capable of affecting a marine animal is to define the stimuli experienced by the animal. The Stimuli include the overall level of activity, the surrounding acoustical environment, and characteristics of the sound when it reaches the animal.

Sounds emitted from a sound-producing activity (Box A1) travel through the environment to create a spatially variable sound field. The received sound at the animal (Box A2) determines the range of possible effects. The received sound can be evaluated in several ways, including number of times the sound is experienced (repetitive exposures), total received energy, or highest SPL experienced. Sounds that are higher than the ambient noise level and within an animal's hearing sensitivity range (Box A3) have the potential to cause effects. There can be any number of individual sound sources in a given activity, each with its own unique characteristics. For example, a Navy training exercise may involve several ships and aircraft using several types of sonar. Environmental factors such as temperature and bottom type impact how sound spreads and attenuates through the environment. Additionally, independent of the sounds, the overall level of activity and the number and movement of sound sources are important to help predict the probable reactions.

The magnitude of the responses is predicted based on the characteristics of the acoustic stimuli and the characteristics of the animal (species, susceptibility, life history stage, size, and past experiences). Very high exposure levels close to explosives have the potential to cause injury. High-level, long-duration, or repetitive exposures may potentially cause some hearing loss. All perceived sounds may lead to behavioral responses, physiological stress, and masking. Many sounds, including sounds that are not detectable by the animal, could have no effect (Box A4).

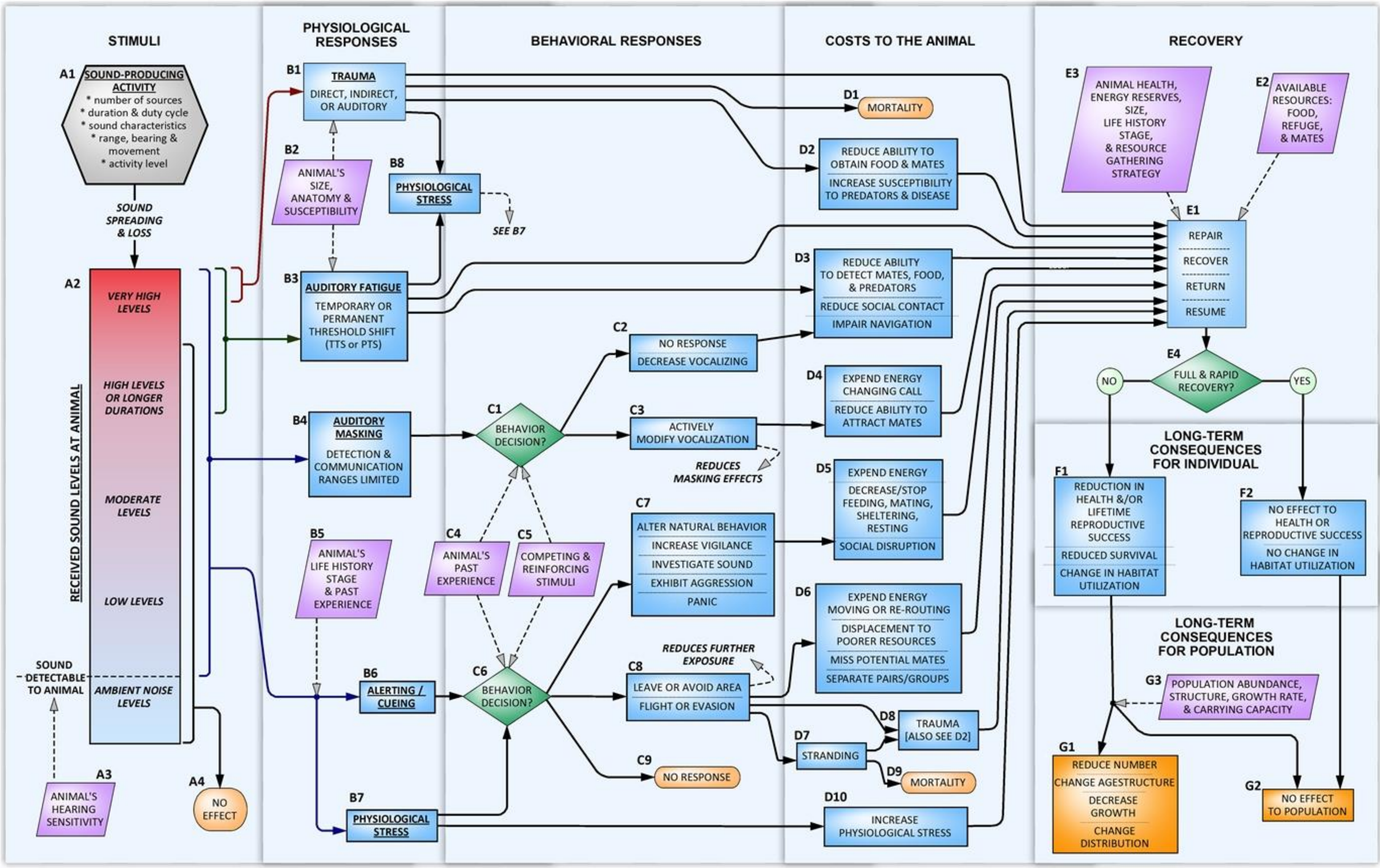

Figure 3.0-2: Flow Chart of the Evaluation Process of Sound-Producing Activities

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3.0.3.7.1 Injury

Injury (Box B1) refers to the direct injury of tissues and organs by shock or pressure waves impinging upon or traveling through an animal's body. Marine animals are well adapted to large, but relatively slow, hydrostatic pressure changes that occur with changing depth. However, injury may result from exposure to rapid pressure changes, such that the tissues do not have time to adequately adjust.

Therefore, injury is normally limited to relatively close ranges from explosions. Injury can be mild and fully recoverable or, in some cases, lead to mortality.

Injury includes both auditory and non-auditory injury. Auditory injury is the direct mechanical injury to hearing-related structures, including tympanic membrane rupture, disarticulation of the middle ear ossicles, and injury to the inner ear structures such as the organ of Corti and the associated hair cells. Auditory injury differs from auditory fatigue in that the latter involves the overstimulation of the auditory system at levels below those capable of causing direct mechanical damage. Auditory injury is always injurious but can be temporary. One of the most common consequences of auditory injury is hearing loss.

Non-auditory injury can include hemorrhaging of small blood vessels and the rupture of gas-containing tissues such as the lung, swim bladder, or gastrointestinal tract. After the ear (or other sound-sensing organs), these are usually the organs and tissues most sensitive to explosive injury. An animal’s size and anatomy are important in determining its susceptibility to non-auditory injury (Box B2). Larger size indicates more tissue to protect vital organs. Therefore, larger animals should be less susceptible to injury than smaller animals. In some cases, acoustic resonance of a structure may enhance the vibrations resulting from noise exposure and result in an increased susceptibility to injury. The size, geometry, and material composition of a structure determine the frequency at which the object will resonate. Because most biological tissues are heavily damped, the increase in susceptibility from resonance is limited.

Vascular and tissue bubble formation resulting from sound exposure is a hypothesized mechanism of injury to breath-holding marine animals. Bubble formation and growth due to direct sound exposure have been hypothesized (Crum & Mao, 1996; Crum et al., 2005); however, the experimental laboratory conditions under which these phenomena were observed would not be replicated in the wild. Certain dive behaviors by breath-holding animals are predicted to result in conditions of blood nitrogen super-saturation, potentially putting an animal at risk for decompression sickness (Fahlman et al., 2014), although this phenomena has not been observed (Houser et al., 2009). In addition, animals that spend long periods of time at great depths are predicted to have super-saturated tissues that may slowly release nitrogen if the animal then spends a long time at the surface (i.e., stranding) (Houser et al., 2009).

Injury could increase the animal’s physiological stress (Box B8), which feeds into the stress response (Box B7) and also increases the likelihood or severity of a behavioral response. Injury may reduce an animal’s ability to secure food by reducing its mobility or the efficiency of its sensory systems, making the injured individual less attractive to potential mates, increasing an individual’s chances of contracting diseases or falling prey to a predator (Box D2), or increasing an animal's overall physiological stress level (Box D10). Severe injury can lead to the death of the individual (Box D1).

Damaged tissues from mild to moderate injury may heal over time. The predicted recovery of direct injury is based on the severity of the injury, availability of resources, and characteristics of the animal. The animal may also need to recover from any potential costs due to a decrease in resource gathering efficiency and any secondary effects from predators or disease. Severe injuries can lead to reduced survivorship (longevity), elevated stress levels, and prolonged alterations in behavior that can reduce an animal's lifetime reproductive success. An animal with decreased energy stores or a lingering injury may be less successful at mating for one or more breeding seasons, thereby decreasing the number of offspring produced over its lifetime.

3.0.3.7.2 Hearing Loss

Hearing loss, also called a noise-induced threshold shift, is possibly the best studied type of effect from sound exposures to animals. Hearing loss manifests itself as loss in hearing sensitivity across part of an animal's hearing range, which is dependent upon the specifics of the noise exposure. Hearing loss may be either PTS, or TTS. If the threshold shift eventually returns to zero (the animal's hearing returns to pre-exposure value), the threshold shift is a TTS. If the threshold shift does not return to zero but leaves some finite amount of threshold shift, then that remaining threshold shift is a PTS. Figure 3.0-3 shows one hypothetical threshold shift that completely recovers, a TTS, and one that does not completely recover, leaving some PTS.

The characteristics of the received sound stimuli are used and compared to the animal's hearing sensitivity and susceptibility to noise (Box A3) to determine the potential for hearing loss. The amplitude, frequency, duration, and temporal pattern of the sound exposure are important parameters for predicting the potential for hearing loss over a specific portion of an animal's hearing range. Duration is particularly important because hearing loss increases with prolonged exposure time. Longer exposures with lower sound levels can cause more threshold shift than a shorter exposure using the same amount of energy overall. The frequency of the sound also plays an important role. Experiments show that animals are most susceptible to hearing loss (Box B3) within their most sensitive hearing range. Sounds outside of an animal's audible frequency range do not cause hearing loss.

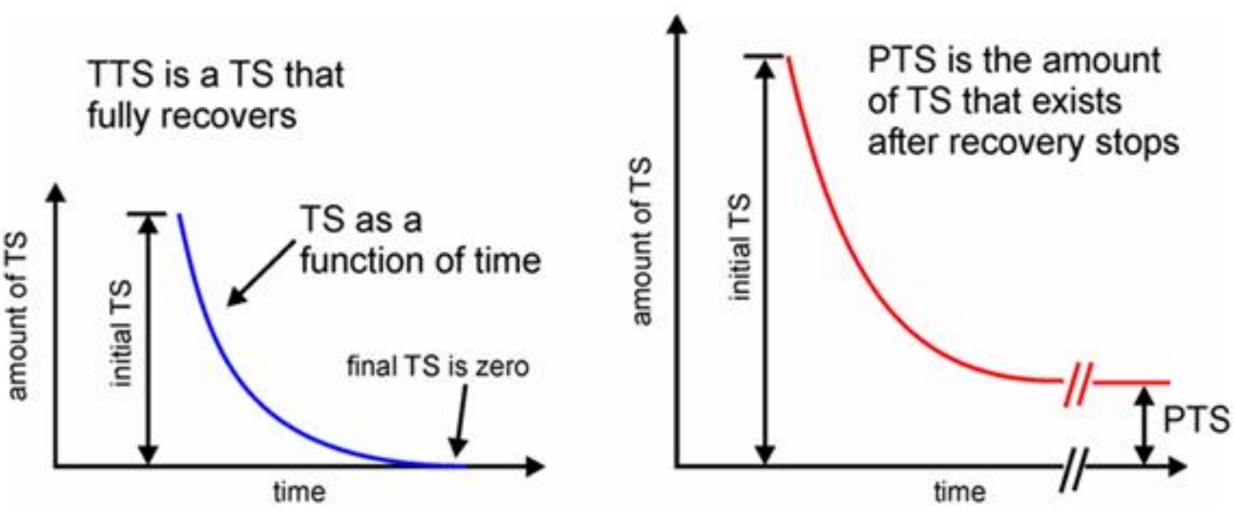

Figure 3.0-3: Two Hypothetical Threshold Shifts

The mechanisms responsible for hearing loss may consist of a variety of mechanical and biochemical processes in the inner ear, including physical damage or distortion of the tympanic membrane (not including tympanic membrane rupture which is considered auditory injury), physical damage or distortion of the cochlear hair cells, hair cell death, changes in cochlear blood flow, and swelling of cochlear nerve terminals (Henderson et al., 2006; Kujawa & Liberman, 2009). Although the outer hair cells are the most prominent target for fatigue effects, severe noise exposures may also result in inner hair cell death and loss of auditory nerve fibers (Henderson et al., 2006).

The relationship between TTS and PTS is complicated and poorly understood, even in humans and terrestrial mammals, where numerous studies failed to delineate a clear relationship between the two. Relatively small amounts of TTS (e.g., less than 40–50 dB measured two minutes after exposure) will recover with no apparent permanent effects; however, terrestrial mammal studies revealed that larger amounts of threshold shift can result in permanent neural degeneration, despite the hearing thresholds returning to normal (Kujawa & Liberman, 2009). The amounts of threshold shift induced by Kujawa and Liberman (2009) were described as being “at the limits of reversibility.” It is unknown whether smaller amounts of threshold shift can result in similar neural degeneration, or if effects would translate to other species such as marine animals.

Hearing loss can increase an animal’s physiological stress (Box B8), which feeds into the stress response (Box B7). Hearing loss can increase the likelihood or severity of a behavioral response and increase an animal's overall physiological stress level (Box D10). Hearing loss reduces the distance over which animals can communicate and detect other biologically important sounds (Box D3). Hearing loss could also be inconsequential for an animal if the frequency range affected is not critical for that animal to hear within, or the hearing loss is of such short duration (e.g., a few minutes) that there are no costs to the individual.

Small to moderate amounts of hearing loss may recover over a period of minutes to days, depending on the amount of initial threshold shift. Severe noise-induced hearing loss may not fully recover, resulting in some amount of PTS. An animal whose hearing does not recover quickly and fully could suffer a reduction in lifetime reproductive success. An animal with PTS may be less successful at mating for one or more breeding seasons, thereby decreasing the number of offspring it can produce over its lifetime.

3.0.3.7.3 Masking

Masking occurs if the noise from an activity interferes with an animal’s ability to detect, understand, or recognize biologically relevant sounds of interest (Box B4). In this context noise refers to unwanted or unimportant sounds that mask an animal’s ability to hear sounds of interest. Sounds of interest include those from conspecifics such as offspring, mates, and competitors; echolocation clicks; sounds from predators; natural, abiotic sounds that may aid in navigation; and reverberation, which can give an animal information about its location and orientation within the ocean. The probability of masking increases as the noise and sound of interest increase in similarity and the masking noise increases in level. The frequency, received level, and duty cycle of the noise determines the potential degree of auditory masking. Masking only occurs during the sound exposure.

A behavior decision (either conscious or instinctive) is made by the animal when the animal detects increased background noise, or possibly, when the animal recognizes that biologically relevant sounds are being masked (Box C1). An animal’s past experiences can be important in determining the behavioral response when dealing with masking (Box C4). For example, an animal may modify its vocalizations to reduce the effects of masking noise. Other stimuli present in the environment can influence an animal’s behavior decision (Box C5) such as the presence of predators, prey, or potential mates.

An animal may exhibit a passive behavioral response when coping with masking (Box C2). It may simply not respond and keep conducting its current natural behavior. An animal may also stop calling until the background noise decreases. These passive responses do not present a direct energetic cost to the animal; however, masking will continue, depending on the acoustic stimuli.

An animal may actively compensate for masking (Box C3). An animal can vocalize more loudly to make its signal heard over the masking noise. An animal may also shift the frequency of its vocalizations away from the frequency of the masking noise. This shift can actually reduce the masking effect for the animal and other animals that are listening in the area.

If masking impairs an animal's ability to hear biologically important sounds (Box D3) it could reduce an animal's ability to communicate with conspecifics or reduce opportunities to detect or attract more distant mates, gain information about their physical environment, or navigate. An animal that modifies its vocalization in response to masking could also incur a cost (Box D4). Modifying vocalizations may cost the animal energy, interfere with the behavioral function of a call, or reduce a signaler's apparent quality as a mating partner. For example, songbirds that shift their calls up an octave to compensate for increased background noise attract fewer or less-desirable mates, and many terrestrial species advertise body size and quality with low-frequency vocalizations (Slabbekoorn & Ripmeester, 2007). Masking may also lead to no measurable costs for an animal. Masking could be of short duration or intermittent such that biologically important sounds that are continuous or repeated are received by the animal between masking noise.

Masking only occurs when the sound source is operating; therefore, direct masking effects stop immediately upon cessation of the sound-producing activity. Masking could have long-term consequences for individuals if the activity was continuous or occurred frequently enough.

3.0.3.7.4 Physiological Stress

Marine animals naturally experience physiological stress as part of their normal life histories. The physiological response to a stressor, often termed the stress response, is an adaptive process that helps an animal cope with changing external and internal environmental conditions. Sound-producing activities have the potential to cause additional stress. However, too much of a stress response can be harmful to an animal, resulting in physiological dysfunction.

If a sound is detected (i.e., heard or sensed) by an animal, a stress response can occur (Box B7). The severity of the stress response depends on the received sound level at the animal (Box A2), the details of the sound-producing activity (Box A1), and the animal's life history stage (e.g., juvenile or adult, breeding or feeding season), and past experience with the stimuli (Box B5). An animal's life history stage is an important factor to consider when predicting whether a stress response is likely (Box B5). An animal's life history stage includes its level of physical maturity (i.e., larva, infant, juvenile, sexually mature adult) and the primary activity in which it is engaged such as mating, feeding, or rearing/caring for young. Prior experience with a stressor may be of particular importance because repeated experience with a stressor may dull the stress response via acclimation (St. Aubin & Dierauf, 2001) or increase the response via sensitization. Additionally, if an animal suffers injury or hearing loss, a physiological stress response will occur (Box B8).

The generalized stress response is characterized by a release of hormones (Reeder & Kramer, 2005) and other chemicals (e.g., stress markers) such as reactive oxidative compounds associated with noise-induced hearing loss (Henderson et al., 2006). Stress hormones include norepinephrine and epinephrine (i.e., the catecholamines), which produce elevations in the heart and respiration rate, increase awareness, and increase the availability of glucose and lipid for energy. Other stress hormones are the glucocorticoid steroid hormones cortisol and aldosterone, which are classically used as an indicator of a stress response and to characterize the magnitude of the stress response (Hennessy et al., 1979).

An acute stress response is traditionally considered part of the startle response and is hormonally characterized by the release of the catecholamines. Annoyance type reactions may be characterized by the release of either or both catecholamines and glucocorticoid hormones. Regardless of the physiological changes that make up the stress response, the stress response may contribute to an animal's decision to alter its behavior.

Elevated stress levels may occur whether or not an animal exhibits a behavioral response (Box D10). Even while undergoing a stress response, competing stimuli (e.g., food or mating opportunities) may overcome any behavioral response. Regardless of whether the animal displays a behavioral response, this tolerated stress could incur a cost to the animal. Reactive oxygen compounds produced during normal physiological processes are generally counterbalanced by enzymes and antioxidants; however, excess stress can lead to damage of lipids, proteins, and nucleic acids at the cellular level (Berlett & Stadtman, 1997; Sies, 1997; Touyz, 2004).

Frequent physiological stress responses may accumulate over time increasing an animal's chronic stress level. Each component of the stress response is variable in time, and stress hormones return to baseline levels at different rates. Elevated chronic stress levels are usually a result of a prolonged or repeated disturbance. Chronic elevations in the stress levels (e.g., cortisol levels) may produce long-term health consequences that can reduce lifetime reproductive success.

3.0.3.7.5 Behavioral Reactions

Behavioral responses fall into two major categories: alterations in natural behavior patterns and avoidance. These types of reactions are not mutually exclusive, and many overall reactions may be combinations of behaviors or a sequence of behaviors. Severity of behavioral reactions can vary drastically between minor and brief reorientations of the animal to investigate the sound, to severe reactions such as aggression or prolonged flight. The type and severity of the behavioral response will determine the cost to the animal. The total number of vehicles and platforms involved, the size of the activity area, the distance between the animal and activity, and the duration of the activity are important considerations when predicting the initial behavioral responses.

A physiological stress response (Box B7) such as an annoyance or startle reaction, or cueing or alerting (Box B6) may cause an animal to make a behavior decision (Box C6). Any exposure that produces an injury or hearing loss is also assumed to produce a stress response (Box B7) and increase the severity or likelihood of a behavioral reaction. Both an animal's experience (Box C4) and competing and reinforcing stimuli (Box C5) can affect an animal's behavior decision. The decision can result in three general types of behavioral reactions: no response (Box C9), area avoidance (Box C8), or alteration of a natural behavior (Box C7).

An animal's past experiences can be important in determining what behavior decision it may make when dealing with a stress response (Box C4). Habituation is the process by which an animal learns to ignore or tolerate stimuli over some period and return to a normal behavior pattern, perhaps after being exposed to the stimuli with no negative consequences. Sensitization is when an animal becomes more sensitive to a set of stimuli over time, perhaps as a result of a past, negative experience that could result in a stronger behavioral response.

Other stimuli (Box C5) present in the environment can influence an animal's behavioral response. These stimuli may be conspecifics or predators in the area or the drive to engage in a natural behavior. Other stimuli can also reinforce the behavioral response caused by acoustic stimuli. For example, the awareness of a predator in the area coupled with the sound-producing activity may elicit a stronger reaction than the activity alone would have.

An animal may reorient, become more vigilant, or investigate if it detects a sound-producing activity (Box C7). These behaviors all require the animal to divert attention and resources, therefore slowing or stopping their presumably beneficial natural behavior. This can be a very brief diversion, or an animal may not resume its natural behaviors until after the activity has concluded. An animal may choose to leave or avoid an area where a sound-producing activity is taking place (Box C8). A more severe form of this comes in the form of flight or evasion. Avoidance of an area can help the animal avoid further effects by avoiding or reducing further exposure. An animal may also choose not to respond to a sound-producing activity (Box C9).

An animal that alters its natural behavior in response to stress or an auditory cue may slow or cease its natural behavior and instead expend energy reacting to the sound-producing activity (Box D5). Natural behaviors include feeding, breeding, sheltering, and migrating. The cost of feeding disruptions depends on the energetic requirements of individuals and the potential amount of food missed during the disruption. Alteration in breeding behavior can result in delaying reproduction. The costs of a brief interruption to migrating or sheltering are less clear.

An animal that avoids a sound-producing activity may expend additional energy moving around the area, be displaced to poorer resources, miss potential mates, or have social interactions affected (Box D6). The amount of energy expended depends on the severity of the behavioral response. Missing potential mates can result in delaying reproduction. Groups could be separated during a severe behavioral response such as flight and offspring that depend on their parents may die if they are permanently separated. Splitting up an animal group can result in a reduced group size, which can have secondary effects on individual foraging success and susceptibility to predators.

Some severe behavioral reactions can lead to stranding (Box D7) or secondary injury (Box D8). Animals that take prolonged flight, a severe avoidance reaction, may injure themselves or strand in an environment for which they are not adapted. Some injury is likely to occur to an animal that strands (Box D8). Injury can reduce the animal's ability to secure food and mates, and increase the animal's susceptibility to predation and disease (Box D2). An animal that strands and does not return to a hospitable environment may die (Box D9).

3.0.3.7.6 Long-Term Consequences

The potential long-term consequences from behavioral responses are difficult to discern. Animals displaced from their normal habitat due to an avoidance reaction may return over time and resume their natural behaviors. This is likely to depend upon the severity of the reaction and how often the activity is repeated in the area. In areas of repeated and frequent acoustic disturbance, some animals may habituate to the new baseline; conversely, species that are more sensitive may not return, or return but not resume use of the habitat in the same manner. For example, an animal may return to an area to feed but no longer rest in that area. Long-term abandonment or a change in the utilization of an area by enough individuals can change the distribution of the population. Frequent disruptions to natural behavior patterns may not allow an animal to recover between exposures, which increase the probability of causing long-term consequences to individuals.

The magnitude and type of effect and the speed and completeness of recovery (i.e., return to baseline conditions) must be considered in predicting long-term consequences to the individual animal (Box E4). The predicted recovery of the animal (Box E1) is based on the cost to the animal from any reactions, behavioral or physiological. Available resources fluctuate by season, location, and year and can play a major role in an animal's rate of recovery (Box E2). Recovery can occur more quickly if plentiful food resources, many potential mates, or refuge or shelter is available. An animal's health, energy reserves, size, life history stage, and resource gathering strategy affect its speed and completeness of recovery (Box E3). Animals that are in good health and have abundant energy reserves before an effect takes place will likely recover more quickly.

Animals that recover quickly and completely are unlikely to suffer reductions in their health or reproductive success, or experience changes in habitat utilization (Box F2). No population-level effects would be expected if individual animals do not suffer reductions in their lifetime reproductive success or change their habitat utilization (Box G2). Animals that do not recover quickly and fully could suffer reductions in their health and lifetime reproductive success; they could be permanently displaced or change how they use the environment; or they could die (Box F1). These long-term consequences to the individual can lead to consequences for the population (Box G1); although, population dynamics and abundance play a role in determining how many individuals would need to suffer long-term consequences before there was an effect on the population.

Long-term consequences to individuals can translate into consequences for populations dependent upon population abundance, structure, growth rate, and carrying capacity. Carrying capacity describes the theoretical maximum number of animals of a particular species that the environment can support. When a population nears its carrying capacity, its growth is naturally limited by available resources and predator pressure. If one, or a few animals, in a population are removed or gather fewer resources, then other animals in the population can take advantage of the freed resources and potentially increase their health and lifetime reproductive success. Abundant populations that are near their carrying capacity (theoretical maximum abundance) that suffer consequences on a few individuals may not be affected overall. Populations that exist well below their carrying capacity may suffer greater consequences from any lasting consequences to even a few individuals. Population-level consequences can include a change in the population dynamics, a decrease in the growth rate, or a change in geographic distribution.

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3.1 Sediments and Water Quality

3.1.1 Assessment of Sediments

The analysis of impacts on sediments and water quality presented in the 2015 Northwest Training and Testing (NWTT) Final Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) (Supplemental) was revised and updated with new information in this section to the extent that the affected environment or the science for evaluating sediment and water quality changed. Relevant literature published or otherwise becoming available since the publication of the 2015 NWTT Final EIS/OEIS was systematically reviewed to assist in determining if sediment and water quality conditions in the Study Area have changed or remain the same.

Information is readily available on the condition of inshore and nearshore sediments and water quality, because of the proximity of those areas to human population centers. However, comparatively less is known about sediments and water quality beyond the continental shelf in ocean basins far from shore. Inshore and nearshore sediments and water quality are negatively impacted mostly by numerous anthropogenic sources (e.g., urban runoff, debris disposal, commercial and recreational vessels) (Keller et al., 2010; Washington Department of Ecology, 2009). Two general assumptions were made in the 2015 NWTT Final EIS/OEIS analysis of impacts on sediment and water quality: (1) water quality and the condition of sediments improves with distance from shore, and (2) deeper waters (generally considered to be greater than 200 m in depth) are generally of higher quality than surface waters. Research published since the analysis in the 2015 NWTT Final EIS/OEIS was completed shows that the concentration of marine debris is increasing in deep oceanic waters far from shore (Cozar et al., 2014; Desforges et al., 2014; Law et al., 2014; National Oceanic and Atmospheric Administration Marine Debris Program, 2016; Woodall et al., 2014). However, considering that the vast majority of marine debris that accumulates in oceanic waters originates in coastal regions, the assumptions noted above from the 2015 NWTT Final EIS/OEIS have not been altered by the new data.

The discussion that follows is based largely on information and data on sediments in the West Coast region from the National Coastal Condition Assessment – 2010 (U.S. Environmental Protection Agency, 2016a). This assessment is the Environmental Protection Agency's (EPA's) fifth coastal condition assessment; however, it is the first in the newly named National Aquatic Resource Surveys series. Even though the series is new, it is regarded as a continuation of the National Coastal Condition Reports (I–IV) series (e.g., see U.S. Environmental Protection Agency (2012a)). Data from the original series were used to evaluate sediments in Section 3.1 (Sediments and Water Quality) of 2015 NWTT Final EIS/OEIS, and data from new series are used in this Supplemental.

Key environmental indicators (e.g., sediment toxicity) used in the new series remain similar to indicators used in the National Coastal Condition Reports (I–IV) series; however, the new National Coastal Condition Assessments are less detailed and use very little data external to the National Aquatic Resource Surveys program (e.g., beach closure or fish advisory information is no longer used). Additionally, the fish tissue and sediment indices used in the new National Coastal Condition Assessments series have been revised based on comments received on previous reports and to reflect advances in science; therefore, the index scores reported in this Supplemental are not directly comparable to scores presented in the National Coastal Condition Reports (I–IV) (U.S. Environmental Protection Agency, 2016a).

As part of updating the series, the EPA revised the criteria for evaluating the condition of sediments in the National Coastal Condition Assessment – 2010 (U.S. Environmental Protection Agency, 2016c). The condition of sediments, quantified by a "sediment quality index," in estuaries is evaluated based on measurements of two criteria: sediment toxicity and the concentrations of sediment contaminants (i.e., sediment chemistry). Previously, total organic carbon was also used as an indicator to assess the condition of sediments, but this metric is no longer used to calculate the sediment quality index. Previous sediment quality assessments in marine waters used the Effects Range Median metric, which is considered adequate for assessing the effects of individual contaminants on the condition of sediments. However, contaminants rarely occur alone in the environment; rather, they are almost always present as complex mixtures in marine sediments. Therefore, as detailed in the EPA-revised criteria, a better metric for assessing the effects of contaminants on the conditions of sediments, is the average (or mean) of the Effects Range Median Quotient. To arrive at this metric the first step is to calculate the Effects Range Median Quotient by dividing the contaminant concentration by its corresponding Effects Range Median threshold. The Mean Effects Range Median Quotient is then calculated by summing the individual Effects Range Median Quotients for all contaminants and dividing by the total number of contaminants in the mixture (i.e., an average of contaminants in the sediment). To assess the degree of contamination, the Mean Effects Range Median Quotient takes into account (1) the composition of multiple contaminants found in sediment samples, and (2) a corresponding measure of the probability that the level of contamination will be toxic to benthic organisms (U.S. Environmental Protection Agency, 2016c). Effects range median thresholds for EPA-listed chemical contaminants are provided in U.S. Environmental Protection Agency (2016c).

The Mean Effects Range Median Quotient is combined with the results from a computer model that relates chemical concentrations to sediment toxicity in benthic invertebrates. Together, the Mean Effects Range Median Quotient and the model results are used to rate sediment chemistry as either good, fair, or poor based on the concentrations of chemical contaminants. For example, for sediment chemistry to be rated "good" the Mean Effects Range Median Quotient must be less than 0.1 and the maximum probability of observing sediment toxicity (i.e., the results of the model) must be less than (or equal to) 0.5 (i.e., no greater than 50 percent). See Table 3.1-1 for descriptions of the sediment chemistry criteria.

The second metric used to assess sediment condition, sediment toxicity, is based on the survival rates of the estuarine amphipod, *Leptocheirus plumulosus*, in sample sediments. The survival rates of amphipods in a test group are compared to a control group, and if the survival rates of the two groups are found to be statistically different, then some degree of sediment toxicity is present in the sampled sediments. The survival rate and the statistical test are used in tandem to rate sediment toxicity (Table 3.1-1). The overall sediment quality index, rating sediments as good, fair, or poor, is based on the sediment toxicity and sediment chemistry scores.

3.1.2 Assessment of Water Quality

The water quality criteria and metrics for determining the water quality index in the National Coastal Condition Assessment – 2010 (U.S. Environmental Protection Agency, 2016a) are the same as the criteria and index used in previous coastal condition assessments and have not changed since the 2015 NWTT Final EIS/OEIS. Refer to Table 3.1-5 in Section 3.1 (Sediments and Water Quality) of the 2015 NWTT Final EIS/OEIS or U.S. Environmental Protection Agency (2016c) for the specific criteria. Note that in the table the site criteria for dissolved inorganic nitrogen rated fair were incorrectly listed as "0.35 – 1.0 mg/L." The correct range is "0.35 – 0.5 mg/L."

Table 3.1-1: Sediment Quality Criteria and Index

Metric or Index	Criteria		
	Good	Fair	Poor
Sediment toxicity	Test results not significantly different from control (p>0.05) and ≥80 percent control-corrected survival	Test results significantly different from control (p≤0.05) and ≥80 percent control-corrected survival or Test not significantly different from control (p>0.05) and <80 percent control-corrected survival	Test results significantly different from control (p<0.05) and <80 percent control-corrected survival
Sediment chemistry	mERM-Q <0.1 and LRM Pmax ≤ 0.5	mERM-Q ≥0.1 - ≤0.5 or LRM Pmax >0.5 - <0.75	mERM-Q >0.5 or LRM Pmax ≥0.75
Sediment quality index	Both sediment chemistry index and sediment toxicity index are rated good	Neither sediment chemistry index nor sediment toxicity index are rated poor, and at least one index is rated fair	Either sediment chemistry index or sediment toxicity index are rated poor

Notes: Sediment total organic carbon (TOC) is no longer used for assessment of estuarine sediments.
TOC = total organic carbon, mERM-Q = mean Effects Range Median quotient, Pmax = maximum probability of observing sediment toxicity, LRM = logistic regression model.
Source: U.S. Environmental Protection Agency (2016c)

Section 312(n) of the Clean Water Act requires the EPA and the Department of Defense (DoD) to jointly establish uniform national discharge standards to control discharges (other than sewage) incidental to the normal operation of military vessels. The Uniform National Discharge Standards program establishes national discharge standards for military vessels in U.S. coastal and inland waters extending seaward to 12 NM. Twenty-five types of discharges were identified as requiring some form of pollution control (e.g., a device or policy) to reduce or eliminate the potential for impacts. The discharges addressed in the program include ballast water, deck runoff, and seawater used for cooling equipment. For a complete list of discharges refer to 40 CFR part 1700.4.

The discharge standards are intended to reduce adverse environmental impacts associated with the discharges, stimulate the development of improved pollution control devices, and advance the development of environmentally compliant vessels. Uniform national discharge standards are being implemented in three phases. Phase I was completed in 1999, and the results of the Phase I analysis concluded that discharges addressed under the Uniform National Discharge Standards program will not have adverse impacts on water quality, sediments, or other resources, including biological resources. Phase II was divided into two batches. The Batch One Final Rule was published in the Federal Register on January 11, 2017. Batch Two is still under development, but the proposed discharge performance standards were published in the Federal Register on October 7, 2016. In Phase III, the DoD, in consultation with the EPA and U.S. Coast Guard, will establish regulations governing the design, construction, installation, and use of marine pollution control devices onboard vessels that must meet the performance standards promulgated in Phase II.

The U.S. Navy adheres to regulations outlined in the Uniform National Discharge Standards program; as such, the analysis of impacts in this Supplemental will be limited to potential impacts from training and testing activities, including impacts from military expended materials, but not impacts from discharges addressed under the Convention for the Prevention of Pollution from Ships (incorporated into U.S. law as 33 U.S.C. sections 1901–1915) or the Uniform National Discharge Standards program.

3.1.3 Affected Environment

The affected environment describes sediment quality and water quality in the Study Area, extending from inland waters to offshore, open-ocean areas and deep sea substrates. For purposes of this Supplemental, the Study Area for sediments and water quality remains the same as the areas identified in the 2015 NWTT Final EIS/OEIS. Existing sediment conditions are discussed in Section 3.1.3.1 (Sediments in the Study Area), followed by water quality in Section 3.1.3.4 (Water Quality in the Study Area).

The West Coast region described in the National Coastal Condition Assessment – 2010 (U.S. Environmental Protection Agency, 2016a), which includes the coastal areas of Washington, Oregon, and California, has a total area of over 2,200 square miles ($mi.^2$) and includes 410 estuaries, bays, and smaller estuarine areas. More than 60 percent of the West Coast region is part of three large estuarine systems—the San Francisco Estuary, the Columbia River Estuary, and Puget Sound (including the Strait of Juan de Fuca); only the Columbia River Estuary and Puget Sound are in the Study Area. Smaller, sub-estuary systems associated with these large systems make up another 27 percent of the West Coast region. The remaining West Coast waterbodies, combined, compose only 12 percent of the total coastal area of the region. Water quality in coastal and inland waters either within or adjacent to Puget Sound and the Columbia River Estuary—areas with a high human population density—heavily influence the overall water quality assessment for the Study Area.

Water quality is generally lower and the concentration of contaminants in coastal sediments is generally higher in densely populated areas (e.g., large coastal cities). The distribution of the human population along the West Coast region varies considerably, with higher population densities occurring in the Seattle–Tacoma area of Puget Sound, in the San Francisco Bay area, and along the Southern California coastline. In contrast, the coastline north of San Francisco Bay through northern Puget Sound (excluding the Seattle–Tacoma area) has a much lower population density.

3.1.3.1 Sediments in the Study Area

The physical characteristics of sediments and their transport into the Study Area are described in Section 3.1 (Sediments and Water Quality) of the 2015 NWTT Final EIS/OEIS and remain accurate and descriptive of current sediment conditions. Briefly, sediments deposited on the continental shelf are mostly transported by rivers, but transport also occurs along the shoreline by local and regional currents and by onshore winds. Most sediments in nearshore areas and on the continental shelf of the North Pacific Ocean are land-derived aluminum silicates transported into the Study Area and deposited at rates of approximately 10 centimeters per 1,000 years. Sediments are also produced locally by particulate organic matter (i.e., detritus) that sinks to the bottom (Chester, 2003). Many types of substances in the water column, both human made and naturally occurring, including contaminants, attach to particles that, over time, settle to the bottom and become incorporated into bottom sediments (Eggleton & Thomas, 2004; Kszos et al., 2003; Wurl & Obbard, 2004).

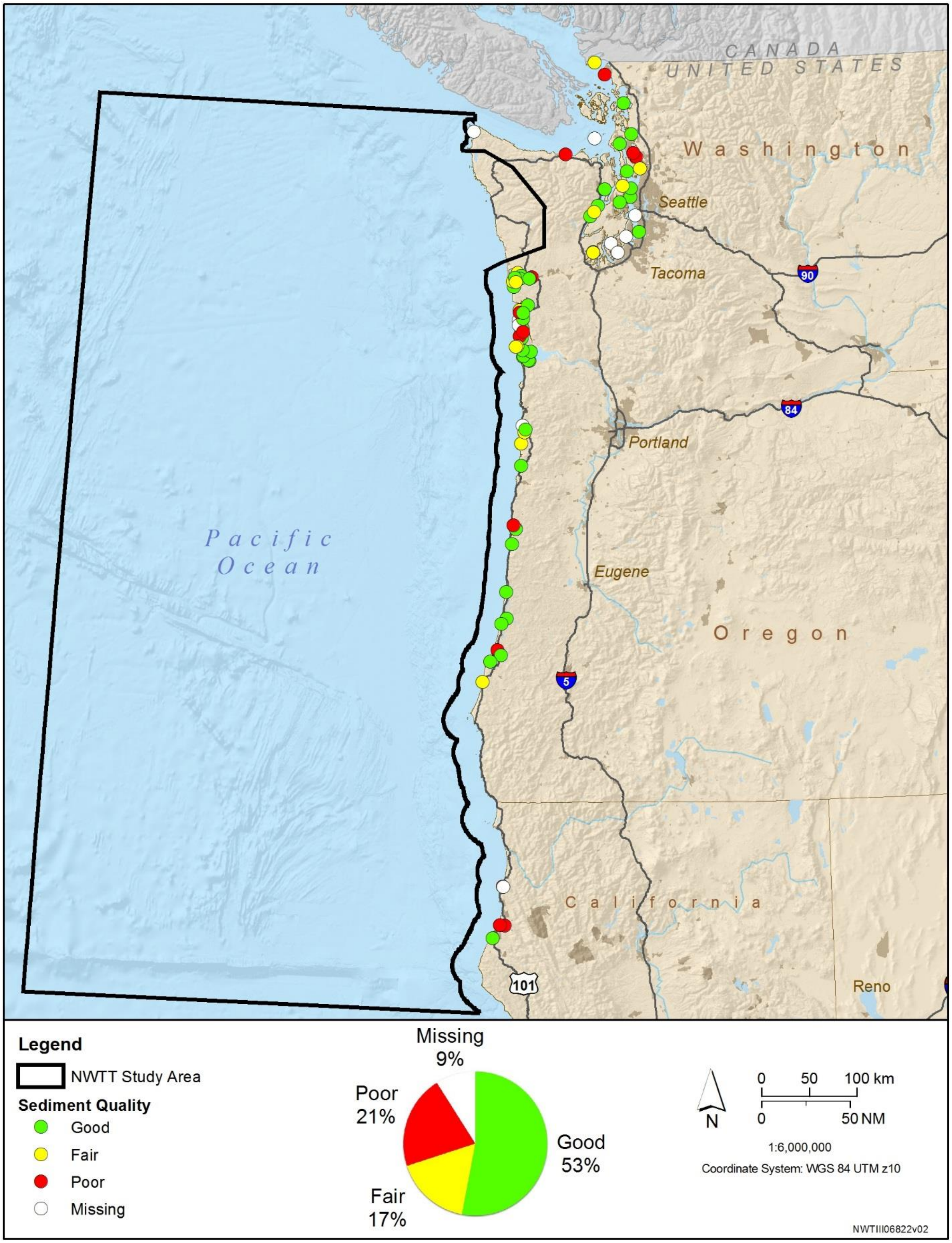
The following subsections discuss sediments for each region in the Study Area (Offshore Area; Inland Waters; and Behm Canal, Alaska). As noted above, the information and data on sediments in the West Coast region is primarily based on the National Coastal Condition Assessment – 2010 (U.S. Environmental Protection Agency, 2016a).

3.1.3.1.1 Sediments in the Offshore Area

Data on sediment quality are not available within the boundary of the Offshore Area, which begins 12 nautical miles from shore except for along portions of the Washington coastline where the boundary extends to shore. As described in Section 3.1.1 (Assessment of Sediments), the analysis assumes that sediment quality generally improves with distance from shore and anthropogenic sources of contaminants. Sediment quality in nearshore and estuarine areas along the coastline are used as a proxy for assessing sediment quality in the Offshore Area with the understanding that the offshore sediments are likely in better condition than the coastal sediments. The condition of sediments in the entire West Coast region extending from Puget Sound to the U.S.-Mexico border was rated 31 percent good, 23 percent fair, and 27 percent poor, with 19 percent of data reported missing (U.S. Environmental Protection Agency, 2016a). A classification of "missing" means that data for at least two sediment quality indicators are missing, and the available data do not suggest a fair or poor rating. Compared to sediment quality reported in the 2015 NWTT Final EIS/OEIS, the condition of sediments in the West Coast Region has declined; 89 percent of sediments were rated good in the 2012 National Coastal Condition Report (IV) (U.S. Environmental Protection Agency, 2012a). However, as discussed above, a comparison is not straightforward given that the criteria used to assess sediment quality have changed.

Within the portion of the West Coast region bordering the Study Area, the condition of sediments is rated higher, with 53 percent good, 17 percent fair, and 21 percent poor, with 9 percent of data reported missing (Figure 3.1-1). Sediment toxicity is the main contributor to poor sediment conditions. Just 57 percent of sediments rated good, 11 percent fair, and 21 percent poor for sediment toxicity, with 11 percent of data reported missing. Sediment toxicity measurements assess the additive and synergistic effects of chemical combinations, both human-derived and naturally occurring chemicals, and the ability of organisms to survive and reproduce in that environment (U.S. Environmental Protection Agency, 2016c). Sediment chemistry, which measures the effect of contaminant concentrations in sediments, was rated much higher at 88 percent good, 4 percent fair, and 0 percent poor, with 9 percent of data reported missing (U.S. Environmental Protection Agency, 2016d).

Some of the sites reporting poor sediment conditions were located north of the Columbia River Estuary, which is downstream of the major metropolitan area surrounding Portland, Oregon, and adjacent to Willapa Bay in Washington. Contaminants flowing downstream from Portland and into the Columbia River Estuary and adjacent coastal areas likely contribute to poor sediment conditions in this area (Figure 3.1-1).



Source: U.S. Environmental Protection Agency (2016a)

Figure 3.1-1: Sediment Quality Adjacent to the Offshore Region of the Study Area

3.1.3.1.2 Sediments in the Inland Waters

The condition of sediments in the Inland Waters region of the Study Area, including the Strait of Juan de Fuca, Puget Sound, Hood Canal, and surrounding the San Juan Islands, is reported as 46 percent good, 19 percent fair, and 15 percent poor, with 19 percent of data reported missing (Figure 3.1-2). Similar to the coastal sediments, poorly rated sediment conditions in the Inland Waters region is driven more by sediment toxicity than the mean concentrations of contaminants in sediments (i.e., sediment chemistry). Fifty-four percent of sediments were rated good for toxicity, 19 percent poor, and 26 percent of data were reported missing. By contrast, 77 percent of sediments in the Inland Waters region were rated good for sediment chemistry and4 percent were rated fair, with 19 percent of data reported missing. No sediments were rated poor for sediment chemistry (U.S. Environmental Protection Agency, 2016d). The Washington State Department of Ecology surveys sediment quality in Washington State inland waters, including the eastern portion of the Strait of Juan de Fuca, Puget Sound, the San Juan Islands, Whidbey Island Basin, Bainbridge Basin, and Admiralty Inlet. The most recent survey results for each of these areas that have become available since the 2015 NWTT Final EIS/OEIS are summarized below.

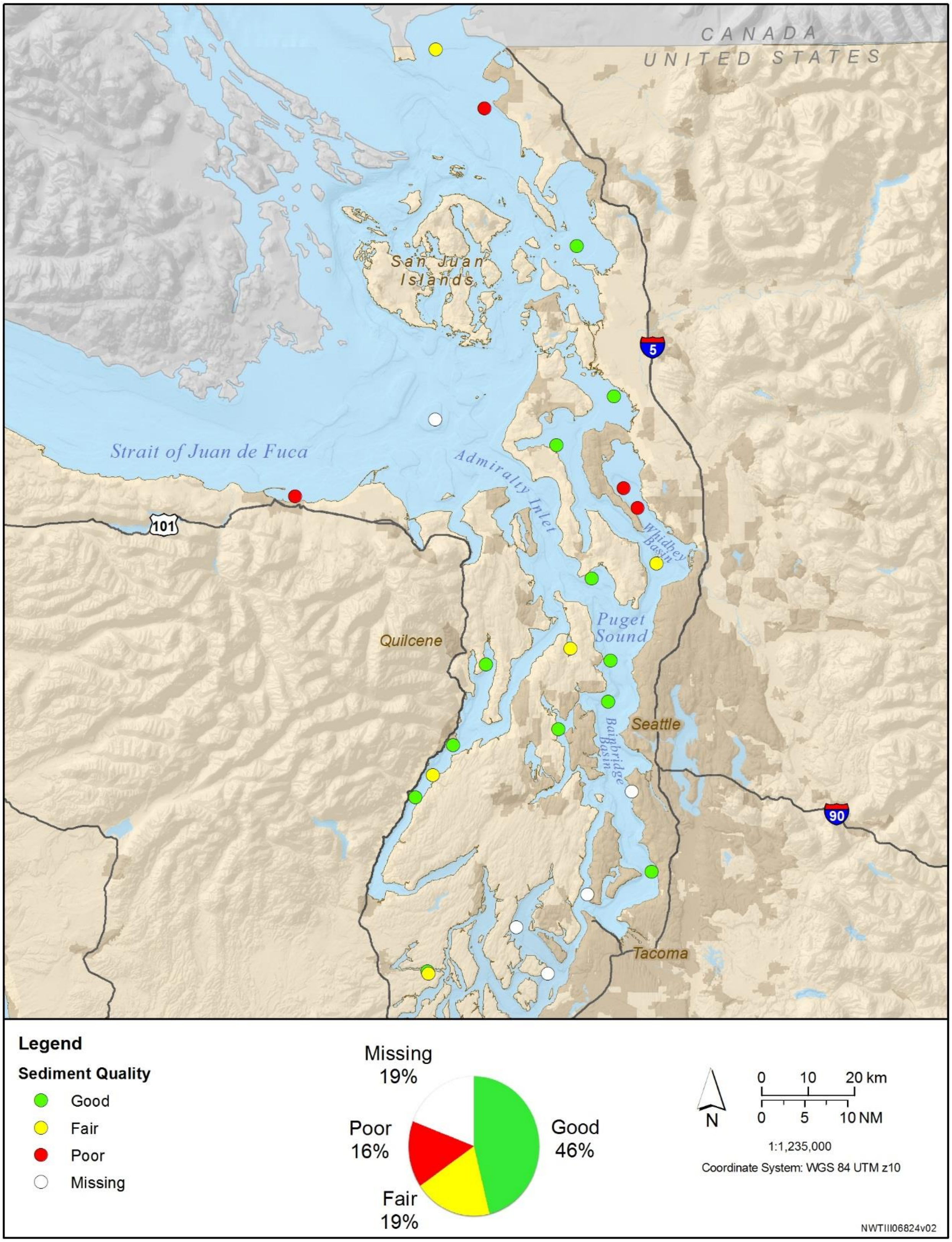
Sediment contaminant concentrations, sediment toxicity, and benthic invertebrate data were collected from multiple locations in each area and combined into indices measuring sediment chemistry, toxicity, benthic invertebrate conditions, and a triad index, which combines the three other measurements.

3.1.3.1.2.1 Eastern Strait of Juan de Fuca

Overall, sediment quality in the eastern Strait of Juan de Fuca has not changed significantly over the 10-year period from 2003 to 2013, based on samples collected from 40 randomly selected sites (Weakland et al., 2015). Sediment chemistry in 2013 was rated 97 percent good and 3 percent fair and above target thresholds. While areas rated good for sediment toxicity decreased between 2003 and 2013, and areas rated poor and fair increased, the differences were not statistically significant. The benthic index remained unchanged between 2003 and 2013 and continued to indicate that 64 percent of benthic invertebrates were adversely affected by benthic conditions. The triad index remained below target thresholds in 2013. The percentage of unimpacted sediments (36 percent) remained the same as in 2003, and the percentage of “possibly impacted” and “inconclusive” areas increased slightly.

3.1.3.1.2.2 Puget Sound

Overall, sediment quality in south Puget Sound (south and west of the Tacoma Narrows) as of 2011 remained unimpacted in about two-thirds of the areas sampled, which is approximately the same as in 1999, based on samples collected from 55 randomly selected sites (Partridge et al., 2014a). Both the sediment chemistry and triad indices were above target thresholds in 1999 and 2011. The largest change was in the sediment toxicity index, which showed that 97 percent of sampled areas were rated as non-toxic in 1999 and just 48 percent rated as non-toxic in 2011. Low-to-moderate toxicity occurred in 43 percent of sediment samples, and one site in Budd Inlet, northeast of Olympia, was rated as having high toxicity in the 2011 data.



Source: U.S. Environmental Protection Agency (2016a)

Figure 3.1-2: Sediment Quality in the Inland Waters Region of the Study Area

Sediment samples collected from 80 locations in the central Puget Sound, from Possession Sound south to Tacoma Narrows and including Seattle and Tacoma, in 1998–1999 were compared to samples collected in 2008–2009 (Partridge et al., 2013a). Overall, sediment quality in central Puget Sound decreased over the 10-year period. The change was driven by a decrease in the benthic index, indicating that a larger portion of benthic invertebrate communities in central Puget Sound were classified as adversely affected by natural and human-related stressors in the 2008–2009 samples. Also, the spatial extent of likely impacted sediments (a metric of the triad index) increased and the extent of unimpacted sediments decreased. Sediments with high toxicity measurements were located at stations in Sinclair Inlet (near Bremerton), Dyes Inlet, and Liberty Bay.

3.1.3.1.2.3 San Juan Islands

Overall, sediment quality in the San Juan Islands did not change between surveys in 2002–2003 and surveys in 2012, based on samples collected from 40 randomly selected sites (Partridge et al., 2014b). Sediment quality remained high in 2012. All survey areas had minimum exposure to chemical contaminants, 92 percent of sediments had no toxicity (the remaining 8 percent had low toxicity), and the triad and chemistry indices met or exceeded target thresholds.

3.1.3.1.2.4 Admiralty Inlet

Overall, sediment quality in Admiralty Inlet decreased between baseline surveys conducted in 1998 and 2002–2003 and surveys conducted in 2014, based on samples collected from 43 randomly selected sites (Weakland et al., 2016). Even with the decrease in sediment quality, target thresholds for sediment chemistry and the triad index were exceeded in 2014 (as they were in the baseline survey years). One hundred percent of sampled areas in the baseline surveys were reported as having minimum exposure to sediment contaminants, as measured by the Sediment Chemistry Index. In 2014, only 76 percent were reported as having minimum exposure and the remaining 24 percent were determined to have low exposure to contaminants. A decrease in the benthic index, indicating that a larger portion of benthic invertebrate communities in Admiralty Inlet were classified as adversely affected in the 2014 samples, was the driver reducing overall sediment quality. In the baseline surveys, just 4 percent of sampled areas were rated adversely affected by natural and human-related stressors, and in 2014 the portion increased to 23 percent.

3.1.3.1.2.5 Bainbridge Basin

Overall, sediment quality in Bainbridge Basin (west of Bainbridge Island) declined between surveys conducted in 1998 and surveys conducted in 2009, based on samples collected from 33 randomly selected sites (Weakland et al., 2013). The sediment chemistry index (measuring contaminant concentrations) remained consistent over the 11-year period. However, sediment toxicity increased, benthic conditions declined, and the triad index showed that the percentage of likely impacted sediments increased from 0 percent in 1998 to 16 percent in 2009. Likely impacted sediments occurred in Liberty Bay, southern Dyes Inlet, Phinney Bay, and adjacent to the southern shore of Sinclair Inlet.

3.1.3.1.2.6 Whidbey Basin

Overall, sediment quality in Whidbey Basin remained the same between baseline surveys conducted in 1997 and surveys conducted in 2007, based on samples collected from 40 randomly selected sites (Partridge et al., 2013b). While overall sediment quality remained consistent over the 10-year period, the four individual indices (sediment chemistry, toxicity, benthic conditions, and the triad index) all showed statistically significant improvements. The percentage of sediments with minimum exposure to contaminants improved from 91 percent in 1997 to 97 percent in 2007. Sediments sampled near Everett that were rated to have moderate to maximum exposure to chemical contaminants in 1997 were rated as having low exposure in 2007. The percentage of non-toxic sediments in Whidbey Basin increased slightly from 94 percent to 95 percent over the 10 years. Sediments at one sample site near Everett were determined to have high toxicity; however, this was an improvement over the 1997 results when multiple sites were rated to have high toxicity. Benthic conditions improved in Whidbey Basin from 1997 to 2007, but 53 percent of sampled sediments remained adversely affected by natural and human-caused stressors.

3.1.3.1.3 Sediments in Western Behm Canal

Sediments in southeast Alaska were not included in the recent National Coastal Condition Assessment – 2010 report (U.S. Environmental Protection Agency, 2016a). Data from the National Coastal Condition Report IV (U.S. Environmental Protection Agency, 2012a), were reported in Section 3.1 (Sediments and Water Quality) of the 2015 NWTT Final EIS/OEIS, and at that time sediment conditions in southeast Alaska were rated 92 percent good and 8 percent fair. There is no scientifically derived data reporting that conditions have changed appreciably since 2015.

3.1.3.2 Marine Debris, Military Expended Materials, and Marine Sediments

A comprehensive review of anthropogenic marine debris, particularly plastics, and their worldwide distribution highlights the growing concern over global environmental impacts and the need for continued scientific research and improved waste disposal management practices (Bergmann et al., 2015). Since the publication of the 2015 NWTT Final EIS/OEIS, which reported on marine debris collected during groundfish surveys in 2007 and 2008, including items of military origin (Keller et al., 2010), the predominance of plastics, and particularly microplastics has become the focus of research on the impacts of anthropogenic debris on the marine environment (Bergmann et al., 2015).

From the early 1970s to the mid-2000s the amount of marine debris that has accumulated in the North Pacific from latitude 25 to 41°N and longitude 130 to 180°W, an area known as the "Garbage Patch," has increased by more than 100 times to a concentration of 459 pieces per square kilometer (Bergmann et al., 2015; Titmus & Hyrenbach, 2011; Venrick et al., 1973). Over 95 percent of that debris was composed of plastics (Titmus & Hyrenbach, 2011), highlighting the critical importance of improving our understanding of how plastics behave in the marine environment and how they impact marine species and habitats, including seafloor sediments.

Many types of plastic are buoyant and will float for years or indefinitely, depending on size and composition, allowing them to be transported thousands of miles in the ocean (U.S. Commission on Ocean Policy, 2004). Although plastics are highly resistant to degradation, when exposed to ultraviolet radiation from the sun they will gradually break down through a process called photo oxidation. However, once plastic debris sinks below the photic zone, degradation rates become much slower, and degradation rates are further reduced once plastic debris reaches the seafloor (Cauwenberghe et al., 2013; Law et al., 2010). Microbial degradation of plastics in marine sediments does occur but has a negligible impact on the amount of plastic that persists in the environment, because the process is slow and often occurs under low-oxygen or even anoxic conditions (Andrady, 2015). Plastics can take hundreds of years to degrade; some plastics may never fully degrade and would persist in the environment indefinitely (Bergmuller et al., 2007).

Microplastics (pieces < 1 millimeter [mm] in size) are pervasive in the marine environment and occur not only in coastal sediments and on the continental shelf but have recently been discovered in deep sea sediments at multiple locations worldwide in depths ranging up to 5,000 m (Cauwenberghe et al., 2013;

Woodall et al., 2014). The average concentration of microplastics in deep sea sediments is estimated to be 200 pieces/m^2; however, this estimate is based on a limited number of samples and could vary widely (Cauwenberghe et al., 2013). No sampling of deep sea sediments has been conducted in the Study Area, but given the accumulation of microplastics in other ocean basins and in surface waters in the Study Area (Doyle et al., 2010) it is likely that microplastic debris is also present in the deep sea sediments of the Study Area.

3.1.3.3 Climate Change and Sediments

Climate change can affect sediments by increasing ocean acidity (i.e., lowering pH), changing storm activity, and influencing coastal upwelling (Cao et al., 2014; Wang et al., 2015). Breitbarth et al. (2010) referred to seawater temperature and pH as "master variables for chemical and biological processes." As pH decreases and conditions become more acidic, metals tend to dissociate (or detach) from sediment particles to which they are bound, becoming more soluble, and reenter the water column. Higher concentrations of metals in the water column may become more bio-available and lead to concerns over toxicity in biological resources, including those at higher trophic levels (Poloczanska et al., 2016).

Climate change and the associated warming of sea surface temperatures in the oceans is likely to increase the occurrence of more intense tropical cyclones and major storms (National Oceanic and Atmospheric Administration, 2017). Major storms can cause substantial resuspension and redistribution of bottom sediments, particularly in shallow nearshore and inland waters (Wren & Leonard, 2005). Subsequently, disturbance of marine sediments can adversely impact water quality in nearshore and coastal areas where excess turbidity reduces water clarity, and contaminants imbedded in sediments are resuspended and become more widely distributed. In the Pacific Northwest, climate change may alter the coastal marine environment by increasing water temperature, vertical stratification in the water column, and the number of extreme precipitation events; and by changing the intensity and timing of coastal winds that drive all-important upwelling events (Wang et al., 2015; Wang et al., 2009). These climate-related phenomena would not occur independently of each other and could potentially accelerate the onset of climate change effects on the marine environment should they occur synergistically (Poloczanska et al., 2016).

It is important to note that the effects of climate change on the marine environment overall are projected with a high degree of uncertainty (Cao et al., 2014). An apparent hiatus in the warming trend of sea surface temperatures in both the North Atlantic and North Pacific over the last decade has caused climate scientists to reconsider climate models that have been projecting an increase in temperature. Recently, researchers concluded that the warming trend has been obscured by naturally occurring variability in climate cycling (referred to as the Pacific Multi-decadal Oscillation in the North Pacific), which drives a decrease in sea surface temperatures, offsetting and obscuring the projected warming associated with climate change (England et al., 2014; Steinman et al., 2015). Once these naturally occurring oscillations reverse, the warming trend is expected to resume and potentially be accelerated by the contribution of human-associated greenhouse gas emissions. Further discussion on the effects of climate change is provided in Section 3.1.3.6 (Climate Change and Marine Water Quality) and in the 2015 NWTT Final EIS/OEIS.

3.1.3.4 Water Quality in the Study Area

The status of water quality in the Study Area remains largely the same as described in Section 3.1 (Sediments and Water Quality) of the 2015 NWTT Final EIS/OEIS. As noted above in Section 3.1.2

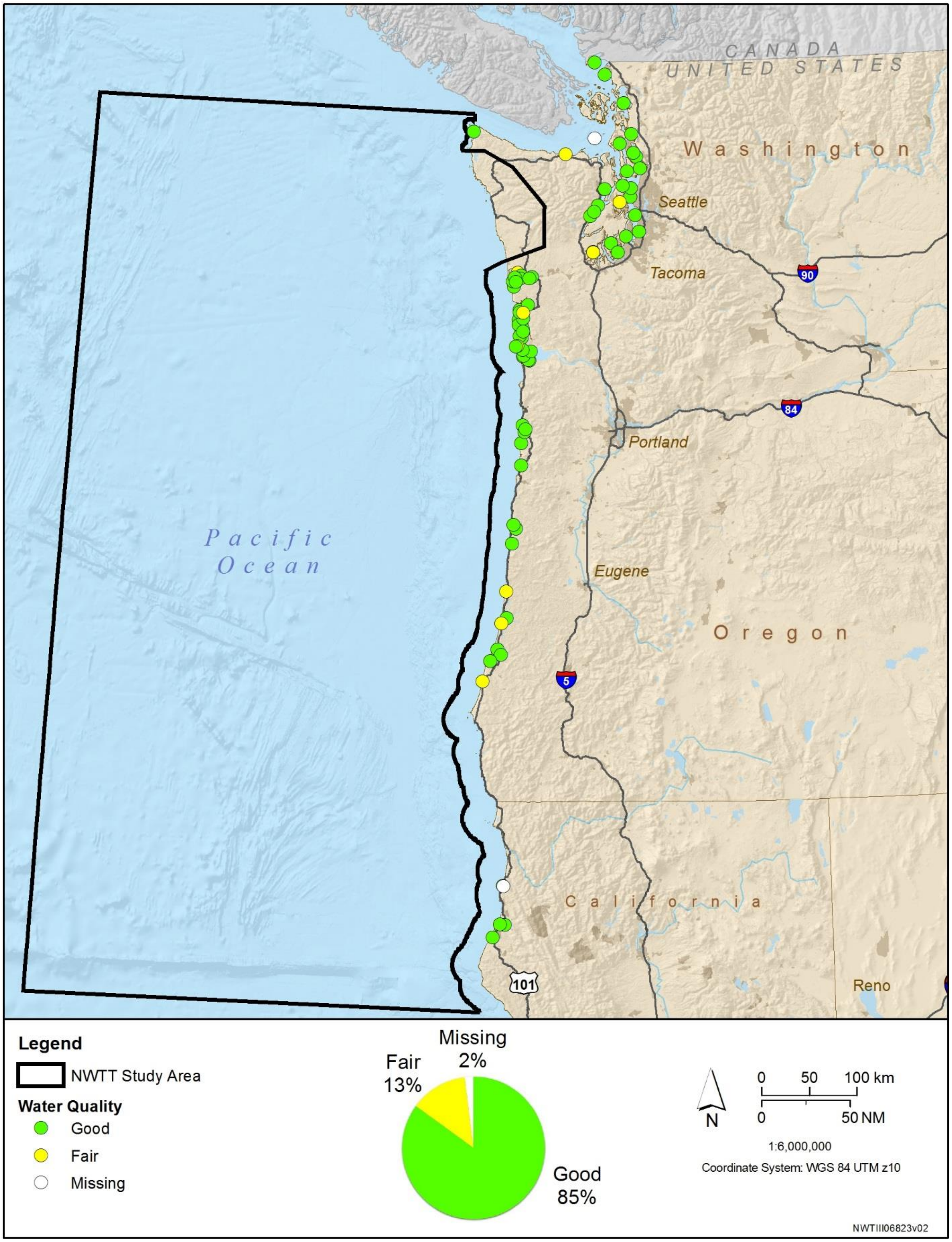
(Assessment of Water Quality), the criteria for evaluating water quality have not changed since publication of the 2015 NWTT Final EIS/OEIS (U.S. Environmental Protection Agency, 2016c).

In general, the environmental contaminants that degrade marine water quality in the Study Area include suspended solids, sediments, nutrients and organic materials (i.e., detritus), metals, synthetic organic compounds (e.g., pesticides and plastics), and pathogens. Sources of these contaminants include runoff from urban and agricultural areas (nonpoint source pollution), commercial and recreational vessels, oil spills, industrial and municipal discharges (point source pollution), legal and illegal ocean dumping, and poorly treated or untreated sewage released into coastal waters (U.S. Environmental Protection Agency, 2016a).

3.1.3.4.1 Water Quality in the Offshore Area

As described in the 2015 NWTT Final EIS/OEIS, water quality in the Offshore Area is influenced by ocean circulation patterns in the North Pacific, particularly the California Current System; freshwater inflow from the Columbia River; large-scale eddies like the semi-permanent eddy off the mouth of the Strait of Juan de Fuca; and prevailing winds (onshore vs. offshore) (Hickey & Banas, 2003).

In the National Coastal Condition Assessment – 2010 report, the water quality index for coastal waters adjacent to the Offshore Area was rated 85 percent good, 13 percent fair, with 2 percent of data reported missing (Figure 3.1-3) (U.S. Environmental Protection Agency, 2016a). As described above, the water quality index is based on measurements of five component indicators: dissolved inorganic nitrogen, dissolved inorganic phosphorous, chlorophyll-*a*, water clarity, and dissolved oxygen. In coastal waters adjacent to the Offshore Area, all indicators except for chlorophyll-*a* concentrations improved from the 2005-2006 survey results to the 2010 survey results as reflected by increases in the percentage of "good" ratings (U.S. Environmental Protection Agency, 2016a). Chlorophyll-*a* concentrations, the one indicator that declined, were rated 55 percent good, 42 percent fair, and 2 percent poor with the remaining 2 percent of data reported missing (U.S. Environmental Protection Agency, 2016b). Chlorophyll-*a* is a surrogate metric for phytoplankton concentrations in surface waters and may be indicative of algal blooms or an elevated abundance of phytoplankton. Overall, coastal waters were rated 96 percent good for both dissolved inorganic nitrogen and dissolved inorganic phosphorus, and 94 percent good for dissolved oxygen. Light transmission, a measure of water clarity, was rated 77 percent good (U.S. Environmental Protection Agency, 2016b).



Source: U.S. Environmental Protection Agency (2016a)

Figure 3.1-3: Water Quality Adjacent to the Offshore Region of the Study Area

3.1.3.4.2 Water Quality in the Inland Waters

Water quality in the Inland Waters region of the Study Area, including the Strait of Juan de Fuca, Puget Sound, Hood Canal, and surrounding the San Juan Islands, is reported as 81 percent good, 15 percent fair, with 4 percent of data reported missing (Figure 3.1-4) (U.S. Environmental Protection Agency, 2016b). The chlorophyll-*a* indicator declined for the entire West Coast region in the National Coastal Condition Assessment-2010, and In the Inland Waters portion of the Study Area, just 50 percent of sites were rated good for chlorophyll-*a* (U.S. Environmental Protection Agency, 2016b). At the remaining sites, chlorophyll-*a* was rated 38 percent fair, 4 percent poor, and 8 percent of data were reported missing (U.S. Environmental Protection Agency, 2016a, 2016b). In contrast, dissolved inorganic nitrogen was rated good at 93 percent of sites, dissolved inorganic phosphorous was rated good for 81 percent of sites, dissolved oxygen was rated good at 62 percent of sites, and light transmission was rated good at 92 percent of sites (U.S. Environmental Protection Agency, 2016b). These conditions are similar to those reported in the 2015 NWTT Final EIS/OEIS, which highlighted eutrophication (linked to high chlorophyll-a concentrations) and low dissolved oxygen levels as issues of concern in the Inland Waters area. Anthropogenic influences including urban runoff, treated effluent, and agricultural runoff, coupled with low levels of mixing and flushing in much of south Puget Sound continue to cause and exacerbate poor water quality conditions.

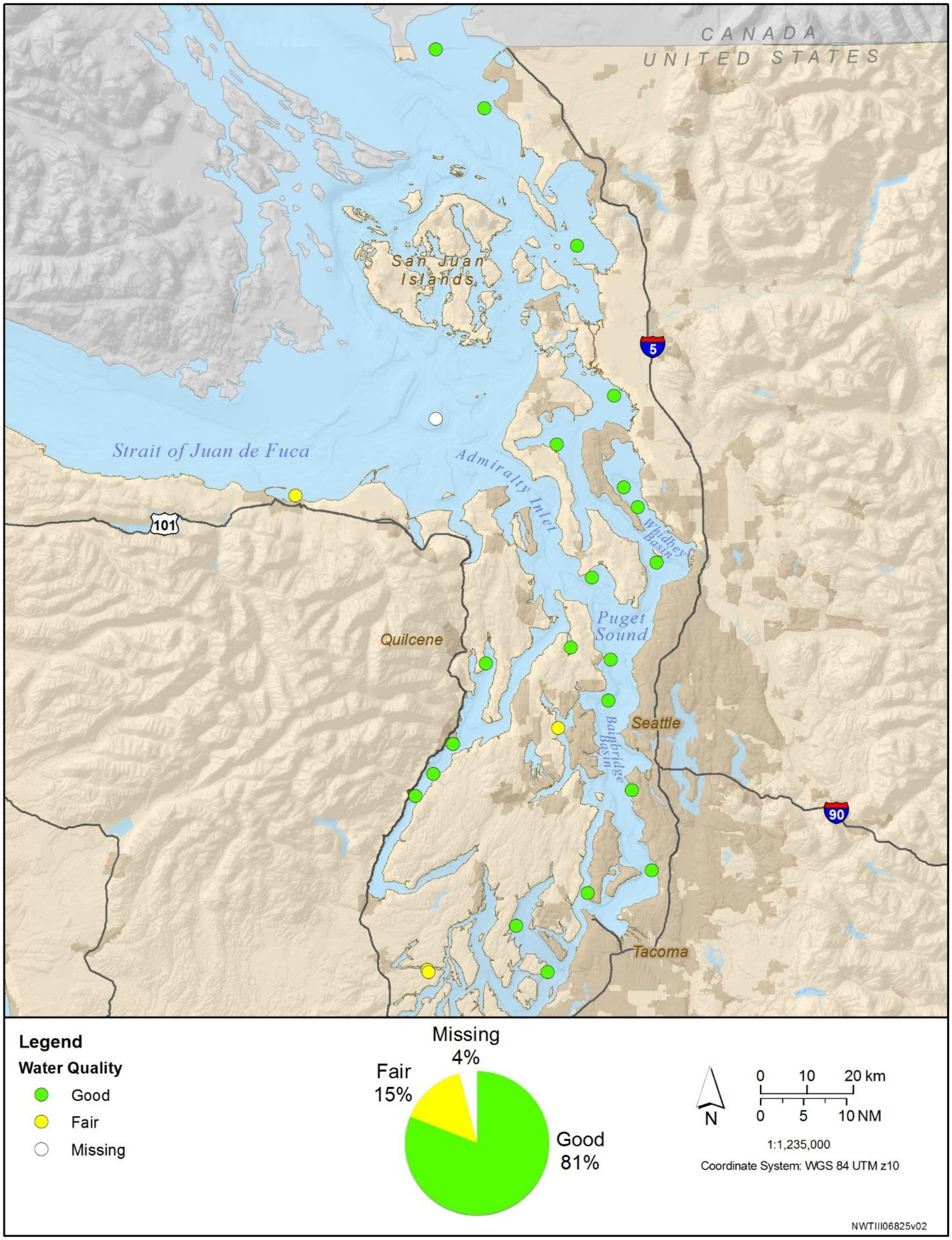
3.1.3.4.3 Water Quality in Western Behm Canal

Water quality in southeast Alaska was not included in the recent National Coastal Condition Assessment – 2010 report (U.S. Environmental Protection Agency, 2016a). Data from the National Coastal Condition Report IV (U.S. Environmental Protection Agency, 2012a), were reported in Section 3.1 (Sediments and Water Quality) of the 2015 NWTT Final EIS/OEIS, and at that time sediment conditions in southeast Alaska were rated 95 percent good and 5 percent fair.

3.1.3.5 Marine Debris and Marine Water Quality

Plastic debris has been accumulating in the marine environment for decades and will continue to do so as the production and disposal of plastic products and materials continues to grow worldwide (Bergmann et al., 2015; Cozar et al., 2014; Doyle et al., 2010). Plastic debris accumulates in surface waters in the open ocean mainly but not exclusively at convergence zones associated with the large subtropical gyres that dominate circulation in the ocean basins (Cozar et al., 2014). Plankton surveys conducted in 2006 and 2007 off the U.S. West Coast, including in the Study Area, and in the southeast Bering Sea off the coast of Alaska, documented the ubiquitous distribution and persistence in the marine environment of plastic debris, particularly plastic particles < 2.5 mm in size (Doyle et al., 2010).

Comparatively little information is available on the types and abundance of marine debris occurring in coastal waters near unpopulated areas and on remote beaches, including portions of the Study Area. However, Davis and Murphy (2015) summarized the results of two independent studies quantifying the distribution of plastic debris along the Inside Passage to Skagway, Alaska, and in inland waters of British Columbia, Canada, and northern Washington, including the Strait of Juan de Fuca and Puget Sound. No plastic debris was collected at a number of sites along the Inside Passage; however, a concentration of up to 200,000 pieces per square kilometer was found in surface waters off Ketchikan, which is located approximately 15 miles south of the Southeast Alaska Ocean Measurement Facility in Western Behm Canal. Ninety-five percent of all debris collected from surface waters during the survey consisted of micro polystyrene foam (< 5 mm in size) and another 1.4 percent consisted of larger pieces of polystyrene foam (Davis & Murphy, 2015).



Source: U.S. Environmental Protection Agency (2016a)

Figure 3.1-4: Water Quality in the Inland Waters Region of the Study Area

Polasek et al. (2017) conducted a survey of five National Park Service areas located along the western and southern coasts of Alaska. While the survey areas were all located north of Behm Canal, the ocean circulation in the Gulf of Alaska and the eastern North Pacific is such that similar types of debris could be transported to the beaches and coastal areas of southeast Alaska. All 28 beaches that were surveyed had marine debris. Hard plastic debris was found on all beaches, and foam (polystyrene) was found at every beach except for one. Various types of rope or netting were present on 23 of the 28 beaches.

Marine debris is also routinely collected along Washington beaches including those adjacent to the Olympic Coast National Marine Sanctuary. Since the earthquake and tsunami that struck Japan in 2011, there has been an increase in the amount of debris slowly moving across the North Pacific and being deposited on beaches and in coastal areas of North America (National Oceanic and Atmospheric Administration, 2016).

Overall, plastic contributed to 60 percent of the total weight of all debris. Given the amount of and nearly universal occurrence of plastic debris found during the survey, it is probable that similar types of debris occur in or near Behm Canal.

Specifically for the Inland Waters, over 600 citizen scientists collected microdebris from sandy beaches, including the eastern portion of the Strait of Juan de Fuca, the San Juan Islands, Puget Sound, and Hood Canal, twice per year from the fall of 2008 through the spring of 2011 (Davis & Murphy, 2015). The surveys were systematic, employing a quadrant-based sampling method, and supervised by researchers to maintain strict protocols. While beaches are not part of the Study Area, debris found at the high tide line on beaches and other shoreline areas are indicative of the types and quantities of debris in the marine and estuarine habitat of the Study Area. Debris was found on 363 of the 402 quadrants (over 90 percent) that were surveyed on 37 beaches in the Inland Waters portion of the Study Area. Pieces of foam (polystyrene) comprised nearly 70 percent of the total count, and plastic fragments and glass made up 11 percent each. Based on these results, Davis and Murphy (2015) estimate that 72 million pieces of debris weighing 5.8 tons are located in a 1 m wide band stretching along all 733 miles of sandy beach habitat in the Salish Sea (which includes the Inland Waters area). This total almost certainly underestimates the total amount of debris in the coastal area, because it excludes debris washed up on other shoreline habitats (e.g., rocky or muddy areas), which make up the remaining 1,733 mi. of coastline. The authors also concluded that debris in the Salish Sea is from local sources and not transported into inland waters from the Pacific Ocean.

3.1.3.6 Climate Change and Marine Water Quality

Marine water quality may be affected in several ways by climate change, such as a decrease in ocean pH (i.e., increasing ocean acidity), a rise in sea surface temperatures, and an increase in the frequency and intensity of extreme storms. As noted above in Section 3.1.3.3 (Climate Change and Sediments), changes in sediment chemistry and disturbance and resuspension of sediments can reduce water quality by increasing turbidity (reducing water clarity), resuspending contaminants, and enabling contaminants to dissociate from particulate matter and remain in the water column (Cao et al., 2014; Schiedek et al., 2007; Wang et al., 2015). Similar effects of climate change on freshwater ecosystems upstream of coastal and inland estuarine waters can exacerbate the direct impacts from climate change on those water bodies (Whitehead et al., 2009).

Marine invertebrates that use calcium carbonate to construct and maintain their shells and skeletal structures (e.g., corals and cocolithophores—a single-celled phytoplankton) are particularly susceptible to increases in ocean acidity, which is a projected effect of climate change (Poloczanska et al., 2016).

Nevertheless, it is unclear how the combination of decreasing pH and increasing water temperatures affect these organisms, which are an important component of the global food chain (McNeil et al., 2004; Poloczanska et al., 2016; Rivero-Calle et al., 2017). Increases in ocean acidity are believed to reduce the availability of carbonate in the water column, which is needed by organisms to generate calcium carbonate structures. However, increases in sea surface temperature associated with climate change appear to stimulate calcification at an even greater rate, essentially overriding the inhibiting effects of lower pH levels (McNeil et al., 2004) and leading to unexpected high abundance of cocolithophores in some ocean regions (Rivero-Calle et al., 2017).

Concerns over climate change modifying the U.S. West Coast upwelling patterns, increasing levels of hypoxia and resulting in ocean acidification have generated targeted research and monitoring efforts at selected "Sentinel Sites" (Lott et al., 2011). The Olympic Coast National Marine Sanctuary, located along the coast of Washington State and extending between 20 and 40 nautical miles offshore, is one of these monitored sites. Scientific uncertainty remains about how and to what degree the effects of climate change will impact water quality and marine species, but acidification of ocean waters could potentially impact the carbon cycle in the ocean and limit the bioavailability of calcium carbonate, which would have implications for organisms at or near the bottom of the marine food chain.

Phytoplankton blooms, including toxic harmful algal blooms, can be characterized on a large scale using satellite-based remote sensing of chlorophyll-*a* concentrations, another metric for assessing water quality, as noted above (Harvey et al., 2015). However, even non-toxic blooms can cause devastating impacts on the ecosystems in bays and estuaries by creating anoxic (low dissolved oxygen) conditions, which are known to result in large and rapid die-offs of fish and benthic invertebrates (Hallegraeff, 2010). The persistence, location, and extent of plankton blooms are influenced by many of the impacts associated with climate change, including pH, sea surface temperature, and storms.

Changes in the chemistry and temperature of marine waters associated with changes in the global climate are already having dramatic effects on marine ecosystems worldwide, including on the planktonic eggs and larval stages of fish and invertebrates in the California Current Ecosystem (Poloczanska et al., 2016). For some species, changing conditions are resulting in shifts in the timing and location of spawning.

3.1.4 Environmental Consequences

Section 3.1 (Sediments and Water Quality) of the 2015 NWTT Final EIS/OEIS analyzed potential impacts of training and testing activities resulting from the following stressors: (1) explosives and explosion byproducts, (2) metals from ordnance and military expended materials, (3) chemicals other than explosives, and (4) other materials. The 2015 NWTT Final EIS/OEIS assessed the likelihood that these stressors would result in the following potential impacts on sediments and water quality:

- The potential release of materials into the water that subsequently disperse, react with seawater, or dissolve over time
- The potential for depositing materials on the seafloor and any subsequent interactions with sediments or the accumulation of such materials over time
- The potential for depositing materials or substances on the seafloor and any subsequent interaction with the water column
- The potential for depositing materials on the seafloor and any subsequent disturbance of those sediments resulting in their resuspension into the water column.

This section evaluates how and to what degree potential impacts on sediments and water quality from stressors described in Section 3.0.1 (Overall Approach to Analysis) may have changed since the analysis presented in the 2015 NWTT Final EIS/OEIS was completed. Tables 2.5-1 through 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 described in the 2015 NWTT Final EIS/OEIS so that the incremental changes in the proposed levels of training and testing can be easily identified.

Tables B-1 and B-2 in Appendix B (Activity Stressor Matrices) show which stressors are associated with each proposed training and testing activity and show that many of the proposed activities introduce stressors on sediments and water quality. The annual number and location of activities and items that include various types of stressors that could impact sediments and water quality are shown in Tables 3.0-12 through 3.0-22. Activities using non-explosive practice munitions, for example, (Table 3.0-14) have the potential to impact sediments. The analysis presented in this section also considers the Navy's standard operating procedures described in Chapter 2 (Description of Proposed Action and Alternatives) and mitigation measures described in Chapter 5 (Mitigation) and Appendix K (Geographic Mitigation Assessment). These measures are not specifically designed to offset potential impacts on sediments or water resources; however, implementation of some of these measures intended to mitigate potential impacts on other marine resources analyzed in this Supplemental will minimize or avoid potential impacts on sediments and water quality. For example, Table 5.4-1 lists several protective measures that avoid or minimize disturbance to sensitive habitats (i.e., kelp beds, eel grass, hard bottom areas, and shipwrecks), and these measures would also reduce the disturbance of sediments on the seafloor.

The following stressors are analyzed in this Supplemental:

- Explosives and explosives byproducts
- Metals
- Chemicals other than explosives
- Other materials

Although stressor names may have changed slightly to remain consistent with other resource sections in this Supplemental, the types of items associated with each stressor are consistent with the items associated with stressors analyzed in the 2015 NWTT Final EIS/OEIS.

3.1.4.1 Explosives and Explosives Byproducts

Explosives are complex chemical mixtures that may affect sediments and water quality through the byproducts of their in-water detonation or through the dispersal of unconsumed explosives into the water column or sediments. Explosive munitions may undergo a high-order detonation or a low-order detonation, or they may fail to detonate. High-order (complete) detonations consume 98–99 percent of the explosive material; the remainder is released into the environment as discrete particles. Low-order (incomplete) detonations consume a lower percentage of the explosive and release larger amounts of explosives materials into the environment. If a munition fails to detonate, the energetic materials it contains may be released into the environment over time as the munitions casing corrodes. In this discussion, the term "residual explosives" means unconsumed explosives remaining after low-order detonations and detonation failures. The term "explosives byproducts" is used to refer to the liquids and gases that remain after detonation of explosives.

Potential impacts from explosives and explosives byproducts on sediments and water quality were analyzed in detail in Section 3.1.3.1 (Explosives and Explosion Byproducts) in the 2015 NWTT Final EIS/OEIS. The discussion presented below summarizes the results of that analysis and cites studies published since the completion of the 2015 NWTT Final EIS/OEIS.

Over 98 percent of residual explosive materials introduced into the marine environment would result from munitions failures. The remaining 2 percent results from low-order detonations. Failure rates for munitions similar to the munitions used in training and testing activities are between 3 and 5 percent, and low-order detonation rates are less than 0.2 percent (see Table 3.1-8 in the 2015 NWTT Final EIS/OEIS). The majority of explosives byproducts from commonly used explosives materials are naturally occurring compounds in the marine environment. For example, 98 percent (by weight) of the explosives byproducts of royal demolition explosive (RDX) consistent of nitrogen, carbon dioxide, water, carbon monoxide, ammonia, and hydrogen (see Table 3.1-7 in the 2015 NWTT Final EIS/OEIS).

The analysis that follows focuses on explosives contained in unexploded munitions. In the event of a munitions failure, the explosive materials would remain encased in the intact munition and would have little or no direct exposure to marine waters. Over time, the munitions casing may corrode and ultimately expose explosive materials to adjacent sediments and the water column. Explosive materials deposited in sediments would be limited to small areas surrounding and adjacent to the munition. Bottom currents would be expected to transport and disperse explosive materials that leach into the water column slowly over time. As described in detail in Section 3.1.3.1 (Explosives and Explosion Byproducts) in the 2015 NWTT Final EIS/OEIS, the solubility, sorption, and volatility of explosive materials are key factors determining how these materials behave in the marine environment. Unconsumed explosives used in training and testing activities would dissolve slowly over time and thus are not very mobile in marine environments (Juhasz & Naidu, 2007).

According to Walker et al. (2006), trinitrotoluene, RDX, and octogen (HMX) experience rapid biological and photochemical degradation in marine systems. The authors noted that productivity in marine and estuarine systems is largely controlled by the limited availability of nitrogen. Because nitrogen is a key component of explosives, they are attractive as substrates for marine bacteria that metabolize other naturally occurring organic matter such as polycyclic aromatic hydrocarbons. Juhasz and Naidu (2007) also noted that microbes use explosives as sources of carbon and energy.

There have been no comprehensive studies of the fate and transport of residual explosives residing on the seafloor in the Study Area, and in this instance a site-specific study is not imperative due to the analysis of potential impacts on sediments and water quality completed in similar marine environments. Research conducted at other sites can inform the analysis of potential impacts on sediments and water quality in the Study Area. Scientific research focused on World War II underwater munitions disposal sites in Hawaii (Briggs et al., 2016; Kelley et al., 2016; Koide et al., 2015) and an intensively used live fire range in the Mariana Islands (Smith & Marx, 2016) were published after the 2015 NWTT Final EIS/OEIS. These publications provide information on the impacts of undetonated materials and unexploded munitions on habitat and marine life.

On a localized scale, the studies at munitions ocean disposal sites in Hawaii investigated the sediments, seawater, or marine life, depending on the study, in close proximity to corroding munitions to determine if released constituents from the munitions (including explosive materials and metals) could be detected. Comparisons were made between disposal site samples and “clean” nearby reference sites. Analysis of the samples showed no confirmed detection for explosive materials despite decades since the disposal and a relatively high concentration of munitions at the site. Munitions residing on the seafloor as a result of training and testing activities would be more widely dispersed with much lower concentrations than munitions in a disposal site.

Investigations by Kelley et al. (2016) and Koide et al. (2015) found that intact munitions (i.e., ones that failed to detonate or non-explosive practice munitions) residing in or on soft sediments habitats provided hard substrate similar to other disposed objects or "artificial reefs" that attracted "hard substrate species," which would not have otherwise colonized the area. Sampling these species revealed that there was no bioaccumulation of munitions-related chemicals in the species (Koide et al., 2016).

On a broader scale, the island of Farallon De Medinilla (in the Mariana Islands) has been used as a target area for both explosive and non-explosive munitions since 1971. Between 1997 and 2012, the Navy has conducted 14 underwater scientific surveys around the island, providing a consistent, long term investigation of a single site where munitions have been used regularly (Smith & Marx, 2016). Marine life assessed during these surveys included algae, corals, benthic invertebrates, sharks, rays, bony fishes, and sea turtles. The investigators found no evidence over the 16-year period, that the condition of the physical or biological resources had been adversely impacted to a significant degree by the training activities (Smith & Marx, 2016). Furthermore, they found that the health, abundance, and biomass of fishes, corals and other marine resources were comparable to or superior to those in similar habitats at other locations within the Mariana Archipelago.

These findings are consistent with other assessments such as that done for the Potomac River Test Range at Dahlgren, Virginia which was established in 1918 and is the Nation's largest fully instrumented, over-the-water gun-firing range. Munitions tested at Dahlgren have included rounds from small-caliber guns up to the Navy's largest (16 inch guns), bombs, rockets, mortars, grenades, mines, depth charges, and torpedoes (U.S. Department of the Navy, 2013b). Results from the assessment indicate that munitions expended at Dahlgren have not contributed significant concentrations of explosive materials or explosives byproducts to the Potomac River water and sediments given those contributions are orders of magnitude less than concentrations already present in the Potomac River from natural and other manmade sources (U.S. Department of the Navy, 2013a).

In summary, multiple investigations since 2007 involving survey and sampling of World War II munitions disposal sites off Oahu Hawaii and other locations, have found the following (Briggs et al., 2016; Edwards & Bełdowski, 2016; Edwards et al., 2016a; Edwards et al., 2016b; Koide et al., 2016; Silva & Chock, 2016): (1) chemicals and degradation products, including explosive materials, from underwater munitions "do not pose a risk to human health or to fauna living in direct contact with munitions"; (2) metals measured in sediment samples next to World War II munitions are lower than naturally occurring marine levels and "do not cause a significant impact on the environment"; and (3) sediment is not a significant sink of chemicals released by degradation of the explosive components in munitions.

The concentration of explosive munitions and any associated explosives byproducts at any single location in the Study Area would be a small fraction of the totals that have accumulated over decades at World War II era disposal sites and military ranges. Based on findings from much more intensively used locations, effects on sediments from the use of explosive munitions during training and testing activities in the Study Area would be negligible by comparison. As a result, explosives and explosives byproducts would have no meaningful effect on sediments or water quality in the Study Area.

3.1.4.1.1 Impacts from Explosives and Explosive Byproducts

3.1.4.1.1.1 Impacts from Explosives and Explosives Byproducts Under Alternative 1

Impacts from Explosives and Explosives Byproducts Under Alternative 1 for Training Activities

Under Alternative 1, the total number of explosive munitions that would be expended during training activities is less than the number proposed for use in the 2015 NWTT Final EIS/OEIS (Table 3.0-16). The largest reductions in the use of explosive munitions are in the number of large-caliber projectiles and medium-caliber projectiles used under Alternative 1 (Table 3.0-16). The number of explosive large-caliber projectiles decreases from 390 to 172 annually, and medium-caliber projectiles decrease from 6,368 to 550 annually (Table 3.0-16). The number of explosive bombs and missiles used annually in the Offshore Area would decrease from a combined total of 37 to 16, a 57 percent reduction, under Alternative 1. The number of underwater detonations occurring in the Inland Waters would remain the same as analyzed in the 2015 NWTT Final EIS/OEIS (42 detonations per year). 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.

The conclusions presented in Section 3.1.3.1.6.2 (Alternative 1) of the 2015 NWTT Final EIS/OEIS remain valid. Specifically, short-term impacts on sediments and water quality would arise from explosives byproducts prior to their degradation, and long-term impacts would arise from the presence of unconsumed explosives encased in intact munitions residing on the seafloor. Impacted sediments and water quality would only be immediately adjacent to the munition. Chemical, physical, or biological changes in sediment or water quality would be measurable, but neither state nor federal standards or guidelines would be violated. This conclusion on the level of impact is based on the following: (1) most of the explosives would be consumed during detonation; (2) the frequency of low-order detonations would be low, and therefore the frequency of releases of explosives directly into the water column would be low; (3) the amounts of explosives used would be small relative to the area over which they would be distributed; and (4) the constituents of explosives would be subject to physical, chemical, and biological processes that would render the materials harmless or otherwise disperse them to undetectable levels.

As described in detail in Section 3.1.3.1.6.2 (Alternative 1) in the 2015 NWTT Final EIS/OEIS and considering the results of studies described in Section 3.1.4.1 (Explosives and Explosives Byproducts) of this Supplemental, the impacts on sediments and water quality would be similar to or less than that described in 2015 NWTT Final EIS/OEIS.

Impacts from Explosives and Explosives Byproducts Under Alternative 1 for Testing Activities

Under Alternative 1, the total number of explosive munitions that would be expended in the Offshore Area during testing activities would increase from 153 as proposed in the 2015 NWTT Final EIS/OEIS to 214 annually. Specifically, the number of explosive sonobuoys used annually would decrease from 142 to 80 (Table 3.0-16). However, the number of torpedoes would increase from 6 to 8, the number of neutralizers would increase from 0 to 36, the number of mines would increase from 0 to 5, and the number of large-caliber projectiles would increase from 0 to 80 (Table 3.0-16).

No explosive munitions would be used in the Inland Waters or Western Behm Canal, and no testing activities involving seafloor detonations are proposed in any part of the Study Area under Alternative 1. 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 three times per year and would use explosives within the water column (see Chapter 2, Description of Proposed Action and Alternatives). This 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 in the Offshore Area. Although this activity would occur closer to shore, it would typically occur in water depths greater than 100 ft., over similar substrates, and the potential impacts on sediments and water quality would be the same as analyzed in the 2015 NWTT Final EIS/OEIS and summarized above.

The conclusions presented in Section 3.1.3.1.6.2 (Alternative 1) of the 2015 NWTT Final EIS/OEIS remain valid. Specifically, short-term impacts on sediments and water quality would arise from explosives byproducts prior to their degradation, and long-term impacts would arise from the presence of unconsumed explosives encased in intact munitions residing on the seafloor. Only sediments and water immediately adjacent to the munition would potentially be impacted over time as the munitions casing degrades and releases explosives. Chemical, physical, or biological changes in sediment or water quality would be measurable, but neither state nor federal standards or guidelines would be violated. This conclusion on the level of impact is based on the following: (1) most of the explosives would be consumed during detonation; (2) the frequency of low-order detonations would be low, and therefore the frequency of releases of explosives directly into the water column would be low; (3) the amounts of explosives used would be small relative to the area over which they would be distributed; and (4) the constituents of explosives would be subject to physical, chemical, and biological processes that would render the materials harmless or otherwise disperse them to undetectable levels.

As described in detail in Section 3.1.3.1.6.2 (Alternative 1) in the 2015 NWTT Final EIS/OEIS and considering the results of studies described in Section 3.1.4.1 (Explosives and Explosives Byproducts) of this Supplemental, the impacts on sediments and water quality would be similar to or less than that described in 2015 NWTT Final EIS/OEIS.

3.1.4.1.1.2 Impacts from Explosives and Explosives Byproducts Under Alternative 2

Impacts from Explosives and Explosives Byproducts Under Alternative 2 for Training Activities

Under Alternative 2, the total number of explosive munitions that would be expended during training activities would increase from 780 under Alternative 1 to 6,981 (Table 3.0-16). The largest increase is in the number of medium-caliber projectiles used in the Offshore Area, which would increase from 550 (under Alternative 1) to 6,490 (under Alternative 2). Other distinctions between Alternative 1 and Alternative 2 are the introduction of two torpedoes, an increase in the use of missiles from 14 under Alternative 1 to 27 under Alternative 2, and an increase in large-caliber projectiles (172 to 390). Overall, the total number of explosive munitions that would be used under Alternative 2 is approximately 2 percent greater than the number of munitions proposed in the 2015 NWTT Final EIS/OEIS, with the primary difference being the number of medium-caliber projectiles (Table 3.0-16). The number of underwater detonations occurring in the Inland Waters would increase from 42 under Alternative 1 and in ongoing activities to 70 under Alternative 2. The activities that use explosive munitions would occur in the same general locations and in a similar manner as under Alternative 1 and in the 2015 NWTT Final EIS/OEIS.

The conclusions presented in Section 3.1.3.1.6.3 (Alternative 2) of the 2015 NWTT Final EIS/OEIS remain valid. Specifically, short-term impacts on sediments and water quality would arise from explosives byproducts prior to their degradation, and long-term impacts would arise from the presence of unconsumed explosives encased in intact munitions residing on the seafloor. Impacted sediments and water quality would be immediately adjacent to the munition. Chemical, physical, or biological changes in sediment or water quality would be measurable, but neither state nor federal standards or guidelines would be violated. This conclusion on the level of impact is based on the following: (1) most of the explosives would be consumed during detonation; (2) the frequency of low-order detonations would be low, and therefore the frequency of releases of explosives directly into the water column would be low; (3) the amounts of explosives used would be small relative to the area over which they would be distributed; and (4) the constituents of explosives would be subject to physical, chemical, and biological processes that would render the materials harmless or otherwise disperse them to undetectable levels.

As described in detail in Section 3.1.3.1.6.3 (Alternative 2) in the 2015 NWTT Final EIS/OEIS and considering the results of studies described in Section 3.1.4.1 (Explosives and Explosives Byproducts) of this Supplemental, the impacts on sediments and water quality would be greater than under Alternative 1 but similar to ongoing activities.

Impacts from Explosives and Explosive Byproducts Under Alternative 2 for Testing Activities

Under Alternative 2, the number of explosive munitions that would be expended in the Offshore Area during testing activities is the same as proposed under Alternative 1 (Table 3.0-16). No explosive munitions would be used in the Inland Waters or Western Behm Canal. The activities that use explosive munitions would occur in the same general locations and in a similar manner as described under Alternative 1.

The conclusions presented in Section 3.1.3.1.6.3 (Alternative 2) of the 2015 NWTT Final EIS/OEIS remain valid. Specifically, short-term impacts on sediments and water quality would arise from explosives byproducts prior to their degradation, and long-term impacts would arise from the presence of unconsumed explosives encased in intact munitions residing on the seafloor. Impacted sediments and water quality would only be immediately adjacent to the munition. Chemical, physical, or biological changes in sediment or water quality would be measurable, but neither state nor federal standards or guidelines would be violated. This conclusion on the level of impact is based on the following: (1) most of the explosives would be consumed during detonation; (2) the frequency of low-order detonations would be low, and therefore the frequency of releases of explosives directly into the water column would be low; (3) the amounts of explosives used would be small relative to the area over which they would be distributed; and (4) the constituents of explosives would be subject to physical, chemical, and biological processes that would render the materials harmless or otherwise disperse them to undetectable levels.

As described in detail in Section 3.1.3.1.6.3 (Alternative 2) in the 2015 NWTT Final EIS/OEIS and considering the results of studies described in Section 3.1.4.1 (Explosives and Explosives Byproducts) of this Supplemental, the impacts on sediments and water quality would be the same as those described under Alternative 1.

3.1.4.1.1.3 Impacts from Explosives and Explosives Byproducts Under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the Study Area. Impacts from explosives and explosives byproducts associated with the Proposed Action on sediments and water quality 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.

3.1.4.2 Metals

Metals would be introduced into the marine environment by activities that expend military materials with metal components including (1) explosive and non-explosive munitions, (2) expended (unrecovered) targets (3) seafloor devices, (4) wires and cables, and (5) certain other military expended materials. These five categories represent the same stressors analyzed in the 2015 NWTT Final EIS/OEIS.

Since the publication of the 2015 NWTT Final EIS/OEIS, the Navy has conducted a review of new literature pertaining to the potential impacts of metals on sediments and water quality. Although additional information was found and briefly summarized in the following paragraph, the new information does not indicate a measurable change to the existing environmental conditions as described in the 2015 NWTT Final EIS/OEIS.

Because of the physical and chemical reactions that occur with metals in marine systems (e.g., precipitation), metals often concentrate in sediments. Thus, metal contaminants in sediments are a greater issue than metal contaminants in the water column. Section 3.1.3.2.1 (Introduction) in the 2015 NWTT Final EIS/OEIS describes the different types of metals contained in munitions and other military expended materials, many of which, such as iron, zinc, copper, aluminum, and manganese, occur naturally in the marine environment.

In general, one of three things happens to materials that come to rest on the ocean floor: (1) they lodge in sediments below 4 in., where there is little or no oxygen; (2) they remain on the ocean floor and begin to react with seawater; or (3) they remain on the ocean floor and become encrusted by marine organisms. As a result, rates of deterioration depend on the metal or metal alloy and the conditions in the immediate marine and benthic environment. If buried deep in ocean sediments, materials tend to decompose at much lower rates than when exposed to seawater (Ankley, 1996). With the exception of torpedo guidance wires and sonobuoy parts, sediment burial appears to be the fate of most ordnance used in marine warfare (Environmental Sciences Group, 2005).

As described in Section 3.1.4.1 (Explosives and Explosives Byproducts), sediment samples collected from World War II era munitions disposal sites and heavily used Navy ranges show that metals are not impacting sediment quality despite longtime exposures to seawater and high concentrations of military munitions composed primarily of metal components (Briggs et al., 2016; Kelley et al., 2016; Koide et al., 2016; Smith & Marx, 2016; U.S. Department of the Navy, 2013a). Sediment sampling was conducted on the Canadian Forces Maritime Experimental and Test Ranges near Nanoose, British Columbia, Canada, located north of the Study Area in the Strait of Georgia to analyze impacts from decades of testing on seafloor sediments (Environmental Sciences Group, 2005). Sediment samples were collected from 37 locations on the range and at six reference locations off-range. The study showed that 14 out of 30 different metals tested had statistically significant higher concentrations on the range compared with the off-range sites. The results suggested that materials composed of metals that were expended during military activities on the range resulted in the higher concentrations of some metals. However, six of the 14 metals with higher concentrations (e.g., arsenic, bismuth, cobalt, manganese, molybdenum) are not used in the materials expended on the range; an explanation for the difference between the on-range and off-range concentrations for those metals has not been discovered (Environmental Sciences Group, 2005). Conversely, aluminum and iron have higher mean concentrations off range than on range, although both of these metals have been used in many of the materials expended on the range and deposited on the seafloor since 1965. Thus, the study was inconclusive in determining how metals in expended materials have impacted sediments on the range (Environmental Sciences Group, 2005).

The concentration of munitions and other expended materials with metal components associated with the Proposed Action be would much less than metal concentrations on a munitions disposal site, a target island used for 45 years, or a water range in a river used for almost 100 years. Therefore, impacts from metals would be expected to be much lower, such that chemical, physical, or biological changes to sediments or water quality in the Study Area would be similar to nearby areas without munitions or other expended materials containing metals. This conclusion is based on the following: (1) most of the metals in expended materials are benign and occur naturally in the marine environment, and those of potential concern make up a small percentage of metals in expended munitions and other objects with metal components; (2) metals released as corrosion products would be diluted in the water column by currents or bound up and sequestered in adjacent sediments; (3) elevated concentrations of metals in sediments would be limited to the immediate area around the expended material; and (4) the areas over which munitions and other objects with metal components would be distributed is larger than at a munitions disposal site, a small island bombing range, or a confined riverine testing range.

3.1.4.2.1 Impacts from Metals

3.1.4.2.1.1 Impacts from Metals Under Alternative 1

Impacts from Metals Under Alternative 1 for Training Activities

Under Alternative 1, the number of military materials with metal components that would be expended during training activities is generally consistent with the number proposed for use in the 2015 NWTT Final EIS/OEIS.

Comparing the number of munitions and sonobuoys containing metals with their corresponding weights provides another perspective on the relative contribution of various items to metals entering the marine environment under Alternative 1. For example, although large-caliber projectiles compose about 19 percent of the total number of items, they represent 59 percent of the total weight of those items (Table 3.1-2).

Table 3.1-2: Comparison of Training Materials with Metal Components Under Alternative 1

Type of Military Expended Material	Percent of Total	
	By Number	By Weight
Sonobuoys	19.0	28.8
Large-caliber projectiles	19.4	59.0
Medium-caliber projectiles	55.2	3.6
Bombs	0.2	7.4
Missiles	< 1	1.0
Small-caliber projectiles	6.2	< 1

Note: < = less than

When the number of military expended materials containing metals from Table 3.0-14,Table 3.0-16, Table 3.0-17, and Table 3.0-19 are summed, the number of items proposed to be expended under Alternative 1 is approximately 8 percent less than the number of items proposed in the 2015 NWTT Final EIS/OEIS. The largest changes are in the number of explosive and non-explosive large-caliber projectiles and medium-caliber projectiles used under Alternative 1, which constitute a substantial portion of items containing metals (Table 3.0-14 and 3.0-16). The number of non-explosive large-caliber projectiles increases by more than 6,000, and the number of medium-caliber projectiles decreases by more than

16,500 (Table 3.0-14). The number of explosive large-caliber projectiles and explosive medium-caliber projectiles both decrease under Alternative 1 (390 to 172 annually for large caliber and 6,368 to 550 annually for medium caliber) (Table 3.0-16).

The activities that expend military materials, including munitions, would occur in the same general locations and in a similar manner as analyzed previously. The analysis is not dependent on quantifying that overall amount of metals introduced into the marine environment. As presented in the 2015 NWTT Final EIS/OEIS and summarized in this Supplemental, the analysis shows that the types of metals deposited from training and testing activities occur naturally in the marine environment and would not impact sediments and water quality. Therefore, the impacts on sediments and water quality from metals in military expended materials would be expected to be the same or slightly reduced compared with ongoing activities.

Therefore, the conclusions presented in Section 3.1.3.2.4.2 (Alternative 1) of the 2015 NWTT Final EIS/OEIS and summarized in Section 3.1.4.2 (Metals) of this Supplemental remain valid. Specifically, metal components would come to rest on the sea floor exposed to seawater or, more likely, buried in sea floor sediments. These metals would slowly corrode over years or decades and release small amounts of metals and metal compounds to adjacent sediments and waters. Changes in metal concentrations in sediment and water would be very local to each fragment of military material. Sediment and water quality would not be affected regionally and neither state nor federal standards or guidelines would be violated.

Impacts from Metals Under Alternative 1 for Testing Activities

Under Alternative 1, the number of military materials with metal components that would be expended during testing activities would increase compared with the number of items proposed for use in the 2015 NWTT Final EIS/OEIS.

As noted in the discussion on training activities above, comparing the number of items containing metals with their corresponding weights provides another perspective on the relative contribution of various items to metals entering the marine environment. Under Alternative 1, for example, large-caliber projectiles compose about 7 percent of the total number of items and represent 13 percent of the total weight of those items (Table 3.1-3).

Table 3.1-3: Comparison of Testing Materials with Metal Components Under Alternative 1

Type of Military Expended Material	Percent of Total	
	By Number	By Weight
Sonobuoys	94.7	96.5
Large caliber projectiles	5.3	3.5
Medium caliber projectiles	0	0
Bombs	0	0
Missiles	0	0
Small-caliber projectiles	0	0

When the number of military expended materials containing metals from Table 3.0-14, Table 3.0-16, Table 3.0-17, and Table 3.0-19 are summed, the number of items increases from approximately 9,500 used in ongoing activities to 23,000 under Alternative 1. The largest change is in the number of targets proposed for use, which would increase from over 6,600 to about 14,000 under Alternative 1. Some subsurface targets are intended for recovery; however, in some cases recovery is not feasible and the targets are expended. The activities that expend military materials containing metals would occur in the same general locations and in a similar manner as analyzed previously. Although the overall amount of metals introduced to the Study Area would increase, the analysis is not dependent on quantifying that amount. As presented in the 2015 NWTT Final EIS/OEIS and summarized in this Supplemental, the analysis shows that the types of metals deposited from training and testing activities occur naturally in the marine environment and would not impact sediments and water quality. Although the number of military expended materials including metals would increase under Alternative 1, the impacts on sediments and water quality from metals would be expected to be the same or slightly greater than impacts from ongoing activities.

Therefore, the conclusions presented in Section 3.1.3.2.4.2 (Alternative 1) of the 2015 NWTT Final EIS/OEIS and summarized in Section 3.1.4.2 (Metals) of this Supplemental remain valid. Specifically, metal components would come to rest on the sea floor exposed to seawater or, more likely, buried in sea floor sediments. These metals would slowly corrode over years or decades and release small amounts of metals and metal compounds to adjacent sediments and waters. Changes in metal concentrations in sediment and water would be very local to each fragment of military material. Water or sediment quality regionally would not be affected and neither state nor federal standards nor guidelines would be violated.

3.1.4.2.1.2 Impacts from Metals Under Alternative 2

<u>Impacts from Metals Under Alternative 2 for Training Activities</u>

Under Alternative 2, the number of military materials with metal components that would be expended during training activities is greater than under Alternative 1 and generally consistent with the number proposed in the 2015 NWTT Final EIS/OEIS.

As noted in the discussion on training activities under Alternative 1, comparing the number of items containing metals with their corresponding weights provides another perspective on the relative contribution of various items to metals entering the marine environment. Under Alternative 2, for example, medium-caliber projectiles compose about 66 percent of the total number of items and represent 6 percent of the total weight of those items (Table 3.1-4).

Table 3.1-4: Comparison of Training Materials with Metal Components Under Alternative 2

Type of Military Expended Material	Percent of Total	
	By Number	By Weight
Sonobuoys	12.5	27.0
Large caliber projectiles	13.2	57.1
Medium caliber projectiles	66.1	6.1
Bombs	< 1	7.4
Missiles	< 1	2.3
Small-caliber projectiles	8.1	< 1

When the number of military expended materials from Table 3.0-14, Table 3.0-16, Table 3.0-17, and Table 3.0-19 are summed, the total number of items proposed to be expended under Alternative 2 is approximately 14 percent greater than under Alternative 1 and approximately 5 percent greater than the number of materials used in ongoing activities. Similar to Alternative 1, the largest changes are in the number of explosive large-caliber projectiles and both explosive and non-explosive medium-caliber projectiles (Table 3.0-14 and 3.0-16). The activities that expend military materials, including munitions, would occur in the same general locations and in a similar manner as under Alternative 1. Although the overall amount of metals introduced to the Study Area would increase, the analysis is not dependent on quantifying that amount. As presented in the 2015 NWTT Final EIS/OEIS and summarized in this Supplemental, the analysis shows that the types of metals deposited from training and testing activities occur naturally in the marine environment and would not impact sediments and water quality. Although the number of military expended materials including metals would be greater than under Alternative 1, the impacts on sediments and water quality from metals would be expected to be the same or slightly greater than under Alternative 1 and equivalent to impacts from ongoing activities.

Therefore, the conclusions presented in Section 3.1.3.2.4.3 (Alternative 2) of the 2015 NWTT Final EIS/OEIS and summarized in Section 3.1.4.2 (Metals) of this Supplemental remain valid. Specifically, metal components would come to rest on the sea floor exposed to seawater or, more likely, buried in sea floor sediments. These metals would slowly corrode over years or decades and release small amounts of metals and metal compounds to adjacent sediments and waters. Changes in metal concentrations in sediment and water would be very local to each fragment of military material. Sediment and water quality would not be affected regionally, and neither state nor federal standards or guidelines would be violated.

Impacts from Metals Under Alternative 2 for Testing Activities

Under Alternative 2, the number of military materials with metal components that would be expended during testing activities is greater than under Alternative 1 and the number proposed in the 2015 NWTT Final EIS/OEIS.

As noted in the discussion on testing activities under Alternative 2, comparing the number of items containing metals with their corresponding weights provides another perspective on the relative contribution of various items to metals entering the marine environment. The relationship between the number of expended items composed of metal and the weight of those items is approximately the same under Alternative 2 compared with Alternative 1 (Table 3.1-5).

Table 3.1-5: Comparison of Testing Materials with Metal Components Under Alternative 2

Type of Military Expended Material	Percent of Total	
	By Number	By Weight
Sonobuoys	90	93.3
Large-caliber projectiles	10	6.7
Medium-caliber projectiles	0	0
Bombs	0	0
Missiles	0	0
Small-caliber projectiles	0	0

Note: < = less than

When the number of military expended materials from Table 3.0-14, Table 3.0-16, Table 3.0-17, and Table 3.0-19 are summed, the number of items proposed to be expended under Alternative 2 is approximately 20 percent greater than under Alternative 1, increasing from about 23,000 to 28,000. In comparison to Alternative 1, the largest increase is in the number of non-explosive practice munitions, which increase from about 4,800 to 7,200 under Alternative 2. Changes compared to ongoing activities are similar to those described above for Alternative 1.

The activities that expend military materials containing metals would occur in the same general locations and in a similar manner as under Alternative 1. Although the overall amount of metals introduced to the Study Area would increase, the analysis is not dependent on quantifying that amount. As presented in the 2015 NWTT Final EIS/OEIS and summarized in this Supplemental, the analysis shows that the types of metals deposited from training and testing activities occur naturally in the marine environment and would not impact sediments and water quality. Therefore, the impacts on sediments and water quality from metals in military expended materials would be expected to be similar or slightly greater than under Alternative 1 and ongoing activities.

Therefore, the conclusions presented in Section 3.1.3.2.4.3 (Alternative 2) of the 2015 NWTT Final EIS/OEIS and summarized in Section 3.1.4.2 (Metals) of this Supplemental remain valid. Specifically, metal components would come to rest on the sea floor exposed to seawater or, more likely, buried in sea floor sediments. These metals would slowly corrode over years or decades and release small amounts of metals and metal compounds to adjacent sediments and waters. Changes in metal concentrations in sediment and water would be very local to each fragment of military material. Sediment and water quality would not be affected regionally, and neither state nor federal standards or guidelines would be violated.

3.1.4.2.1.3 Impacts from Metals Under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the Study Area. Impacts from metals associated with the Proposed Action on sediments and water quality 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.

3.1.4.3 Chemicals Other than Explosives

Chemicals other than explosives are associated with the following military expended materials: (1) solid-fuel propellants in missiles and rockets; (2) Otto Fuel II torpedo propellant and combustion byproducts; (3) other chemicals associated with explosive munitions; and (4) chemicals that simulate chemical warfare agents, referred to as “simulants.”

Following a review of recent literature, including government technical documents, reports, and scientific journals, the information presented on chemicals other than explosives in the Study Area, as described in the 2015 NWTT Final EIS/OEIS, has not appreciably changed.

3.1.4.3.1 Impacts from Chemicals Other than Explosives

<u>Solid-fuel propellants in missiles and rockets</u>: The EPA issued a paper characterizing the munitions constituents accumulated at over 30 military sites around the United States and Canada where explosives and solid fuel propellants have been used for years (U.S. Environmental Protection Agency, 2012b). The sites assessed in the paper were all land-based ranges; however, the results are useful for analyzing similar activities conducted at sea. The paper includes a case study measuring the amount of residual perchlorate remaining from firing a rocket with solid fuel propellant. The study concluded that 99.997 percent of perchlorate is consumed by the rocket motor (U.S. Environmental Protection Agency, 2012b). Fitzpatrick et al. (2006) found similar results from an air-launched AIM-7 missile, a missile used

by the Navy and similar to missiles proposed for use during training and testing activities. These studies, and others cited in each paper, demonstrate that the motors used in rockets and missiles are highly efficient at burning propellant fuels, leaving only trace amounts often at undetectable levels in the environment. In the event of a munitions failure resulting in unconsumed solid propellant in a rocket or missile entering the marine environment, only small amounts of perchlorates would be released into sediments or the water column as the solid fuel (in the form of cubes) is exposed to seawater. The leaching rate would decrease over time as the concentration of perchlorate in the propellant declined (U.S. Department of the Navy, 2008).

Ammonium perchlorate typically accounts for 50 to 85 percent of the propellant by weight. Perchlorates are readily soluble, with a low affinity for binding to sediments and organic matter and would persist in the environment potentially impacting sediments and the water quality. Perchlorates occur naturally in the environment, but at high concentrations can reach toxicity in plants and animals (Martinelango, 2006; Van Wijk & Hutchinson, 1995). Bacteria and other microbes in the marine environment have been shown to metabolize or otherwise degrade perchlorate into benign chemical products, such as chloride (Chaudhuri et al., 2002; Logan et al., 2001; Okeke et al., 2002). Refer to Section 3.1.3.3.7.1 (Solid-Fuel Propellants) in the 2015 NWTT Final EIS/OEIS for additional analysis.

Otto Fuel II torpedo propellant and combustion byproducts: As discussed in detail in Section 3.1.3.3.7.2 (Otto Fuel II and Combustion Byproducts) in the 2015 NWTT Final EIS/OEIS, combustion byproducts from Otto Fuel II would be released into the water column only in small amounts during combustion. Furthermore, all non-explosive torpedoes are typically recovered for reuse following training and testing activities, which removes any unconsumed fuel from the environment after completion of the activity. Combustion byproducts of Otto Fuel II would be released into the water column where they would dissolve, dissociate, or be dispersed and diluted. Except for hydrogen cyanide, combustion byproducts (such as carbon dioxide, carbon monoxide, nitrogen, hydrogen, methane, and ammonia) are not a concern, because they occur naturally in seawater, are consumed or otherwise chemically converted through biological or other processes, and would not impact water quality (U.S. Department of the Navy, 1996).

One combustion byproduct, hydrogen cyanide, does not normally occur in seawater and can pose a risk at high concentrations; however, it is soluble in seawater and would be diluted to less than 1 µg/L (1.0 part per billion) – below EPA recommended concentrations (U.S. Environmental Protection Agency, 2010) – at a distance of approximately 18 feet from the center of the torpedo's path when first discharged. Additional dilution would occur thereafter, with the rate of dilution depending, in part, upon circulation in the water column in the vicinity of the discharge. Refer to Section 3.1.3.3.7.2 (Otto Fuel II and Combustion Byproducts) in the 2015 NWTT Final EIS/OEIS for additional analysis.

Other chemicals associated with explosive munitions: Residual chemical constituents associated with explosive munitions can remain in the environment after low-order (i.e., incomplete) detonations and in unconsumed explosives. These constituents, listed in Table 3.1-20 of the 2015 NWTT Final EIS/OEIS, are in addition to the explosives contained in the munition. Lead azide, titanium compounds, perchlorates, barium chromate, and fulminate of mercury are not naturally constituents of seawater. Another residual constituent, lead oxide, is a rare, naturally occurring mineral (Agency for Toxic Substances and Disease Registry, 2007).

Simulants: Simulants were not analyzed in the 2015 NWTT Final EIS/OEIS. The Department of Defense is developing equipment to detect chemical and biological warfare agents and uses harmless compounds, referred to as simulants, as safe substitutes to test the detection equipment. The detectors monitor for the presence of chemical and biological warfare agents and protect military personnel and civilians from the threat of exposure to these agents. The simulants will trigger a response by sensors in the detection equipment without irritating or injuring the personnel involved in the test. Simulants must have one or more characteristics of a real chemical or biological agent—size, density, or aerosol behavior—to effectively mimic the agent.

Simulants are selected using the following criteria: (1) safety to humans and the environment, and (2) the ability to trigger a response by sensors used in the detection equipment. Simulants would be benign (e.g., low toxicity or effects potential) from a human health, safety, and environmental perspective. Exposure levels during testing activities would be well below concentrations associated with any adverse human health or environmental effects. The degradation products of simulants used during testing would also be harmless. Given these characteristics of simulants used during testing activities, it is reasonable to conclude that simulants would have no impact on sediments and water quality in the Study Area. Simulants are not analyzed further in this section.

3.1.4.3.1.1 Impacts from Chemicals Other than Explosives Under Alternative 1

<u>Impacts from Chemicals Other than Explosives Under Alternative 1 for Training Activities</u>

Under Alternative 1, the number of explosive and non-explosive missiles using solid fuel propellants would decrease from 42, proposed in the 2015 NWTT Final EIS/OEIS, to 18. No explosive torpedoes and 16 non-explosive torpedoes (all recovered) would be used during training activities under Alternative 1 (Tables 3.0-15 and 3.0-16). No torpedoes were proposed for training activities in the 2015 NWTT Final EIS/OEIS.

As described in Section 3.1.4.1.1.1 (Impacts from Explosives and Explosives Byproducts Under Alternative 1), the number of explosive munitions that would be expended during training activities would decrease from over 6,800 proposed in the 2015 NWTT Final EIS/OEIS to 780. Based on the detailed analysis in Section 3.1.3.1 (Explosives and Explosion Byproducts) in the 2015 NWTT Final EIS/OEIS and the summary of recent studies in Section 3.1.4.1 (Explosives and Explosives Byproducts) in this Supplemental, concentrations of chemical constituents associated with explosive munitions is expected to be localized to areas adjacent to the munition and similar to concentrations from unimpacted nearby sites.

The analysis in the 2015 NWTT Final EIS/OEIS concluded that, based on the small amount of chemicals other than explosives that would remain from training activities, chemicals would either be undetectable or would have only a minimal and localized impact on sediments and water quality in the Study Area. The impacts on sediments and water quality would be similar to or less than that described in 2015 NWTT Final EIS/OEIS.

<u>Impacts from Chemicals Other than Explosives Under Alternative 1 for Testing Activities</u>

Under Alternative 1, no missiles using solid rocket propellant would be used during testing activities, and no missiles were proposed for use in the 2015 NWTT Final EIS/OEIS. The number of explosive and non-explosive torpedoes using Otto Fuel II propellant would decrease from 518 proposed in the 2015 NWTT Final EIS/OEIS to 512 annually (Table 3.0-15 and Table 3.0-16).

As described in Section 3.1.4.1.1.1 (Impacts from Explosives and Explosives Byproducts Under Alternative 1), the number of explosive munitions that would be expended in the Offshore Area during testing activities increases from 153 proposed in the 2015 NWTT Final EIS/OEIS to 214. Based on the detailed analysis in Section 3.1.3.1 (Explosives and Explosion Byproducts) in the 2015 NWTT Final EIS/OEIS and the summary of recent studies in Section 3.1.4.1 (Explosives and Explosives Byproducts) in this Supplemental, concentrations of chemical constituents associated with explosive munitions is expected to be localized to areas adjacent to the munition and similar to concentrations from unimpacted nearby sites.

As described in Section 3.1.4.3.1 (Impacts from Chemicals Other Than Explosives), chemical and biological simulants are benign and would have no impact on sediments and water quality.

The analysis in the 2015 NWTT Final EIS/OEIS concluded that, based on the small amount of chemicals other than explosives that would remain from testing activities, chemicals would either be undetectable or would have only a minimal and localized impact on sediments and water quality in the Study Area. The impacts on sediments and water quality would be similar to or less than that described in 2015 NWTT Final EIS/OEIS.

3.1.4.3.1.2 Impacts from Chemicals Other than Explosives Under Alternative 2

Impacts from Chemicals Other than Explosives Under Alternative 2 for Training Activities

Under Alternative 2, the number of explosive and non-explosive missiles using solid fuel propellants would increase from 18 under Alternative 1 to 42. The number of missiles proposed in the 2015 NWTT Final EIS/OEIS) was also 42. The number of explosive torpedoes using Otto Fuel II during training activities would increase from 0 under Alternative 1 to 2, and the number of non-explosive torpedoes would increase from 16 to 18 (Table 3.0-15 and Table 3.0-16). No torpedoes were proposed for training activities in the 2015 NWTT Final EIS/OEIS.

As described in Section 3.1.4.1.1.2 (Impacts from Explosives and Explosives Byproducts Under Alternative 2), the number of explosive munitions expended under Alternative 2 would increase from 780 to 6,981 (Table 3.0-16). The number of underwater detonations occurring in the Inland Waters would increase from 42, for ongoing activities and under Alternative 1, to 70 under Alternative 2. Overall, the number of explosive munitions proposed to be expended under Alternative 2 is approximately 2 percent greater than the number of explosives proposed in the 2015 NWTT Final EIS/OEIS (Table 3.0-16).

Based on the detailed analysis in Section 3.1.3.1 (Explosives and Explosion Byproducts) in the 2015 NWTT Final EIS/OEIS and the summary of recent studies in Section 3.1.4.1 (Explosives and Explosives Byproducts) in this Supplemental, concentrations of chemical constituents associated with explosive munitions is expected to be localized to areas adjacent to the munition and similar to concentrations from unimpacted nearby sites.

The analysis in the 2015 NWTT Final EIS/OEIS concluded that, based on the small amount of chemicals other than explosives that would remain from training activities, chemicals would either be undetectable or would have only a minimal and localized impact on sediments and water quality in the Study Area. The impacts on sediments and water quality would be similar to or slightly greater than under Alternative 1.

Impacts from Chemicals Other than Explosives Under Alternative 2 for Testing Activities

Under Alternative 2, no missiles using solid rocket propellant would be used during testing activities. The number of explosive and non-explosive torpedoes using Otto Fuel II propellant would increase from 512 under Alternative 1 to 555 (Table 3.0-15 and Table 3.0-16).

According to Section 3.1.4.1.1.2 (Impacts from Explosives and Explosives Byproducts Under Alternative 2), the number of explosive munitions that would be expended in the Offshore Area during testing activities is the same as proposed under Alternative 1 (Table 3.0-16). No explosive munitions would be used in the Inland Waters or Western Behm Canal. The activities that use explosive munitions would occur in the same general locations and in a similar manner as described under Alternative 1.

Based on the detailed analysis in Section 3.1.3.1 (Explosives and Explosion Byproducts) in the 2015 NWTT Final EIS/OEIS and the summary of recent studies in Section 3.1.4.1 (Explosives and Explosives Byproducts) in this Supplemental, concentrations of chemical constituents associated with explosive munitions is expected to be localized to areas adjacent to the munition and similar to concentrations from unimpacted nearby sites. As described in Section 3.1.4.3.1 (Impacts from Chemicals Other Than Explosives), chemical and biological simulants are benign (i.e., low toxicity or effects potential from a human health, safety, and environmental perspective) and would have no impact on sediments and water quality.

The analysis in the 2015 NWTT Final EIS/OEIS concluded that, based on the small amount of chemicals other than explosives that would remain from testing activities, chemicals would either be undetectable or would have only a minimal and localized impact on sediments and water quality in the Study Area. The impacts on sediments and water quality would the same as impacts under Alternative 1.

3.1.4.3.1.3 Impacts from Chemicals Other than Explosives Under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the Study Area. Impacts from chemicals other than explosives associated with the Proposed Action on sediments and water quality 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.

3.1.4.4 Other Materials

Other materials include marine markers and flares, chaff, towed and stationary targets, parachutes, and miscellaneous non-metal components of other devices that were not analyzed in Section 3.1.4.1 (Explosives and Explosives Byproducts), Section 3.1.4.2 (Metals), and Section 3.1.4.3 (Chemicals Other than Explosives). Some expended materials used in training and testing activities are composed of both metal and non-metal components (e.g., targets), and a detailed breakdown of the constituent materials making up each item is not available. Therefore, some items, such as targets, are included in totals presented in this section as well as in previous sections analyzing impacts on metals. Nonmetallic components are made mainly of nonreactive or slowly reactive materials (e.g., glass, carbon fibers, and plastics), or materials such as rubber, cloth, and concrete that break down or decompose into naturally occurring or benign constituents through physical, chemical, and biological processes. Most of these objects would settle to the sea floor where they would (1) be exposed to seawater, (2) become lodged in or covered by seafloor sediments, (3) become encrusted (e.g., by rust) through oxidation, (4) dissolve slowly, or (5) be covered by marine organisms such as coral. Plastics or other lightweight materials (e.g., polystyrene foam) may float or descend to the bottom over time, depending upon their buoyancy.

The various types of expended materials that would be used during training and testing activities are described in detail in Section 3.1.3.4 (Other Materials) in the 2015 NWTT Final EIS/OEIS. That section describes the constituent components of marine markers, flares, and chaff as well as other items and the fate and transport of those constituents in the marine environment. Pyrotechnic materials in marine markers and flares are largely consumed during use, and combustion byproducts are released into the air and would have limited contact with the water. The chemical constituents of marine markers and flares are listed in Table 3.1-21, and the constituents of chaff are listed in Table 3.1-22 of the 2015 NWTT Final EIS/OEIS. The vast majority of these other materials and items made up of other materials would be expended in the Offshore Area and not in the Inland Waters portion of the Study Area.

The analysis in the 2015 NWTT Final EIS/OEIS concluded that the potential impacts of other materials on sediments and water quality would be short term for items that degrade into benign constituents and long term for items that are composed of persistent materials, such as plastics, that break down over years. However, the potential changes to the chemical, physical, or biological properties of sediments and marine waters from the introduction of these other materials would not be measurable as many of the constituent materials occur naturally in the marine environment and would not be detectable above background levels.

3.1.4.4.1 Impacts from Other Materials

3.1.4.4.1.1 Impacts from Other Materials Under Alternative 1

<u>Impacts from Other Materials Under Alternative 1 for Training Activities</u>

The number of times training activities using other materials (e.g., chaff) occur annually under Alternative 1 is shown in Table 2.5-1. Appendix A (Navy Activities Descriptions) describes the training activities that use the various types of other materials and the types of stressors associated with those activities.

Under Alternative 1, the number of other materials that would be expended during training activities is generally consistent with the number proposed for use in the 2015 NWTT Final EIS/OEIS. For example, the number of parachutes used in training activities increases by about 5 percent, from about 9,100 proposed in the 2015 NWTT EIS/OEIS to about 9,500 under Alternative 1 (Table 3.0-20). When the total amount of other expended materials from Tables 3.0-14 through 3.0-22 are combined (excluding munitions and other metal items described above), the number of items proposed to be expended under Alternative 1 increases by approximately 5 percent compared with the number of items proposed in the 2015 NWTT Final EIS/OEIS. This change does not appreciably change the impact conclusions presented in the 2015 NWTT Final EIS/OEIS and summarized above in Section 3.1.4.4 (Other Materials). Therefore, the impacts on sediments and water quality from other expended materials would be expected to be the same or slightly greater compared with ongoing activities.

<u>Impacts from Other Materials Under Alternative 1 for Testing Activities</u>

New testing activities not addressed in the 2015 NWTT Final EIS/OEIS would involve the use of a biodegradable polymer as part of a marine vessel stopping system, and, in a separate activity, a new countermeasure emulator device. Marine vessel-stopping systems are designed to deliver the appropriate measure(s) to affect a vessel’s propulsion and associated control surfaces to significantly slow and potentially stop the advance of the vessel.

The biodegradable polymers that the Navy uses are designed to temporarily interact with the propeller(s) of a target craft rendering the craft ineffective. Some of the polymer constituents would dissolve within two hours of immersion whereas other components would last longer. Based on the constituents of the biodegradable polymers the Navy proposes to use, it is anticipated that the material will break down into small pieces within a few days to weeks. These smaller pieces will break down further and dissolve into the water column within weeks to a few months. Degradation and dispersal timelines are influenced by water temperature, currents, and other oceanographic features. Overall, the longer the polymer remains in the water, the weaker it becomes making it more brittle and likely to break. The final products are all environmentally benign and will ultimately be dispersed to undetectable concentrations within the water column. Refer to Section 3.0.3.3.5.3 (Biodegradable Polymer) and Table 3.0-21 for information on how often and where biodegradable polymers are used in the Study Area.

A new countermeasure emulator not addressed in the 2015 NWTT Final EIS/OEIS is a device that contains a gas generator module and noisemaker module that would be deployed in the water at various depths. The gas generator module contains solid pucks composed of iron and lithium hydride, which would be released from the device underwater, allowing the lithium hydride to react strongly with water and generating bubbles for several minutes. The pucks would be totally consumed in use, degrading to gases and non-toxic, naturally occurring, compounds. Following the activity, the noisemaker module would be recovered. Given that the residual substances remaining after the pucks dissolve are naturally occurring compounds and that the other components of the device are recovered, no impacts on sediments or water quality are anticipated from this device.

The number of times testing activities using other materials (e.g., decelerators/parachutes) occur annually under Alternative 1 is shown in Tables 2.5-2 and 2.5-3. Appendix A (Navy Activities Descriptions) describes the testing activities that use the various types of other materials and the types of stressors associated with those activities.

Under Alternative 1, the total number of other materials that would be expended during testing activities decreases compared with the totals from the 2015 NWTT Final EIS/OEIS. The decrease is primarily a result of reducing the number of flares from 600 to 0 (which reduces the number of expended items associated with the use of flares from 2,400 to 0) and reducing the number of marine markers from 190 to 0 under Alternative 1. When the total amount of other expended materials from Tables 3.0-14 through 3.0-22 are combined (excluding munitions and other metal items described above), the number of items proposed to be expended under Alternative 1 decreases from approximately 7,000 items proposed in the 2015 NWTT Final EIS/OEIS to 4,200 (about a 42 percent reduction).

This change does not appreciably change the impact conclusions presented in the 2015 NWTT Final EIS/OEIS and summarized above in Section 3.1.4.4 (Other Materials). Therefore, the impacts on sediments and water quality from other expended materials would be expected to be the same or slightly reduced compared with ongoing activities.

3.1.4.4.1.2 Impacts from Other Materials Under Alternative 2

<u>Impacts from Other Materials Under Alternative 2 for Training Activities</u>

The number of times training activities using other materials (e.g., chaff) occur annually under Alternative 2 is shown in Table 2.5-1. Appendix A (Navy Activities Descriptions) describes the training activities that use the various types of other materials and the types of stressors associated with those activities.

Under Alternative 2, the number of other materials that would be expended during training activities is generally consistent with the number proposed for use in the 2015 NWTT Final EIS/OEIS and under Alternative 1. When the total amount of other expended materials from Tables 3.0-14 through 3.0-22 are combined (excluding munitions and other metal items), the number of items proposed to be expended under Alternative 2 increases by approximately 6 percent compared with the number of items proposed in the 2015 NWTT Final EIS/OEIS and approximately 1 percent compared with Alternative 1.

This change does not appreciably change the impact conclusions presented in the 2015 NWTT Final EIS/OEIS and summarized above in Section 3.1.4.4 (Other Materials). Therefore, the impacts on sediments and water quality from other expended materials would be expected to be the same or slightly greater compared with ongoing activities and activities under Alternative 1.

Impacts from Other Materials Under Alternative 2 for Testing Activities

The number of times testing activities using other materials (e.g., chaff) occur annually under Alternative 2 is shown in Tables 2.5-2 and 2.5-3. Appendix A (Navy Activities Descriptions) describes the testing activities that use the various types of other materials and the types of stressors associated with those activities.

Under Alternative 2, the total number of other materials that would be expended during testing activities decreases compared with the total from the 2015 NWTT Final EIS/OEIS and is greater than the number of other material expended under Alternative 1. The decrease, compared with ongoing activities, is primarily a result of reducing the number of flares and marine markers to 0, consistent with Alternative 1. When the total amount of other expended materials from Tables 3.0-14 through 3.0-22 are combined (excluding munitions and other metal items), the number of items proposed to be expended under Alternative 2 decreases from approximately 7,000 items proposed in the 2015 NWTT Final EIS/OEIS to 4,200 (about a 41 percent reduction). The number of other expended materials is approximately the same as under Alternative 1.

This change does not appreciably change the impact conclusions presented in the 2015 NWTT Final EIS/OEIS and summarized above in Section 3.1.4.4 (Other Materials). Therefore, the impacts on sediments and water quality from other expended materials would be expected to be the same or slightly reduced compared with ongoing activities and approximately the same as impacts under Alternative 1.

3.1.4.4.2 Impacts from Other Materials Under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the Study Area. Impacts from other materials associated with the Proposed Action on sediments and water quality 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.

3.1.4.5 Secondary Stressors

Air pollutants discharged as a result of Navy training and testing activities could have secondary or indirect impacts on water quality (no impacts on sediments would occur). The scavenging of air pollutants from the atmosphere by water droplets—both during cloud formation and during rainfall—is a well-known and well-studied atmospheric process. Water droplets can scavenge 85 percent or more of air pollutants during a rainfall event. In so doing, rainfall transfers these pollutants from the atmosphere to the surface. Rainfall scavenging of nitrogen oxides and sulfur oxides from the atmosphere creates dilute solutions of nitric and sulfuric acid (i.e., “acid rain”).

The coastal areas of the Pacific Northwest receive more than 6 feet of rainfall in an average year, representing tens of billions of gallons of water. Total emissions of criteria air pollutants from training and testing activities would amount to several hundred tons per year, dispersed over large ocean areas in the Study Area. Conservatively assuming that emissions occurred at such times and places that all emissions were captured by rainfall (instead of being dispersed) and deposited on the surface of the ocean, it is still highly unlikely that pollutant concentrations in a single rainfall event would be measurable in the marine environment, and pollutant concentrations averaged over time would be below detection limits. Upon contact with the ocean surface, pollutants would immediately be dispersed into a much larger volume of water. Thus diluted, these pollutants would have a negligible effect on water quality in the Study Area. Additional information on impacts from air emissions is provided in Section 3.2 (Air Quality) of the 2015 NWTT Final EIS/OEIS and summarized in Section 3.2 (Air Quality) of this Supplemental.

3.1.4.5.1 Impacts from Secondary Stressors

3.1.4.5.1.1 Impacts from Secondary Stressors Under Alternative 1 and Alternative 2

The changes in the numbers of activities that would generate air emissions under Alternative 1 and Alternative 2 are shown primarily in Table 3.0-11, which presents the number of activities using aircraft, and Table 3.0-12, which presents the number of activities involving vessel movements. The changes under Alternative 1 and Alternative 2 would not appreciably change the impact conclusions for secondary stressors presented in the 2015 NWTT Final EIS/OEIS.

3.1.4.5.1.2 Impacts from Secondary Stressors Under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the Study Area. Impacts from secondary stressors associated with the Proposed Action on sediments and water quality 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.

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3.2 Air Quality

3.2.1 Introduction and Methods

The approach to analyzing air quality impacts produced by the Proposed Action was explained in the 2015 Northwest Training and Testing (NWTT) Final Environmental Impact Statement (EIS)/Overseas EIS (OEIS). Laws, regulations, and guidance that were described in the previous EIS/OEIS remain applicable to this Supplemental Environmental Impact Statement Supplemental, with two exceptions.

First, the previous EIS/OEIS relied on draft guidance from the Council on Environmental Quality, put forth on December 18, 2014, to analyze the impacts that greenhouse gases emitted by the Proposed Action would have on climate. On August 1, 2016, the Council on Environmental Quality put forward the finalized guidance, removing the suggested 25,000-metric ton threshold for quantification of projected greenhouse gas (GHG) from the 2014 revised draft guidance. Executive Order (EO) 13783 (March 28, 2017) led to the withdrawal of this final guidance for further consideration. EO 13693 was revoked by EO 13834, issued on May 17, 2018, which establishes policy for federal agencies to prioritize actions that reduce waste, cut costs, enhance the resilience of federal infrastructure and operations, and enable more effective accomplishment of their missions. Department of Defense (DoD) Directive 4715.21, Climate Change Adaptation and Resilience, issued on January 14, 2016, establishes policy and assigns responsibilities to provide the DoD with the resources necessary to assess and manage risks associated with the impacts of climate change. Although it is not required, GHG emissions are quantified in this Supplemental but are analyzed by illustrating their cumulative contribution to climate change.

Secondly, a new eight-hour National Ambient Air Quality Standard (NAAQS) of 0.070 parts per million for ozone was adopted (U.S. Environmental Protection Agency, 2016). The final rule was signed on October 1, 2015, and became effective December 28, 2015. The previous (2008) ozone standards additionally remain in effect in some areas. Revocation of the previous (2008) ozone standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards. NAAQS for criteria pollutants are presented in Table 3.2-1. The attainment status of the NWTT Study Area and the associated regulatory thresholds remains unchanged from the 2015 NWTT Final EIS/OEIS.

Table 3.2-1: National Ambient Air Quality Standards

Pollutant	***Primary/ Secondary***	***Averaging Time***	***Level***	***Form***
Carbon monoxide	Primary	8 hours	9 parts per million	Not to be exceeded more than once per year
		1 hour	35 parts per million	
Lead	Primary and secondary	Rolling 3-month period	0.15 micrograms per cubic meter(1)	Not to be exceeded
Nitrogen dioxide	Primary	1 hour	100 parts per billion	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years

Table 3.2-1: National Ambient Air Quality Standards (continued)

Pollutant		*Primary/ Secondary*	*Averaging Time*	*Level*	*Form*
Nitrogen dioxide (continued)		Primary and secondary	1 year	53 parts per billion[2]	Annual mean
Ozone		Primary and secondary	8 hours	0.070 parts per million[3]	Annual 4th-highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution (particulate matter)	Particulate matter less than or equal to 2.5 microns in diameter	Primary	1 year	12.0 micrograms per cubic meter	Annual mean, averaged over 3 years
Particle Pollution (particulate matter)	Particulate matter less than or equal to 2.5 microns in diameter	Secondary	1 year	15.0 micrograms per cubic meter	Annual mean, averaged over 3 years
Particle Pollution (particulate matter)	Particulate matter less than or equal to 2.5 microns in diameter	Primary and secondary	24 hours	35 micrograms per cubic meter	98th percentile, averaged over 3 years
Particle Pollution (particulate matter)	Particulate matter less than or equal to 10 microns in diameter	Primary and secondary	24 hours	150 micrograms per cubic meter	Not to be exceeded more than once per year on average over 3 years
Sulfur dioxide		Primary	1 hour	75 parts per billion[4]	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
Sulfur dioxide		Secondary	3 hours	0.5 parts per million	Not to be exceeded more than once per year

(1) In areas designated nonattainment for the lead standards prior to the promulgation of the current (2008) standards, and for which implementation plans to attain or maintain the current (2008) standards have not been submitted and approved, the previous standards (1.5 micrograms per cubic meter as a calendar quarter average) also remain in effect.
(2) The level of the annual nitrogen dioxide standard is 0.053 parts per million. It is shown here in terms of parts per billion for the purposes of clearer comparison to the 1-hour standard level.
(3) Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) ozone standards additionally remain in effect in some areas. Revocation of the previous (2008) ozone standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards.
(4) The previous sulfur dioxide standards (0.14 parts per million 24-hour and 0.03 parts per million annual) will additionally remain in effect in certain areas: (1) any area for which it is not yet one year since the effective date of designation under the current (2010) standards, and (2) any area for which implementation plans providing for attainment of the current (2010) standard have not been submitted and approved and which is designated nonattainment under the previous sulfur dioxide standards or is not meeting the requirements of a State Implementation Plan call under the previous sulfur dioxide standards (40 Code of Federal Regulations 50.4(3)). A State Implementation Plan call is a USEPA action requiring a state to resubmit all or part of its State Implementation Plan to demonstrate attainment of the required National Ambient Air Quality Standards.
Source: U.S. Environmental Protection Agency (2016), last updated January 7, 2016.

3.2.1.1 General Conformity Evaluation

If a federal action is not an emergency response action presumed to conform under the Rule, does not meet the approved facility emissions budget, is not a listed exempt activity, and is not covered by the Transportation Conformity Rule, then a conformity demonstration evaluating total direct and indirect emissions must be made. The total direct and indirect emissions evaluation considers emission increases that are reasonably foreseeable at the time the Conformity analysis is conducted. The emission increases are compared to "*de minimis*" thresholds. Projected emissions at or above the *de minimis* level trigger the requirement for conformity determination. For conformity purposes, only the emissions of nonattainment and maintenance pollutants and precursors in non-attainment and maintenance areas are considered. Similar to the NEPA analysis, the conformity analysis focuses on the increase or decrease in emissions. Unlike NEPA, there is no need to discuss alternatives or "no action" alternatives. The only relevant emissions are the net increases when all increases and decreases are considered. This is because the relevant ongoing emissions are already included in the applicable State Implementation and Maintenance plans.

It should also be noted that the conformity *de minimis* levels are useful as NEPA analysis screening thresholds to determine significance. That is because they are identical to "major source" thresholds applicable to new stationary sources under the federal Clean Air Act. As such, they represent reasoned decisions under two regulatory programs as quantities that represent thresholds of increased concern. The thresholds are lowered as the air quality of a nonattainment or maintenance area worsens. For example, the threshold for an ozone precursor is ten tons per year in an extreme nonattainment area, but 100 tons per year in a moderate nonattainment area. In attainment areas, the major emitting facility threshold of 250 tons per year of a pollutant is the threshold of increased concern; therefore, this threshold is also a suitable screening threshold. In NEPA terms, the foregoing means that the thresholds serve as screening level thresholds of significance. That is, where emissions of a pollutant are below the threshold, they would not be significant absent compounding factors, such as proximity of sensitive receptors. Where those emissions exceed the threshold, they demand a harder look at factors such as region of dispersal. It should be noted that the thresholds are conservative in that they are designed to apply to stationary sources. However, we are applying them to sources that may be diffused and dispersed. It should also be noted that by increasing and decreasing with the air quality of a region, these thresholds take into account other activities in the region in the past and present. As such they are measures of cumulative impacts.

3.2.2 Affected Environment

3.2.2.1 Region of Influence

The Study Area for this Supplemental is the same as analyzed in the 2015 NWTT Final EIS/OEIS. For purposes of this Supplemental, the region of influence for air quality remains the same as that identified in the 2015 NWTT Final EIS/OEIS (U.S. Department of the Navy, 2015), which includes the Study Area as well as adjoining land areas several miles inland, which may from time to time be downwind from emission sources associated with the Proposed Action.

3.2.2.2 Climate of the Northwest Training and Testing Study Area

Climate in the Study Area was discussed in the 2015 NWTT Final EIS/OEIS. The climate within the region of influence has not changed since the publication of the 2015 NWTT Final EIS/OEIS (Climatemps.com, 2017). The climate of the coastal Pacific Northwest is generally characterized by cool, dry summers and mild winters with abundant precipitation. Average annual air temperature gradually decreases, and average annual precipitation gradually increases from northern California to southeastern Alaska. Total annual rainfall approximately doubles, from about 70 inches (in.) (178 centimeters [cm]) per year in northern California to over 150 in. (381 cm) per year in Ketchikan, Alaska.

3.2.2.3 Regional Air Pollutant Sources and Emissions

Regional air pollutant sources include both marine activities and shore facilities. The pollutant sources within the Study Area in Washington, Oregon, California, and Alaska were discussed in the 2015 NWTT Final EIS/OEIS and have not changed since that document was prepared.

3.2.2.4 Existing Air Quality

Existing air quality within the Study Area in Washington, Oregon, California, and Alaska was discussed in the 2015 NWTT Final EIS/OEIS. Generally, air quality in offshore ocean areas is better than the air quality of adjacent onshore areas because there are few or no large sources of criteria air pollutants offshore. Much of the air pollutants found in offshore areas are transported there from adjacent land areas by low-level offshore winds, so concentrations of criteria air pollutants generally decrease with increasing distance from land. No criteria air pollutant monitoring stations are in offshore areas; thus, air quality in the Study Area must be inferred from the air quality in adjacent land areas where air pollutant concentrations are monitored. The Seattle-Tacoma 1-hour ozone area stopped being designated as a maintenance area when the implementation rule for the 1997 8-hour ozone NAAQS revoked the 1-hour standard in 2005. Since that time, this area is designated as attainment/unclassifiable for all ozone NAAQS. The 2015 ozone NAAQS does not trigger any conformity requirement for any area in WA, OR, or AK. As of October 11, 2016, the Seattle-Tacoma transitioned from a maintenance area for carbon monoxide (CO) to an attainment area. The area completed the 20-year maintenance period required by the CAA. The Seattle-Kent-Tacoma is still designated as maintenance for the particulate matter ≤ 10 microns in diameter (PM_{10}) NAAQS, and the Tacoma area is still designated as maintenance for particulate matter ≤ 2.5 microns in diameter ($PM_{2.5}$)

3.2.3 Environmental Consequences

This section evaluates how and to what degree the activities described in Chapter 2 (Description of Proposed Action and Alternatives) could impact air quality within the Study Area. Tables 2.5-1 through 2.5-3 present the baseline and proposed training and testing activity locations for each alternative (including number of activities and ordnance expended). The air quality stressors vary in intensity, frequency, duration, and location within the Study Area. The stressor applicable to air quality in the Study Area analyzed herein include criteria air pollutants.

The majority of these emissions occur beyond state waters, with the majority of emissions in most areas occurring beyond the state water boundaries. In addition to the activities occurring beyond territorial waters, there would be activities closer to shore; these were evaluated to assess local onshore impacts. Emissions within 3 NM of shore are within the area of influence for onshore areas, and therefore have the potential to affect air quality onshore. The discussions that follow evaluate the nearshore emissions within regional areas that include nonattainment or maintenance areas. Nearshore is defined as within 3 NM from shore. This is based on the definition of State waters and is the area within which emissions would be most likely to migrate onshore due to proximity. The emissions within 3 NM of the nonattainment/maintenance areas are compared with baseline emissions currently occurring within 3 NM of these areas. The net emissions associated with the Proposed Action are then compared to the General Conformity *de minimis/*major source thresholds for nonattainment/maintenance areas. The

Navy training and testing activities offshore of Oregon and California occur exclusively more than 12 NM from shore, so Air Quality Control Regions in those states are not affected.

Criteria air pollutant emissions were estimated for vessels, aircraft, and ordnance. For each alternative, emissions were estimated by Air Quality Control Region and by type of activity (training or testing). The emission estimates are provided in Appendix C (Air Quality Example Calculations). Hazardous air pollutants, also known as toxic air pollutants or air toxics, are those pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects. Hazardous air pollutants emissions are typically one or more orders of magnitude smaller than concurrent emissions of criteria air pollutants. Mobile sources operating as a result of the Proposed Action would be functioning intermittently over a large area and would produce negligible ambient hazardous air pollutants in a localized area not located near any publicly accessible areas. For this reason, hazardous air pollutants analyzed qualitatively in the 2015 NWTT Final EIS/OEIS remain valid and are not further analyzed in this document.

3.2.3.1 Criteria Air Pollutants

The potential impacts of criteria air pollutants were evaluated in the 2015 NWTT Final EIS/OEIS by estimating the emissions from training and testing activities in the Study Area for each alternative. The analysis concluded that, for the Preferred Alternative (Alternative 1), reasonably foreseeable emissions of criteria air pollutants in attainment areas would not cause federal ambient air quality standards to be exceeded, reasonably foreseeable emissions of criteria air pollutants in maintenance areas would not exceed applicable federal *de minimis* levels, and the public would not be exposed to substantial concentrations of hazardous air pollutants.

Most of the activities included in the Proposed Action that produce emissions are similar to those described in the 2015 NWTT Final EIS/OEIS. Modifications include changes to tempo of activity and renaming or combining related types of activities for greater clarity in this document and consistency across all Navy at-sea planning documents. The tempo and types of training and testing activities have fluctuated because of the introduction of new technologies, the evolving nature of international events, advances in warfighting doctrine and procedures, and changes in force structure. Such developments influence the frequency, type, duration, intensity, and location of required training and testing activities. The activities analyzed in this Supplemental are largely a continuation of activities that have been ongoing and were analyzed previously in the 2015 NWTT Final EIS/OEIS. The new and renamed training and testing events are listed in Tables 2.5-1, 2.5-2, and 2.5-3 of this Supplemental.

The estimates of criteria air pollutant emissions for each alternative are organized by activity (i.e., either training or testing). These emissions are further categorized by region (e.g., Air Quality Control Region) so that differences in background air quality, atmospheric circulation patterns, regulatory requirements, and sensitive receptors can be addressed. Total air pollutant emissions for Navy training and testing activities in the Study Area under each alternative are also estimated. The delta (increase or decrease) in total estimated emissions of each criteria pollutant or relevant precursor is then compared to the *de minimis*/major source threshold or the major emitting facility threshold, as appropriate for a given pollutant/precursor in a given area. If there are no compounding factors, then pollutants/precursors below the thresholds can be presumed to be not significant. Emission deltas above the thresholds demand consideration of other factors, as they may be significant.

3.2.3.1.1 Baseline Emissions

The baseline emissions, such as carbon monoxide (CO), nitrogen oxides (NO_x), volatile organic compounds (VOC), sulfur oxides (SO_x), PM_{10}, and $PM_{2.5}$, are defined as the emissions estimated for the Preferred Alternative that was proposed in the 2015 NWTT Final EIS/OEIS (U.S. Department of the Navy, 2015). Total criteria air pollutant baseline emissions are summarized in Table 3.2-2.

Table 3.2-2: Estimated Annual Baseline Criteria Air Pollutant Emissions

Source	*Emissions by Air Pollutant (tons per year)*					
	CO	*NO_X*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*
Training activities	343.8	210.1	26.9	54.8	11.8	11.8
Testing activities	47.3	44.3	7.2	6.0	2.4	2.4
Total Study Area	**391.1**	**254.4**	**34.1**	**60.8**	**14.2**	**14.2**

Notes: CO = carbon monoxide, NO_X = nitrogen oxides, $PM_{2.5}$ = particulate matter ≤ 2.5 microns in diameter, PM_{10} = particulate matter ≤ 10 microns in diameter, SO_x = sulfur oxides, VOC = volatile organic compounds.

3.2.3.1.2 Impacts from Criteria Pollutants Under Alternative 1

3.2.3.1.2.1 Impacts from Criteria Pollutants Under Alternative 1 for Training Activities

Under Alternative 1, the annual number of Navy training activities in the Study Area would, in most cases, decrease or remain the same in comparison to the 2015 NWTT Final EIS/OEIS Preferred Alternative levels. Exceptions are Air Combat Maneuver, Tracking Exercise – Maritime Patrol Aircraft, Surface Ship Sonar Maintenance, and Precision Anchoring. Emissions of criteria pollutants from training activities less than 3,000 ft. above ground level would decrease relative to baseline emissions. Table 3.2-3 lists the estimated training-related criteria air pollutant and precursor emissions in the Study Area by Air Quality Control Region under Alternative 1. Training and testing activities offshore of Oregon and California occur exclusively more than 12 NM from shore, so Air Quality Control Regions in those states are not affected. Under Alternative 1, about 49 percent of training emissions would be produced in state waters (0–3 NM offshore), approximately 1 percent would be produced in federal waters (3–12 NM offshore), and about 50 percent of training emissions would be produced in international waters (more than 12 NM offshore).

The air pollutant that would be emitted in the greatest quantity by aircraft under Alternative 1 is NO_x, followed by SO_x and CO. These pollutants are emitted mostly by aircraft involved in anti-submarine warfare training activities. The air pollutant that would be emitted in the greatest quantities by surface vessels is CO, followed by NO_x and SO_x. These pollutants are emitted by vessels involved in a variety of training activities in the offshore operational areas, including anti-submarine warfare, anti-surface warfare, and electronic warfare. The air pollutant that would be emitted in the greatest quantity by munitions is CO, which would be emitted under Alternative 1 by bombs, rockets, missiles, smokes, flares, and gun rounds. Under Alternative 1, training emissions would decrease on average about 16 percent, for all pollutants in the Study Area compared to the baseline.

Table 3.2-3: Estimated Annual Criteria Air Pollutant Emissions from Training Under Alternative 1

Air Quality Control Region	*Source Type*	*Air Pollutant Emissions (tons per year)*					
		CO	*NO_x*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*
Olympic-Northwest Washington Intrastate (WA)	Aircraft	0.3	0.3	0.0	0.1	0.2	0.2
	Vessels	70.8	32.6	4.4	9.4	0.8	0.8
	Ordnance	0.0	0.0	0.0	0.0	0.0	0.0
	Subtotal	**71.1**	**32.9**	**4.4**	**9.5**	**1.0**	**1.0**
Puget Sound Intrastate (WA)	Aircraft	0.1	0.1	0.0	0.0	0.1	0.1
	Vessels	57.6	30.0	3.6	11.0	0.8	0.8
	Ordnance	0.0	0.0	0.0	0.0	0.0	0.0
	Subtotal	**57.7**	**30.1**	**3.6**	**11.1**	**0.8**	**0.8**
Federal (3–12 NM)	Aircraft	0.2	0.2	0.0	0.1	0.2	0.2
	Vessels	1.0	2.2	0.1	1.4	0.1	0.1
	Ordnance	0.0	0.0	0.0	0.0	0.0	0.0
	Subtotal	**1.2**	**2.4**	**0.1**	**1.4**	**0.2**	**0.2**
International (+12 NM)	Aircraft	7.8	40.9	1.8	9.4	6.1	6.1
	Vessels	32.7	64.2	2.2	47.3	2.0	2.0
	Ordnance	2.6	0.2	0.0	0.0	0.8	0.8
	Subtotal	**43.1**	**105.3**	**4.0**	**56.7**	**9.0**	**9.0**
Study Area	**Total**	173.1	170.6	12.1	78.6	11.0	11.0

Notes: (1) NM = nautical miles, CO = carbon monoxide, NO_X = nitrogen oxides, $PM_{2.5}$ = particulate matter ≤ 2.5 microns in diameter, PM_{10} = particulate matter ≤ 10 microns in diameter, SO_x = sulfur oxides, VOC = volatile organic compounds.
(2) Table includes criteria pollutant precursors (e.g., VOC). Individual values may not add exactly to total values due to rounding. Only air pollutants emitted below 3,000 feet above ground level are included in the analysis. $PM_{2.5}$ is included in PM_{10}.
(3) Training and testing activities offshore of Oregon and California occur exclusively more than 12 NM from shore, so Air Quality Control Regions in those states are not affected.
(4) No training activities occur in Alaska.

3.2.3.1.2.2 Impacts from Criteria Pollutants Under Alternative 1 for Testing Activities

Under Alternative 1, the annual number of Navy testing activities in the Study Area would increase in comparison to the 2015 NWTT Final EIS/OEIS Preferred Alternative levels. This includes testing activities that were not previously analyzed, such as Undersea Warfare Testing, Simulant Testing, and Radar Testing. Emissions of all criteria pollutants would also significantly increase relative to the baseline emissions. The majority of emission increase is due to emissions from Mine Detection and Classification Testing, Unmanned Underwater Vehicle Testing, and Torpedo Tests – Non-Explosive. Table 3.2-4 lists the estimated testing-related criteria air pollutant and precursor emissions in the Study Area by region under Alternative 1. Training and testing activities offshore of Oregon and California occur exclusively more than 12 NM from shore, so Air Quality Control Regions in those states are not affected.

Table 3.2-4: Estimated Annual Criteria Air Pollutant Emissions from Testing Under Alternative 1

Air Quality Control Region	***Source Type***	***Air Pollutant Emissions (tons per year)***					
		CO	***NO_x***	***VOC***	***SO_x***	***PM_{10}***	***$PM_{2.5}$***
Southeast Alaska Intrastate (AK)	Aircraft	0.0	0.0	0.0	0.0	0.0	0.0
	Vessels	5.7	11.7	0.4	8.5	0.4	0.4
	Ordnance	0.0	0.0	0.0	0.0	0.0	0.0
	Subtotal	**5.7**	**11.7**	**0.4**	**8.5**	**0.4**	**0.4**
Olympic-Northwest Washington Intrastate (WA)	Aircraft	0.7	2.0	0.1	0.5	0.5	0.5
	Vessels	27.3	57.0	2.1	44.8	0.8	0.8
	Ordnance	0.0	0.0	0.0	0.0	0.0	0.0
	Subtotal	**28.0**	**59.0**	**2.2**	**45.3**	**1.3**	**1.3**
Puget Sound Intrastate (WA)	Aircraft	0.0	0.0	0.0	0.0	0.0	0.0
	Vessels	2.6	7.6	0.4	6.4	0.8	0.8
	Ordnance	0.0	0.0	0.0	0.0	0.0	0.0
	Subtotal	**2.6**	**7.7**	**0.4**	**6.4**	**0.8**	**0.8**
Federal (3–12 NM)	Aircraft	0.0	0.0	0.0	0.0	0.0	0.0
	Vessels	1.1	2.3	0.1	1.7	0.1	0.1
	Ordnance	0.0	0.0	0.0	0.0	0.0	0.0
	Subtotal	**1.2**	**2.4**	**0.1**	**1.7**	**0.1**	**0.1**
International (+12 NM)	Aircraft	0.7	2.4	0.1	0.6	0.5	0.5
	Vessels	29.1	58.4	2.6	49.5	3.7	3.7
	Ordnance	0.0	0.0	0.0	0.0	0.0	0.0
	Subtotal	**29.8**	**60.7**	**2.7**	**50.1**	**4.1**	**4.1**
Study Area	**Total**	**67.2**	**141.4**	**5.7**	**112.0**	**6.7**	**6.7**

Notes: (1) NM = nautical mile(s), CO = carbon monoxide, NO_X = nitrogen oxides, $PM_{2.5}$ = particulate matter ≤ 2.5 microns in diameter, PM_{10} = particulate matter ≤ 10 microns in diameter, SO_x = sulfur oxides, VOC = volatile organic compounds.
(2) Table includes criteria pollutant precursors (e.g., VOC). Individual values may not add exactly to total values due to rounding. Only air pollutants emitted below 3,000 feet above ground level are included in the analysis. $PM_{2.5}$ is included in PM_{10}.
(3) Training and testing activities offshore of Oregon and California occur exclusively more than 12 NM from shore, so Air Quality Control Regions in those states are not affected.

Under Alternative 1, emissions from testing activities would significantly increase within the Study Area compared to the 2015 NWTT Final EIS/OEIS Preferred Alternative. This increase is due to additional testing operations, including operations that were previously not analyzed, and updated emission factors for vessels. The updated emission factors for NO_x and SO_x are significantly higher for certain vessels, including guided-missile destroyer (DDG). Table 3.2-5 compares the Vessel Emissions from Testing Under Alternative 1, based on updated and previous emission factors from the 2015 NWTT Final EIS/OEIS.

Table 3.2-5: Comparison of Vessel Emissions from Testing Under Alternative 1 Using Updated and Previous Emission Factors

Source	*Emissions by Air Pollutant (tons per year)*					
	CO	*NO_X*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*
Total Vessel Testing Emissions, Alternative 1 - Updated Emission Factors	67.2	141.4	5.7	112.0	6.7	6.7
Total Vessel Testing Emissions, Alternative 1 – Previous Emission Factors	139.29	91.02	10.18	48.87	8.25	8.25
Net change (tpy)	-72.09	50.38	-4.48	63.13	-1.55	-1.55

Notes: (1) CO = carbon monoxide, NO_X = nitrogen oxides, $PM_{2.5}$ = particulate matter ≤ 2.5 microns in diameter, PM_{10} = particulate matter ≤ 10 microns in diameter, SO_x = sulfur oxides, tpy = tons/year, VOC = volatile organic compounds. (2) Table includes criteria pollutant precursors (e.g., VOC). Individual values may not add exactly to total values due to rounding. Only air pollutants emitted below 3,000 feet above ground level are included in the analysis. $PM_{2.5}$ is included in PM_{10}.

As shown in Table 3.2-4, based on the updated emission factors, about 46 percent of testing emissions would be produced 3 NM or more from shore. About 54 percent of air pollutant emissions would be produced in state waters. As shown in Table 3.2-4, the air pollutant that would be emitted in the greatest quantity by aircraft under Alternative 1 is NO_x, followed by CO and SO_x. These emissions are associated mostly with aircraft involvement in anti-submarine warfare. As shown in Table 3.2-4, the air pollutant that would be emitted in the greatest quantities by surface vessels is NO_x, followed by CO and SO_x. These emissions are associated with vessel involvement in a variety of testing activities. No air pollutants would be emitted by munitions, which would consist of torpedoes and sonobuoys.

Table 3.2-6 presents the total estimated emission results under Alternative 1 within the Study Area and includes all emissions generated, regardless of proximity to the coastline. The majority of these emissions occur beyond state waters, with the majority of emissions in most areas occurring beyond the state water boundaries. Under Alternative 1, the annual numbers of Navy training and testing activities in the Study Area would increase. The estimated emissions would also increase, on average about 24 percent, for NO_x, PM_{10} and $PM_{2.5}$ in the Study Area compared to the baseline. Emissions of SO_x increase significantly, primarily due to the impact of the updated vessels emission factors. In terms of screening thresholds, the bulk of emissions are outside territorial waters, where attainment status is undefined and generally meets attainment criteria. The major emitting facility 250-ton threshold is not exceeded in the Study Area as a whole. A closer look at emissions within three nautical miles of shore shows that there are also no exceedances of *de minimis*/major source thresholds in the two affected maintenance areas.

Table 3.2-6: Estimated Annual Criteria Air Pollutant Emissions in the Northwest Training and Testing Study Area Under Alternative 1

Source	*Emissions by Air Pollutant (tons per year)*					
	CO	*NO_X*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*
Training activities	173.1	170.7	12.1	78.7	11.1	11.1
Testing activities	67.3	141.4	5.7	112.0	6.7	6.7
Total Study Area	240.4	312.1	17.8	190.7	17.8	17.8
2015 NWTT Final EIS/OEIS Preferred Alternative	391.1	254.4	34.1	60.8	14.2	14.2
Net change (tpy)	-150.7	57.7	-16.3	129.9	3.6	3.6
Net change (%)	-39%	23%	-48%	214%	25%	25%

Notes: (1) CO = carbon monoxide, NO_X = nitrogen oxides, $PM_{2.5}$ = particulate matter ≤ 2.5 microns in diameter, PM_{10} = particulate matter ≤ 10 microns in diameter, SO_x = sulfur oxides, tpy = tons/year, VOC = volatile organic compounds. (2) Table includes criteria pollutant precursors (e.g., VOC). Individual values may not add exactly to total values due to rounding. Only air pollutants emitted below 3,000 feet above ground level are included in the analysis. $PM_{2.5}$ is included in PM_{10}.

No training or testing activities would take place in a nonattainment area. The only maintenance areas within the Study Area are for PM_{10} and $PM_{2.5}$. Specifically, within the Puget Sound Intrastate Air Quality Control Region, Pierce County, and Seattle-Kent-Tacoma are designated as maintenance for the PM_{10} NAAQS, and the Tacoma area is designated as maintenance for $PM_{2.5}$. In the region managed by Olympic Region Clean Air Agency, Thurston County is an air quality maintenance area for PM_{10}. As a conservative estimate it was assumed that all of the activities occurring within the Puget Sound Intrastate Air Quality Control Region and the Olympic-Northwest Washington Air Quality Control Region would take place in the maintenance areas for PM_{10} and $PM_{2.5}$. Table 3.2-7 presents the estimated nearshore emissions within the Olympic Northwest Washington Intrastate under Alternative 1 as compared with baseline nearshore emissions. Table 3.2-8 presents the estimated nearshore emissions within the Puget Sound Intrastate under Alternative 1 as compared with baseline nearshore emissions. The net emissions increases are compared with the applicable General Conformity Rule *de minimis* thresholds.

Table 3.2-7: Estimated Net Change in Annual Air Pollutant Emissions from Training and Testing Activities in the Olympic Northwest Washington Intrastate (Within 3 NM) Under Alternative 1

Source	*Emissions by Air Pollutant (tons per year)*					
	CO	*NO_X*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*
Total Emissions from all Sources	99.1	91.9	6.6	54.8	2.3	2.3
Baseline	110.9	59.3	9.0	12.1	2.1	2.1
Net Increase (Decrease)	(11.8)	32.6	(2.4)	42.7	0.2	0.2
De Minimis Threshold	N/A	N/A	N/A	N/A	100	100

Notes: (1) CO = carbon monoxide, NO_X = nitrogen oxides, $PM_{2.5}$ = particulate matter ≤ 2.5 microns in diameter, PM_{10} = particulate matter ≤ 10 microns in diameter, SO_x = sulfur oxides, tpy = tons/year, VOC = volatile organic compounds. (2) Table includes criteria pollutant precursors (e.g., VOC). Individual values may not add exactly to total values due to rounding. Only air pollutants emitted below 3,000 feet above ground level are included in the analysis. $PM_{2.5}$ is included in PM_{10}.

Table 3.2-8: Estimated Net Change in Annual Air Pollutant Emissions from Training and Testing Activities in the Puget Sound Intrastate (Within 3 NM) Under Alternative 1

Source	*Emissions by Air Pollutant (tons per year)*					
	CO	*NO_X*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*
Total Emissions from all Sources	60.3	37.7	4.0	17.5	1.7	1.7
Baseline	83.3	39.3	6.1	8.6	1.0	1.0
Net Increase (Decrease)	(23.0)	(1.6)	(2.1)	8.9	0.7	0.7
De Minimis Threshold	N/A	N/A	N/A	N/A	100	100

Notes: (1) CO = carbon monoxide, NO_X = nitrogen oxides, $PM_{2.5}$ = particulate matter ≤ 2.5 microns in diameter, PM_{10} = particulate matter ≤ 10 microns in diameter, SO_x = sulfur oxides, tpy = tons/year, VOC = volatile organic compounds. (2) Table includes criteria pollutant precursors (e.g., VOC). Individual values may not add exactly to total values due to rounding. Only air pollutants emitted below 3,000 feet above ground level are included in the analysis. $PM_{2.5}$ is included in PM_{10}.

Total air pollutant emissions from these activities would be well below the *de minimis* thresholds for PM_{10} and $PM_{2.5}$. As a result, no further analysis of conformity is required under Alternative 1 and a Record of Non-Applicability would be prepared in accordance with Navy guidance. Representative air pollutant emissions calculations and a Record of Non-Applicability are provided in Appendix C (Air Quality Example Calculations).

3.2.3.1.2.3 Summary – Alternative 1

The increase in criteria pollutants and relevant precursors in the Study Area as a whole is well below the major emitting facility threshold of 250 tons per year. Criteria air pollutants emitted in the Study Area within state waters could be transported ashore but would not affect the attainment status of the relevant air quality control regions. The amounts of air pollutants emitted in the Study Area and subsequently transported ashore would be minor because (1) emissions from Navy training and testing activities would be small compared to the amounts of air pollutants emitted by mobile and stationary emission sources ashore, including motor vehicles; (2) the pollutants are emitted over large areas (i.e., the Study Area is an area source); (3) the distances the air pollutants would be transported are often large; and (4) the pollutants would be substantially dispersed during transport. The criteria air pollutants emitted over nonterritorial waters within the Study Area would be dispersed over vast areas of open ocean and thus would not cause significant harm to environmental resources in those areas. Net emission increases of relevant pollutants and precursors within the maintenance areas in the Study Area are below the applicable General Conformity Rule *de minimis* thresholds. Therefore, no significant impacts on air quality as a result of criteria pollutants over territorial waters would occur, and no significant harm to air quality as a result of criteria pollutants over non-territorial waters would occur.

3.2.3.1.3 Impacts from Criteria Pollutants Under Alternative 2

3.2.3.1.3.1 Impacts from Criteria Pollutants Under Alternative 2 for Training Activities

Under Alternative 2, the annual number of Navy training activities in the Study Area would remain approximately that same as the 2015 NWTT Final EIS/OEIS Preferred Alternative levels. Emissions of all criteria pollutants would slightly increase relative to the 2015 NWTT Final EIS/OEIS Preferred Alternative emissions. Table 3.2-9 lists the estimated training-related criteria air pollutant and precursor emissions in the Study Area by region under Alternative 2. Under Alternative 2, about 54 percent of training emissions would be produced in state waters (0–3 NM offshore), about 1 percent would be produced in federal waters (3–12 NM offshore), and about 45 percent of training emissions would be produced in international waters (more than 12 NM offshore).

Table 3.2-9: Estimated Annual Criteria Air Pollutant Emissions from Training Under Alternative 2

Air Quality Control Region	*Source Type*	*Air Pollutant Emissions (tons per year)*					
		CO	*NO_x*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*
Olympic-Northwest Washington Intrastate (WA)	Aircraft	0.3	0.4	0.0	0.1	0.2	0.2
	Vessels	87.8	39.6	5.4	11.1	1.0	1.0
	Ordnance	0.0	0.0	0.0	0.0	0.0	0.0
	Subtotal	**88.1**	**40.0**	**5.4**	**11.2**	**1.2**	**1.2**
Puget Sound Intrastate (WA)	Aircraft	0.1	0.1	0.0	0.0	0.1	0.1
	Vessels	73.5	36.8	4.6	12.6	0.9	0.9
	Ordnance	0.0	0.0	0.0	0.0	0.0	0.0
	Subtotal	**73.6**	**36.9**	**4.6**	**12.7**	**1.0**	**1.0**
Federal (3–12 NM)	Aircraft	0.3	0.3	0.0	0.1	0.2	0.2
	Vessels	1.0	2.2	0.1	1.4	0.1	0.1
	Ordnance	0.0	0.0	0.0	0.0	0.0	0.0
	Subtotal	**1.3**	**2.5**	**0.1**	**1.5**	**0.3**	**0.3**

Table 3.2-9: Estimated Annual Criteria Air Pollutant Emissions from Training Under Alternative 2 (continued)

Air Quality Control Region	*Source Type*	*Air Pollutant Emissions (tons per year)*					
		CO	*NO_x*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*
International (+12 NM)	Aircraft	8.9	41.8	1.9	9.7	7.4	7.4
	Vessels	34.1	66.9	2.3	49.5	2.1	2.1
	Ordnance	2.7	0.2	0.0	0.0	0.8	0.8
	Subtotal	**45.7**	**108.9**	**4.2**	**59.1**	**10.4**	**10.4**
Study Area	**Total**	**208.6**	**188.2**	**14.3**	**84.5**	**12.8**	**12.8**

Notes: (1) CO = carbon monoxide, NO_X = nitrogen oxides, $PM_{2.5}$ = particulate matter ≤ 2.5 microns in diameter, PM_{10} = particulate matter ≤ 10 microns in diameter, SO_x = sulfur oxides, VOC = volatile organic compounds.
(2) Table includes criteria pollutant precursors (e.g., VOC). Individual values may not add exactly to total values due to rounding. Only air pollutants emitted below 3,000 feet above ground level are included in the analysis. $PM_{2.5}$ is included in PM_{10}.
(3) Training and testing activities offshore of Oregon and California occur exclusively more than 12 NM from shore, so Air Quality Control Regions in those states are not affected.
(4) No training activities occur in Alaska.

The air pollutant that would be emitted in the greatest quantity by aircraft under Alternative 2 is NO_x, followed by SO_x and CO. These pollutants are emitted mostly by aircraft involved in anti-submarine warfare training activities. The air pollutant that would be emitted in the greatest quantities by surface vessels is CO, followed by NO_x and SO_x. These pollutants are emitted by vessels involved in a variety of training activities, including anti-submarine warfare, anti-surface warfare, and electronic warfare. The air pollutant that would be emitted in the greatest quantity by munitions is CO, which would be emitted under Alternative 2 by bombs, rockets, missiles, smokes, flares, and gun rounds. Under Alternative 2, training emissions would decrease on average by about 4 percent for all pollutants in the Study Area compared to the baseline.

3.2.3.1.3.2 Impacts from Criteria Pollutants Under Alternative 2 for Testing Activities

Under Alternative 2, the annual number of Navy testing activities in the Study Area would increase in comparison to the 2015 NWTT Final EIS/OEIS Preferred Alternative levels. Table 3.2-10 lists the estimated testing-related criteria air pollutant and precursor emissions in the Study Area by air quality control region under Alternative 2. About 50 percent of testing-related emissions would be produced more than 3 NM offshore, while the remaining 50 percent of emissions would be produced within 3 NM of shore. Emissions of all criteria pollutants would significantly increase relative to the 2015 NWTT Final EIS/OEIS Preferred Alternative emissions. One of the main factors affecting this increase is the updated set of emission factors for vessels. The updated emission factors for NO_x and SO_x are significantly higher for certain vessels, including guided-missile destroyer (DDG). Table 3.2-11 compares the Vessel Emissions from Testing Under Alternative 2, based on updated and previous emission factors from the 2015 NWTT Final EIS/OEIS.

Table 3.2-10: Estimated Annual Criteria Air Pollutant Emissions from Testing Under Alternative 2

Air Quality Control Region	*Source Type*	*Air Pollutant Emissions (tons per year)*					
		CO	*NO_x*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*
Southeast Alaska Intrastate (AK)	Aircraft	0.0	0.0	0.0	0.0	0.0	0.0
	Vessels	7.6	15.5	0.5	11.3	0.5	0.5
	Ordnance	0.0	0.0	0.0	0.0	0.0	0.0
	Subtotal	**7.6**	**15.5**	**0.5**	**11.3**	**0.5**	**0.5**
Olympic-Northwest Washington Intrastate (WA)	Aircraft	0.7	2.2	0.1	0.5	0.5	0.5
	Vessels	27.9	58.2	2.1	45.7	2.8	2.8
	Ordnance	0.0	0.0	0.0	0.0	0.0	0.0
	Subtotal	**28.6**	**60.3**	**2.3**	**46.2**	**3.3**	**3.3**
Puget Sound Intrastate (WA)	Aircraft	0.0	0.0	0.0	0.0	0.0	0.0
	Vessels	1.8	6.2	0.3	5.3	0.8	0.8
	Ordnance	0.0	0.0	0.0	0.0	0.0	0.0
	Subtotal	**1.8**	**6.2**	**0.3**	**5.3**	**0.8**	**0.8**
Federal (3–12 NM)	Aircraft	0.1	0.1	0.0	0.0	0.0	0.0
	Vessels	1.7	3.6	0.1	2.6	0.1	0.1
	Ordnance	0.0	0.0	0.0	0.0	0.0	0.0
	Subtotal	**1.8**	**3.6**	**0.1**	**2.6**	**0.2**	**0.2**
International (+12 NM)	Aircraft	0.8	2.4	0.1	0.6	0.5	0.5
	Vessels	30.3	61.0	2.7	51.8	3.8	3.8
	Ordnance	0.0	0.0	0.0	0.0	0.0	0.0
	Subtotal	**31.1**	**63.4**	**2.8**	**52.4**	**4.3**	**4.3**
Study Area	**Total**	**70.9**	**149.1**	**6.0**	**117.8**	**9.0**	**9.0**

Notes: (1) CO = carbon monoxide, NO_X = nitrogen oxides, $PM_{2.5}$ = particulate matter ≤ 2.5 microns in diameter, PM_{10} = particulate matter ≤ 10 microns in diameter, SO_x = sulfur oxides, VOC = volatile organic compounds.

(2) Table includes criteria pollutant precursors (e.g., VOC). Individual values may not add exactly to total values due to rounding. Only air pollutants emitted below 3,000 feet above ground level are included in the analysis. $PM_{2.5}$ is included in PM_{10}.

(3) Training and testing activities offshore of Oregon and California occur exclusively more than 12 NM from shore, so Air Quality Control Regions in those states are not affected.

Table 3.2-11: Comparison of Vessel Emissions from Testing Under Alternative 2 Using Updated and Previous Emission Factors

Source	*Emissions by Air Pollutant (tons per year)*					
	CO	*NO_X*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*
Total Vessel Testing Emissions, Alternative 2 - Updated Emission Factors	69.35	144.43	5.75	116.64	3.83	3.83
Total Vessel Testing Emissions, Alternative 2 – Previous Emission Factors	148.43	96.47	10.83	51.18	8.63	8.63
Net change (tpy)	-79.08	47.96	-5.08	65.46	-4.80	-4.80

Notes: (1) CO = carbon monoxide, NO_X = nitrogen oxides, $PM_{2.5}$ = particulate matter ≤ 2.5 microns in diameter, PM_{10} = particulate matter ≤ 10 microns in diameter, SO_x = sulfur oxides, tpy = tons/year, VOC = volatile organic compounds.
(2) Table includes criteria pollutant precursors (e.g., VOC). Individual values may not add exactly to total values due to rounding. Only air pollutants emitted below 3,000 feet above ground level are included in the analysis. $PM_{2.5}$ is included in PM_{10}.

The air pollutant that would be emitted in the greatest quantity by aircraft under Alternative 2 is NO_x, followed by CO and SO_x. These pollutants are emitted mostly by aircraft involved in anti-submarine warfare. The air pollutant that would be emitted in the greatest quantities by surface vessels is CO, followed by NO_x and SO_x. These pollutants are emitted by vessels involved in a variety of testing activities. No air pollutants would be emitted by munitions, which would consist of torpedoes and sonobuoys.

Table 3.2-12 presents the total estimated emission results under Alternative 2 within the Study Area and includes all emissions generated, regardless of proximity to the coastline. The majority of these emissions occur beyond state waters, with the majority of emissions in most areas occurring beyond the state water boundaries.

Table 3.2-12: Estimated Annual Criteria Air Pollutant Emissions in the Northwest Training and Testing Study Area Under Alternative 2

Source	*Emissions by Air Pollutant (tons per year)*					
	CO	*NO_X*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*
Training activities	208.6	188.2	14.3	84.5	12.8	12.8
Testing activities	70.9	149.1	9.7	117.8	9.0	9.0
Total Study Area	279.6	337.3	24.0	202.3	21.9	21.9
Baseline	391.1	254.4	34.1	60.8	14.2	14.2
Net change (tpy)	-111.5	82.9	-10.1	141.5	7.7	7.7
Net change (%)	-29%	33%	-30%	233%	54%	54%

Notes: (1) CO = carbon monoxide, NO_X = nitrogen oxides, $PM_{2.5}$ = particulate matter ≤ 2.5 microns in diameter, PM_{10} = particulate matter ≤ 10 microns in diameter, SO_x = sulfur oxides, tpy = tons per year, VOC = volatile organic compounds.
(2) Table includes criteria pollutant precursors (e.g., VOC). Individual values may not add exactly to total values due to rounding. Only air pollutants emitted below 3,000 feet above ground level are included in the analysis. $PM_{2.5}$ is included in PM_{10}.

Under Alternative 2, the annual number of training and testing activities in the Study Area would increase relative to the baseline. Emissions of NO_x, SO_x, PM_{10} and $PM_{2.5}$ would increase due to increases in the numbers of several training activities and the addition of new activities resulting in vessel emissions. Some of the emission increase is due to the use of updated vessel emission factors for these pollutants. In terms of screening thresholds, the bulk of emissions are outside territorial waters, where attainment status is undefined and generally meets attainment criteria. The major emitting facility 250-ton threshold is not exceeded in the Study Area as a whole. A closer look at emissions within three nautical miles of shore shows that there are also no exceedances of *de minimis*/major source thresholds in the two affected maintenance areas.

No training or testing activities would take place in a nonattainment area. The only maintenance areas within the Study Area are for PM_{10} and $PM_{2.5}$. Specifically, within the Puget Sound Intrastate Air Quality Control Region, Pierce County and Seattle-Kent-Tacoma are designated as maintenance for the PM_{10} NAAQS, and the Tacoma area is designated as maintenance for $PM_{2.5}$. In the region managed by Olympic Region Clean Air Agency, Thurston County is an air quality maintenance area for PM_{10}. As a conservative estimate it was assumed that all of the activities occurring within the Puget Sound Intrastate Air Quality Control Region and the Olympic-Northwest Washington Air Quality Control Region would take place in the maintenance areas for PM10 and PM2.5. Table 3.2-13 presents the estimated nearshore emissions within the Olympic Northwest Washington Intrastate under Alternative 2 as compared with baseline nearshore emissions. Table 3.2-14 presents the estimated nearshore emissions within the Puget Sound Intrastate under Alternative 2 as compared with baseline nearshore emissions. The net emissions increases are compared with the applicable General Conformity Rule *de minimis* thresholds.

Table 3.2-13: Estimated Net Change in Annual Air Pollutant Emissions from Training and Testing Activities in the Olympic Northwest Washington Intrastate (Within 3 NM) Under Alternative 2

Source	*Emissions by Air Pollutant (tons per year)*					
	CO	*NO_X*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*
Total Emissions from all Sources	116.7	100.3	7.7	57.5	4.5	4.5
Baseline	110.9	59.3	9.0	12.1	2.1	2.1
Net Increase (Decrease)	5.8	41.0	(1.3)	45.4	2.4	2.4
De Minimis Threshold	N/A	N/A	N/A	N/A	100	100

Notes: (1) CO = carbon monoxide, NO_X = nitrogen oxides, $PM_{2.5}$ = particulate matter ≤ 2.5 microns in diameter, PM_{10} = particulate matter ≤ 10 microns in diameter, SO_x = sulfur oxides, tpy = tons/year, VOC = volatile organic compounds
(2) Table includes criteria pollutant precursors (e.g., VOC). Individual values may not add exactly to total values due to rounding. Only air pollutants emitted below 3,000 feet above ground level are included in the analysis. $PM_{2.5}$ is included in PM_{10}.

Table 3.2-14: Estimated Net Change in Annual Air Pollutant Emissions from Training and Testing Activities in the Puget Sound Intrastate (Within 3 NM) Under Alternative 2

Source	*Emissions by Air Pollutant (tons per year)*					
	CO	*NO_X*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*
Total Emissions from all Sources	75.4	43.1	4.9	18.0	1.8	1.8
Baseline	83.3	39.3	6.1	8.6	1.0	1.0
Net Increase (Decrease)	-7.9	3.8	-1.2	9.4	0.8	0.8
De Minimis Threshold	N/A	N/A	N/A	N/A	100	100

Notes: (1) CO = carbon monoxide, NO_X = nitrogen oxides, $PM_{2.5}$ = particulate matter ≤ 2.5 microns in diameter, PM_{10} = particulate matter ≤ 10 microns in diameter, SO_x = sulfur oxides, tpy = tons/year, VOC = volatile organic compounds
(2) Table includes criteria pollutant precursors (e.g., VOC). Individual values may not add exactly to total values due to rounding. Only air pollutants emitted below 3,000 feet above ground level are included in the analysis. $PM_{2.5}$ is included in PM_{10}.

Total air pollutant emissions from these activities would be well below the *de minimis* thresholds for PM_{10} and $PM_{2.5}$. As a result, no further analysis of conformity is required under Alternative 2, and a Record of Non-Applicability would be prepared in accordance with Navy guidance. Representative air pollutant emissions calculations and a Record of Non-Applicability are provided in Appendix C (Air Quality Example Calculations).

3.2.3.1.3.3 Summary – Alternative 2

As noted previously, change to relevant emissions in the Study Area are below relevant screening thresholds. Criteria air pollutants emitted in the Study Area could be transported ashore but would not affect the attainment status of the relevant air quality control regions. The amounts of air pollutants emitted in the Study Area and subsequently transported ashore would be minimal because (1) emissions from Navy training and testing activities would be small compared to the amounts of air pollutants emitted by mobile and stationary emission sources ashore, including motor vehicles; (2) the air pollutants would be emitted over a large area; (3) the distances the air pollutants would be transported are often large, and (4) the pollutants would be substantially dispersed during transport. The criteria air pollutants emitted over nonterritorial waters within the Study Area would be dispersed over vast areas of open ocean and thus would not cause significant harm to environmental resources in those areas. Net emission increases within the maintenance areas in the Study Area are below the applicable Major Source/General Conformity Rule *de minimis* thresholds. Therefore, no significant impacts on air quality as a result of criteria pollutants over territorial waters would occur, and no significant harm to air quality as a result of criteria pollutants over non-territorial waters would occur.

3.2.3.1.4 Impacts from Criteria Pollutants Under the No Action Alternative

Under the No Action Alternative, the proposed training and testing activities would not occur. Other military activities not associated with this Proposed Action would continue to occur. Air emissions, 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 air pollutants within the 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 emissions, but would not measurably improve air quality in the Study Area.

3.2.3.2 Greenhouse Gases and Climate Change

Activities conducted as part of the Proposed Action would involve mobile sources using fossil fuel combustion as a source of power. Additionally, the expenditure of munitions could generate greenhouse gas emissions. Greenhouse emissions, depending on type, can persist in the atmosphere for extended periods of time, from 12 years for methane to up to 200 years for carbon dioxide. Climate change was discussed in the 2015 NWTT Final EIS/OEIS in Section 4.4.4 (Climate Change); that discussion remains valid and current.

Greenhouse gas emissions were calculated using emissions factors provided by the U.S. Navy for aircraft and vessels and published by the USEPA for munitions. Greenhouse gas emissions are summarized in Table 3.2-15. Baseline greenhouse gas emissions (i.e., emissions from existing activities) are also presented in the table.

Table 3.2-15: Estimated Annual Greenhouse Gas Emissions in the Northwest Training and Testing Study Area

Alternative	*Annual CO_2-Equivalent Emissions CO_2 Eq. (in lb./Year)*	*Annual CO_2-Equivalent Emissions CO_2 Eq. (in Metric Tons/Year)*
Baseline	343,373,185	155,891
Alternative 1	366,532,941	166,406
Increase in emissions for Alternative 1 compared to Baseline	23,159,757	10,515
Alternative 2	387,801,978	176,062
Increase in emissions for Alternative 2 compared to Baseline	44,428,794	20,171

Note: CO2 Eq. = carbon dioxide equivalent

Table 3.2-16 compares the estimated Annual Greenhouse Gas Emissions to the greenhouse gas emissions in the states within the Study Area. The estimated baseline carbon dioxide equivalent emissions range from 0.04 percent of the total carbon dioxide equivalent emissions generated by the activities conducted in California in 2016 to approximately 0.45 percent of the total carbon dioxide equivalent emissions generated by activities conducted in Alaska in 2015, with the percentage of carbon dioxide equivalent emissions increasing for Alternatives 1 and 2.

Table 3.2-16: Comparison of Annual Greenhouse Gas Emissions to Emissions in the States Within the Study Area

Alternative	*Annual CO_2-Equivalent Emissions CO_2 Eq. (in MM Metric Tons/Year)*	*Annual CO_2-Equivalent Emissions CO_2 Eq. (in MM Metric Tons/Year)*			
		California (2016)	*Oregon (2016)*	*Washington (2013)*	*Alaska (2015)*
		429	62	94.4	39.56
Baseline	0.156	0.04%	0.25%	0.17%	0.39%
Alternative 1	0.166	0.04%	0.27%	0.18%	0.42%
Alternative 2	0.176	0.04%	0.28%	0.19%	0.45%

Note: The states' referenced GHG emissions are based on the latest published data.

3.2.3.3 Summary of Potential Impacts (Combined Impacts of All Stressors) on Air Quality

3.2.3.3.1 Alternative 1

As discussed in Section 3.2.3.1 (Criteria Air Pollutants) and the Hazardous Air Pollutants discussion in the 2015 NWTT Final EIS/OEIS, emissions associated with Study Area training and testing under Alternative 1 would primarily occur at least 12 NM offshore. Fixed-wing aircraft emissions typically occur above the 3,000 ft. mixing layer. Given these characteristics, the impacts on air quality from the combination of these resource stressors are expected to be similar to the impacts on air quality for any of these stressors taken individually without any additive, synergistic, or antagonistic interaction. Emissions of criteria pollutants and hazardous air pollutants are expected to increase under Alternative 1 compared to the baseline emissions, but by amounts below relevant screening thresholds. Within state waters, a comparison of estimated emissions under Alternative 1 to the baseline indicates that most pollutant emissions would be reduced. Any increases within state waters would be below relevant screening thresholds.

3.2.3.3.2 Alternative 2

As discussed in Sections 3.2.3.1 (Criteria Air Pollutants) and the Hazardous Air Pollutants discussion in the 2015 NWTT Final EIS/OEIS, emissions associated with Study Area training and testing under Alternative 2 primarily would occur at least 12 NM offshore. Fixed-wing aircraft emissions typically occur above the 3,000 ft. mixing layer. Given these characteristics, the impacts on air quality from the combination of these resource stressors are expected to be similar to the impacts on air quality for any of these stressors taken individually without any additive, synergistic, or antagonistic interaction. Emissions of most criteria pollutants and hazardous air pollutants are expected to increase under Alternative 2 compared to the 2015 NWTT Final EIS/OEIS Preferred Alternative emissions, but by amounts below relevant screening thresholds. Within state waters, a comparison of estimated emissions under Alternative 2 to the baseline indicates that most pollutant emissions would be reduced. Any increases within state waters would be below relevant screening thresholds.

3.2.3.3.3 No Action Alternative

Under the No Action Alternative analyzed in this Supplemental, the Navy would not conduct proposed at-sea training and testing activities in the NWTT Study Area. Air emissions, 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.

REFERENCES

U.S. Department of the Navy. (2015). *Northwest Training and Testing Environmental Impact Statement/Overseas Environmental Impact Statement, Final*. Pearl Harbor, HI: U.S. Pacific Fleet.

U.S. Environmental Protection Agency. (2016). *National Ambient Air Quality Standards Table*. Retrieved from https://www.epa.gov/criteria-air-pollutants/naaqs-table.

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3.3 Marine Habitats

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3.3 Marine Habitats

3.3.1 Affected Environment

For purposes of this Supplemental Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) (Supplemental), the Study Area for marine habitats remains the same as that identified in the 2015 Northwest Training and Testing (NWTT) Final EIS/OEIS.

3.3.1.1 Existing Conditions

Following a review of recent literature, the existing conditions of marine habitats in the Study Area as listed in the 2015 NWTT Final EIS/OEIS have not appreciably changed. As such, the information presented in the 2015 NWTT Final EIS/OEIS remains valid. Table 3.3-1 in the 2015 NWTT Final EIS/OEIS shows the habitat types within the open ocean, and bays and estuaries of the Study Area, and these habitat types have not changed.

The Magnuson-Stevens Fishery Conservation and Management Act, which was reauthorized and amended by the Sustainable Fisheries Act (1996), requires eight regional fishery management councils to describe and identify Essential Fish Habitat (EFH) in their respective regions, to specify actions to conserve and enhance that EFH, and to minimize the adverse effects of fishing on EFH. Congress defined EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." Many of the habitats in the Study Area are protected under EFH. Habitats in the Study Area that are protected under the Magnuson-Stevens Fishery Conservation and Management Act as EFH and Habitat Areas of Particular Concern designations have not changed. The water itself, as marine habitat, is assessed in terms of water quality impacts in Section 3.1 (Sediments and Water Quality) and as part of EFH in 3.9 (Fishes), so it is not addressed further here.

3.3.1.2 Soft, Hard, or Vegetated Shores, and Aquatic Beds

The descriptions and locations of soft, hard, or vegetated shores, and aquatic beds, as discussed in the 2015 NWTT Final EIS/OEIS have not changed in the Offshore Area, Inland Waters, or the Western Behm Canal (Alaska). As such, the information presented in the 2015 NWTT Final EIS/OEIS remains valid.

3.3.1.3 Soft Bottoms, Hard Bottoms, and Artificial Structures

The descriptions and locations of soft bottom, hard bottom (e.g., seamounts and hydrothermal vents), and artificial structures (e.g., artificial reefs, shipwrecks, fish-aggregating devices) as discussed in the 2015 NWTT Final EIS/OEIS (see Figure 3.3-1 through 3.3-3 in the 2015 NWTT Final EIS/OEIS) have not changed in the Offshore Area, Inland Waters, or the Western Behm Canal (Alaska). As such, the information presented in the 2015 NWTT Final EIS/OEIS remains valid. Shipwreck data has been updated and is discussed in Section 3.10 (Cultural Resources).

3.3.2 Environmental Consequences

The 2015 NWTT Final EIS/OEIS considered training and testing activities that currently occur in the Study Area and considered all potential stressors related to marine habitats. The stressors applicable to marine habitats in the Study Area for this Supplemental are the same stressors considered in the 2015 NWTT Final EIS/OEIS:

- **Explosives** (in-water explosions)
- **Physical disturbance and strike** (vessels and in-water devices, military expended materials, seafloor devices)

This section evaluates how and to what degree potential impacts on marine habitats from stressors described in Section 3.0.1 (Overall Approach to Analysis) may have changed since the analysis presented in the 2015 NWTT Final EIS/OEIS was completed. Proposed training and testing activities, 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 are presented in Table 2.5-1, Table 2.5-2, and Table 2.5-3 in Chapter 2 (Description of Proposed Action and Alternatives). The tables also present the same information for activities proposed in the 2015 NWTT Final EIS/OEIS so that the proposed levels of training and testing under this supplement can be easily compared.

The analysis presented in this section also considers standard operating procedures, which are described in Section 2.3.3 (Standard Operating Procedures) of this Supplemental, and mitigation measures described in Chapter 5 (Mitigation). The Navy would implement these measures to avoid or reduce potential impacts on marine habitats from stressors associated with the proposed training and testing activities.

3.3.2.1 Explosive Stressors

3.3.2.1.1 Impacts from Explosives

As stated in the 2015 NWTT Final EIS/OEIS, the potential impacts of denotations on marine habitats are assessed according to size of charge (net explosive weight), charge radius, height above the bottom, substrate types in the area, and equations linking all these facts. Since the physical structure of the water column is not affected by explosions, only explosions on or near the bottom are expected to potentially impact abiotic substrates. Soft bottoms are preferred for mine shape placement, and as such, most events would occur there, since this habitat type is likely to recover from these activities. Cobble, rocky reef, and other hard-bottom habitat may be scattered throughout the area, but those areas would be avoided during training to the maximum extent practicable. Detonations during training activities are likely to occur in the same general area (Crescent Harbor Explosive Ordnance Disposal training range; Naval Air Station Whidbey Island; and Hood Canal Explosive Ordnance Disposal Training Range, Naval Base Kitsap Bangor), which would further decrease the total area impacted. The recovery for habitats in areas of repeated detonations would be expected to be prolonged.

No training activities with seafloor detonations are proposed in the Offshore Area or Western Behm Canal under any alternative, and no testing activities with seafloor detonations are proposed in any part of the Study Area under any alternative; therefore, only training activities in the Inland Waters portion of the Study Area and testing activities in the Offshore Area (associated with mine countermeasure and neutralization testing) will be analyzed for impacts from underwater explosives. Underwater detonations that occur on or near the bottom are used only during mine warfare training activities; all other detonations used in training and testing activities occur in the water column or in the air. The impacts of underwater explosions vary with the bottom habitat type.

3.3.2.1.1.1 Impacts from Explosive Stressors Under Alternative 1

Impacts from Explosive Stressors Under Alternative 1 for Training Activities

Under Alternative 1, the number of proposed training activities involving underwater explosives would remain the same as those proposed in the 2015 NWTT Final EIS/OEIS. Explosive Ordnance Disposal Mine Neutralization Training remains the same as proposed in the 2015 NWTT Final EIS/OEIS. This activity occurs in Crescent Harbor and Hood Canal. The habitat in these areas has not changed.

Although the primary habitat of the Inland Waters where underwater explosives would occur is soft bottom, small portions of hard-bottom habitat are present. As described in the 2015 NWTT Essential Fish Habitat Assessment (EFHA), explosive impacts on the hard-bottom habitat could occur by reducing the quality and quantity of non-living habitats that constitute EFH and Habitat Areas of Particular Concern. As concluded in the 2015 NWTT EFHA, these impacts would be permanent but minimal in Crescent Harbor Explosive Ordnance Disposal training range; Naval Air Station Whidbey Island; and Hood Canal Explosive Ordnance Disposal Training Range, Naval Base Kitsap Bangor. In contrast, impacts on the soft bottom were determined to be short term and minimal.

Mitigation measures, as defined in Appendix K (Geographic Mitigation Assessment), will avoid or reduce potential impacts on live hard bottom, artificial reefs, and shipwrecks. Impacts on EFH in the water column are summarized in corresponding resource sections (e.g., Section 3.8, Marine Invertebrates; and Section 3.9, Fishes).

Impacts from Explosive Stressors Under Alternative 1 for Testing Activities

Under Alternative 1, mine countermeasure and neutralization testing and torpedo explosive testing activities are proposed in the Offshore Area. Mine Countermeasure and Neutralization testing is a new activity for testing as compared to the 2015 NWTT Final EIS/OEIS (see Table 2.3-2). Since the physical structure of the water column is not affected by explosions, only explosions on or near the bottom are expected to potentially impact abiotic substrate. Although mine countermeasure and neutralization testing may occur on the sea floor, explosive denotations in the Offshore Area would only occur in the water column, typically in water depths greater than 100 feet. Therefore, impacts to marine habitat from mine countermeasure and neutralization testing would not occur under Alternative 1. Torpedo explosive testing would also occur in the water column as described in the 2015 NWTT Final EIS/OEIS (see Table 2.5-2), and although tempo would increase under Alternative 1 when compared to the tempo analyzed in the 2015 NWTT Final EIS/OEIS, there would be no impact to marine habitat in the Offshore Area. Explosions associated with testing activities under Alternative 1 would have no impact to marine habitat structure in the Offshore Area.

Mitigation measures, as defined in Appendix K (Geographic Mitigation Assessment), will avoid or reduce potential impacts on live hard bottom. Impacts on EFH in the water column are summarized in corresponding resource sections (e.g., Section 3.8, Marine Invertebrates; and Section 3.9, Fishes).

3.3.2.1.1.2 Impacts from Explosive Stressors Under Alternative 2

Impacts from Explosive Stressors Under Alternative 2 for Training Activities

Under Alternative 2, the number of proposed training activities that would involve the use of underwater explosives in the Inland Waters would stay the same compared to the number of activities proposed in the 2015 NWTT Final EIS/OEIS (see Table 2.5-1) and would be the same compared to Alternative 1. Therefore, underwater explosions under Alternative 2 would impact marine habitats as described under Alternative 1.

Mitigation measures, as defined in Appendix K (Geographic Mitigation Assessment), will avoid or reduce potential impacts on live hard bottom. Impacts on EFH in the water column are summarized in corresponding resource sections (e.g., Section 3.8, Marine Invertebrates; and Section 3.9, Fishes).

Impacts from Explosive Stressors Under Alternative 2 for Testing Activities

Under Alternative 2, the number of proposed testing activities that would involve the use of underwater explosives in the Offshore Area would stay the same compared to the number of activities proposed under Alternative 1. Therefore, underwater explosions under Alternative 2 would impact marine habitats as described under Alternative 1.

Mitigation measures, as defined in Appendix K (Geographic Mitigation Assessment), will avoid or reduce potential impacts on live hard bottom. Impacts on EFH in the water column are summarized in corresponding resource sections (e.g., Section 3.8, Marine Invertebrates; and Section 3.9, Fishes).

3.3.2.1.1.3 Impacts from Explosive Stressors Under the No Action Alternative

Under the No Action Alternative, the proposed training and testing activities would not occur. Other military activities not associated with this Proposed Action would continue to occur. Explosive stressors associated with the Proposed Action 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.

The No Action Alternative would lessen the potential for impacts on the marine habitat (including EFH) from explosive stressors, but would not measurably improve the condition of marine habitat (including EFH) throughout the Study Area because the impacts are so minimal under Alternatives 1 or 2. These areas have the potential to regain habitat value, but as they are so limited in area, the impact to the greater ecosystem would be undetectable.

3.3.2.2 Physical Disturbance and Strike Stressors

Bottom habitats could be disturbed by vessel and in-water device strikes, military expended materials, and seafloor devices used for military training and testing. As stated in the 2015 NWTT Final EIS/OEIS, impacts of physical disturbance or strike resulting from military training and testing activities on biogenic soft bottom (e.g., seagrass, macroalgae, etc.) and hard bottom (e.g., corals, sponges, tunicates, oysters, mussels, macroalgae, etc.) habitats are discussed in Sections 3.7 (Marine Vegetation) and 3.8 (Marine Invertebrates), respectively.

No training activities with vessels (see Table 3.0-12) and in-water strikes (see Table 3.0-13) are proposed in the Western Behm Canal Portion of the Study Area under any of the alternatives. Therefore, there would be no impact to marine habitats in the Western Behm Canal portion of the Study Area from training activities with vessels and in-water devices. Testing activities with vessels and in-water devices would occur in the Western Behm Canal. Neither testing nor training activities with military expended materials would occur under any of the alternatives.

3.3.2.2.1 Impacts from Vessels and In-Water Devices

3.3.2.2.1.1 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 number of proposed training activities involving the movement of vessels (see Table 3.0-12) would remain generally consistent with those proposed in the 2015 NWTT Final EIS/OEIS. Vessel movement during training would decrease slightly in the Offshore Area (from 1,156 to 1,144) and in the Inland Waters (from 368 to 327) and would not occur in the Western Behm Canal, resulting in a small net decrease in activities in the Study Area. The activities would occur in the same locations and in a similar manner as were analyzed previously. Most vessel movements and local disturbances of the surface water would be short term in nature, with some temporary increase in suspended sediment in shallow areas. Therefore, vessel movement for training activities in the Offshore Area, Inland Waters, and Western Behm Canal would have no effect on marine habitats under Alternative 1.

Impacts on marine habitats from vessels under Alternative 1 would be minimal and recoverable because (1) vessel activities that could come into contact with marine habitats would be located in previously disturbed areas, (2) most vessel movements and local disturbances of the surface water would be short term in nature with some temporary increase in suspended sediment in shallow areas, and (3) Navy protective measures would be implemented. As shown in the 2015 NWTT Final EIS/OEIS, vessels have no permanent effect on marine habitats. This Supplemental shows that, although the number of events change, the stressor still has no permanent effect on marine habitats. Therefore, vessels would not be expected to affect marine habitats.

Under Alternative 1, the number of proposed training activities involving the use of in-water devices (see Table 3.0-13) would increase compared with those proposed in the 2015 NWTT Final EIS/OEIS. 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 (from 495 to 541 in the Offshore Area, from 1 every two years to 59 in the Inland Waters, and none in the Western Behm Canal [see Table 3.0-13]); all the new uses are associated with small, slow-moving unmanned underwater vehicles, which all move on the surface of the water or in the water column and do not move quickly enough or push enough water around to disturb bottom habitats. The proposed increase of over 100 in-water devices and vessel movements would not change the conclusion presented in the 2015 NWTT Final EIS/OEIS. As the analysis in the 2015 NWTT Final EIS/OEIS concluded, under Alternative 1, training activities in the Offshore Area would not include activities where in-water devices would contact bottom substrates. Therefore, in-water devices for training activities in the Offshore Area would have no effect on marine habitats under Alternative 1.

In the Inland Waters, the training activities, including maritime homeland defense/security mine countermeasures integrated exercises, were discussed in the 2015 NWTT Final EIS/OEIS and have not changed. Much of these exercises would occur in previously disturbed areas. These in-water devices used for training activities could have an effect on marine habitats under Alternative 1. The training activities would occur primarily over soft-bottom habitats. However, a large part of the bottom habitat in the north end of the Puget Sound is rock, and activities could occur there as well. The effect on marine habitats would not alter the marine habitat's ability to function, but would create a disturbance on the soft bottom habitat in the vicinity of the device operation. However, soft-bottom substrate would be expected to shift back following a disturbance through tidal energy or storm generated waves (Davis, 2009; Halpern et al., 2008; Kennett, 1982).

Impacts on marine habitats from in-water devices under Alternative 1 would be minimal and recoverable because (1) in-water activities that could come into contact with marine habitats would be located in previously disturbed areas, (2) in-water devices are deployed at depths where they would not likely come in contact with marine habitat, and (3) Navy protective measures would be implemented. As shown in the 2015 NWTT Final EIS/OEIS, in-water devices have no permanent effect on marine habitats. This Supplemental shows that, although the number of events change, the stressor still has no permanent effect on marine habitats. Therefore, in-water devices would not be expected to affect marine habitats.

Any activities' conditions that might affect EFH would not change substantively from the 2015 NWTT Final EIS/OEIS preferred alternative; therefore, no new impacts are expected. Therefore, the EFHA from 2015 remains valid and the conclusions from it have not changed. Mitigation measures, as defined in Appendix K (Geographic Mitigation Assessment), will avoid or reduce potential impacts on live hard bottom. Impacts on EFH in the water column are summarized in corresponding resource sections (e.g., Section 3.8, Marine Invertebrates; and Section 3.9, Fishes).

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

Under Alternative 1, the number of proposed testing activities involving the movement of vessels (see Table 3.0-12) would remain generally consistent with those proposed in the 2015 NWTT Final EIS/OEIS. Vessel movement would increase in the Offshore Area (from 181 to 283 annual activities), in the Inland Waters (from 916 to 918), and in the Western Behm Canal (from 60 to 63), resulting in a net increase of approximately 1.3 percent in the Study Area. 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 activities remain unlikely to impact marine habitats. Therefore, vessel movement for testing activities in the Offshore Area, Inland Waters, and Western Behm Canal would have no effect on marine habitats under Alternative 1.

Impacts on marine habitats from vessels under Alternative 1 would be minimal and recoverable because (1) vessel activities that could come into contact with marine habitats would be located in previously disturbed areas, (2) most vessel movements and local disturbances of the surface water would be short term in nature with some temporary increase in suspended sediment in shallow areas, and (3) Navy protective measures would be implemented. As shown in the 2015 NWTT Final EIS/OEIS, vessels have no permanent effect on marine habitats. This Supplemental shows that, although the number of events change, the stressor still has no permanent effect on marine habitats. Therefore, vessels would not be expected to affect marine habitats.

Under Alternative 1, the number of proposed testing activities involving the use of in-water devices (see Table 3.0-13) would increase compared with those proposed in the 2015 NWTT Final EIS/OEIS. While in-water device movement would increase in the Offshore Area (from 156 to 215 annual activities), it increases in the Inland Waters (from 576 to 664) and increases in the Western Behm Canal (from 8 to 19), resulting in a net increase of approximately 24 percent in the Study Area (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 in-water device activities remain unlikely to impact marine habitats. For the current Proposed Action, the same testing activities in the Offshore Area as described in the 2015 NWTT Final EIS/OEIS would include activities where in-water devices would contact bottom substrates, such as with certain types of unmanned underwater vehicles in the Quinault Range Site at Pacific Beach in the tidal zone. This portion of the Study Area is predominately sandy bottom. These in-water devices used for testing activities could have an effect on marine habitats under Alternative 1. This effect would not alter the marine habitat's ability to function, but would create a disturbance on the soft-bottom habitat in the vicinity of the device operation. However, sand substrate would be expected to shift back following a disturbance through tidal energy or storm generated waves (Davis, 2009; Halpern et al., 2008; Kennett, 1982).

Testing activities in the Inland Waters portion of the Study Area would include activities using in-water devices that contact bottom substrates. The activities would occur primarily over soft-bottom habitat, and impacts would not alter the marine habitat's ability to function, but would create a disturbance on the soft-bottom habitat in the vicinity of the device operation. However, the soft-bottom substrate would be expected to shift back following a disturbance through tidal energy, bottom currents in deeper areas, or storm generated waves.

Marine habitats in the Western Behm Canal portion of the Study Area would not be impacted by in-water devices testing activities because the activities would not contact bottom substrates. Although the sediment in the Western Behm Canal is variable across the seafloor, generally sediments range from soft sediments to hard exposed bedrock. Soft-bottom sediment is expected to recover after a temporary disturbance due to normal sediment transport.

Impacts on marine habitats from in-water devices under Alternative 1 would be minimal and recoverable because (1) in-water activities that could come into contact with marine habitats would be located in previously disturbed areas, (2) in-water devices are deployed at depths where they would not likely come in contact with marine habitat, and (3) Navy protective measures would be implemented. As shown in the 2015 NWTT Final EIS/OEIS, in-water devices have no permanent effect on marine habitats. This Supplemental shows that, although the number of events change, the stressor still has no permanent effect on marine habitats. Therefore, in-water devices would not be expected to affect marine habitats.

Any activities' conditions that might affect EFH would not change substantively from the 2015 NWTT Final EIS/OEIS preferred alternative; therefore, no new impacts are expected. Therefore, the EFHA from 2015 remains valid and the conclusions from it have not changed. Mitigation measures, as described in Appendix K (Geographic Mitigation Assessment), will avoid or reduce potential impacts on live hard bottom. Impacts on EFH in the water column are summarized in corresponding resource sections (e.g., Section 3.8, Marine Invertebrates; and Section 3.9, Fishes).

3.3.2.2.1.2 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 number of proposed training activities involving the movement of vessels (see Table 3.0-12) would decrease in the Offshore Area (from 1,156 to 1,249) and increase in the Inland Waters (from 368 to 409) compared with those proposed in the 2015 NWTT Final EIS/OEIS. Vessel movement would increase slightly (from 1,471 to 1,658) in the Study Area (Table 3.0-12) compared to Alternative 1.

Under Alternative 2, the number of proposed training activities involving the movement of in-water devices would increase in the Offshore Area (from 495 to 547) and increase in the Inland Waters (from 1 every two years to 73 per year) compared with those proposed in the 2015 NWTT Final EIS/OEIS. In-water device movement would increase slightly from (600 to 620) in the Study Area compared to Alternative 1 (from 541 to 547 in the Offshore Area and from 1 every two years to 73 in the Inland Waters) (Table 3.0-13). All of the increased in-water device activities are associated with small, slow-moving unmanned underwater vehicles, which all move on the surface of the water or in the water column and do not move quickly enough or push enough water around to disturb bottom habitats. The proposed increase of approximately 100 in-water devices would not change that conclusion presented in the 2015 NWTT Final EIS/OEIS. Therefore, just as described for Alternative 1, impacts on marine habitats in the Offshore Area, Inland Waters, and Western Behm Canal from physical disturbance and strike under Alternative 2 would be minimal and recoverable because (1) vessel and in-water activities that could come into contact with marine habitats would be located in previously disturbed area, (2) most vessel movements and local disturbances of the surface water would be short term in nature with some temporary increase in suspended sediment in shallow areas, (3) in-water devices would be deployed at depths where they would not likely come in contact with marine habitat, and (4) the implementation of Navy protective measures would be implemented. Therefore, vessels and in-water devices would not be expected to affect marine habitats.

Any activities' conditions that might affect EFH would not change substantively from the 2015 NWTT Final EIS/OEIS preferred alternative; therefore, no new impacts are expected. Therefore, the EFHA from 2015 remains valid and the conclusions from it have not changed. Mitigation measures, as defined in Appendix K (Geographic Mitigation Assessment), will avoid or reduce potential impacts on live hard bottom. Impacts on EFH in the water column are summarized in corresponding resource sections (e.g., Section 3.8, Marine Invertebrates; and Section 3.9, Fishes).

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

Under Alternative 2, the number of proposed testing activities involving the movement of vessels (see Table 3.0-12) would increase compared to those proposed in the 2015 NWTT Final EIS/OEIS and increase compared to Alternative 1. Vessel movement would increase in the Offshore Area (from 283 to 295), in the Inland Waters (from 918 to 1,028), and the Western Behm Canal (from 63 to 77) compared to Alternative 1. There is also an overall increase in the use of in-water devices compared to Alternative 1 (from 215 to 224 in the Offshore Area, from 664 to 689 in the Inland Waters, and unchanged in the Western Behm Canal [see 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, impacts to marine habitats during vessel and in-water device activities would be unlikely. The proposed increase of vessel and in-water device activities would not change that conclusion. Therefore, impacts on marine habitats from physical disturbance and strike under Alternative 2 would be minimal and recoverable because (1) vessel and in-water activities that could come into contact with marine habitats would be located in previously disturbed areas, (2) most vessel movements and local disturbances of the surface water would be short term in nature with some temporary increase in suspended sediment in shallow areas, (3) in-water devices would be deployed at depths where they would not likely come in contact with marine habitat, and (4) Navy protective measures would be implemented. Therefore, vessels and in-water devices would not be expected to affect marine habitats.

Any activities' conditions that might affect EFH would not change substantively from the 2015 NWTT Final EIS/OEIS preferred alternative; therefore, no new impacts are expected. Therefore, the EFHA from 2015 remains valid and the conclusions from it have not changed. Mitigation measures, as defined in Appendix K (Geographic Mitigation Assessment), will avoid or reduce potential impacts on live hard bottom. Impacts on EFH in the water column are summarized in corresponding resource sections (e.g., Section 3.8, Marine Invertebrates; and Section 3.9, Fishes).

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

Under the No Action Alternative, the proposed training and testing activities would not occur. Other military activities not associated with this Proposed Action would continue to occur. Physical disturbance and strike stressors from in-water devices associated with the Proposed Action 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.

The No Action Alternative would lessen the potential for impacts on the marine habitat (including EFH) from physical disturbance and strike stressors, but would not measurably improve the condition of marine habitat (including EFH) throughout the Study Area because the impacts are so minimal under

Alternatives 1 or 2. These areas have the potential to regain habitat value but, as they are so limited in area, the impact to the greater ecosystem would be undetectable.

3.3.2.2.2 Impacts from Military Expended Materials

Military expended materials that could impact marine habitats include non-explosive practice munitions (Table 3.0-14), other military materials (Table 3.0-15), explosive munitions that may result in fragments (Table 3.0-16), and targets (Table 3.0-17).

3.3.2.2.2.1 Impacts from Military Expended Materials Under Alternative 1

Impacts from Military Expended Materials Under Alternative 1 for Training Activities

Under Alternative 1, 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. The activities that expend military materials would occur in the same locations and in a similar manner as were analyzed previously. The majority of military training items would be expended in the open ocean, where substrates would primarily be clays and silts. Military expended material expended near the coastal portions of the Offshore Area would be limited to small-caliber projectiles, flares, sonobuoys, and target fragments. These materials would be expended in an area of soft-bottom habitat, mainly sand, which is dynamic in nature. These materials would be small, and would typically be covered by sediment (through wave, tide, current, storm, or normal water movements of sediment or storm generated waves) or colonized by benthic organisms. Therefore, under Alternative 1, military material expended by training activities in the Offshore Area would have a temporary impact on marine habitats.

In the Inland Waters, military expended material could act as anchor points in the shifting bottom habitats, and could be colonized by benthic organisms. The small size, and small total footprint compared to available habitat, of military expended materials would not change the habitat structure. Therefore, military expended material from training activities in the Inland Waters would have no adverse impact on marine habitats.

Impacts on marine habitats from military expended materials under Alternative 1 would be minimal and recoverable because military expended material would be colonized by benthic organisms; therefore, they would not be expected to affect marine habitats. The 2015 NWTT EFHA stated that military expended materials may adversely affect substrate EFH. These effects ranged from minimal and long term to permanent.

Mitigation measures, as defined in Appendix K (Geographic Mitigation Assessment), will avoid or reduce potential impacts on live hard bottom. Impacts on EFH in the water column are summarized in corresponding resource sections (e.g., Section 3.8, Marine Invertebrates; and Section 3.9, Fishes).

Impacts from Military Expended Materials Under Alternative 1 for Testing Activities

Under Alternative 1, the number of military materials that would be expended during testing activities is generally consistent with the number proposed for use in the 2015 NWTT Final EIS/OEIS. The activities that expend military materials would occur in the same locations and in a similar manner as were analyzed previously for training activities. However, new testing activities in the Offshore Area, including mine countermeasure and neutralization testing (e.g., explosive fragments from neutralizer), and new military expended materials from Kinetic Energy Weapon Testing (e.g., kinetic energy rounds and large-caliber projectiles) were analyzed in Appendix F (Military Expended Material and Direct Strike Impact Analyses). According to the new analysis, the change in number of military expended material due to testing activities would be minor.

As described under training activities for military expended materials, the majority would be expended in open oceans where habitats are primarily soft bottom of the Offshore Area. Sand is dynamic in nature, and the materials would be small and typically would be covered by sediment through wave, tide, current, storm, or normal water movements of sediment or storm generated waves or colonized by benthic organisms. The small size of military expended materials, and the placement of them on soft mobile sediments, would not change the habitat structure. Therefore, military material expended during testing activities in the Offshore Area would affect marine habitats but would have no adverse impact.

As with training activities, military expended materials used during testing activities would be expended primarily over soft-bottom sediment which would be expected to shift back following a disturbance. The small size, and small total footprint compared to available habitat, of military expended materials would not change the habitat structure. Therefore, military expended material from testing activities in the Inland Waters would affect marine habitats.

The 2015 NWTT EFHA stated that military expended materials may adversely affect substrate EFH. These effects ranged from minimal and long term to permanent.

Mitigation measures, as described in Appendix K (Geographic Mitigation Assessment), will avoid or reduce potential impacts on live hard bottom. Impacts on EFH in the water column are summarized in corresponding resource sections (e.g., Section 3.8, Marine Invertebrates; and Section 3.9, Fishes).

3.3.2.2.2.2 Impacts from Military Expended Materials Under Alternative 2

<u>Impacts from Military Expended Materials Under Alternative 2 for Training Activities</u>

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 and varies between slight increases and decreases compared to Alternative 1. Under Alternative 2, however, there would be 43,112 medium-caliber projectiles compared to 26,660 in the Offshore Area under Alternative 1, and 6,057 small-caliber projectile casings expended in the Inland Waters compared to 3,036 under Alternative 1. The activities that expend military materials would occur in the same locations and in a similar manner as were analyzed previously. Therefore, the impacts to marine vegetation would be expected to be the same. Impacts on marine habitats from military expended materials under Alternative 2 would be minimal and recoverable because military expended material would be colonized by benthic organisms, since they would be anchor points in the shifting bottom habitats.

The 2015 NWTT EFHA stated that military expended materials may adversely affect substrate EFH. These effects ranged from minimal and long term to permanent.

Mitigation measures, as defined in Appendix K (Geographic Mitigation Assessment), will avoid or reduce potential impacts on live hard bottom. Impacts on EFH in the water column are summarized in corresponding resource sections (e.g., Section 3.8, Marine Invertebrates; and Section 3.9, Fishes).

<u>Impacts from Military Expended Materials Under Alternative 2 for Testing Activities</u>

Under Alternative 2, the number of military materials that would be expended during testing activities is generally consistent with the number proposed for use in the 2015 NWTT Final EIS/OEIS and under Alternative 1, with the exception of sonobuoys in the Offshore Area and anchors in the Inland Waters increasing under Alternative 2 compared to Alternative 1. Sub-surface stationary targets are typically recovered, and while they are appropriately included in the military expended materials category, pose no actual risk of physical disturbance and strike to marine habitats. When these are removed from the analysis, the military expended materials are reduced. The activities that expend military materials would occur in the same locations and in a similar manner as were analyzed previously. Impacts on marine habitats from military expended materials under Alternative 2 would be minimal and recoverable because military expended material would be colonized by benthic organisms, since they would provide anchor points in the shifting bottom habitats.

The 2015 NWTT EFHA stated that military expended materials may adversely affect substrate EFH. These effects ranged from minimal and long term to permanent.

Mitigation measures, as defined in Appendix K (Geographic Mitigation Assessment), will avoid or reduce potential impacts on live hard bottom. Impacts on EFH in the water column are summarized in corresponding resource sections (e.g., Section 3.8, Marine Invertebrates; and Section 3.9, Fishes).

3.3.2.2.2.3 Impacts from Military Expended Materials Under the No Action Alternative

Under the No Action Alternative, the proposed testing and training activities would not occur. Other military activities not associated with this Proposed Action would continue to occur. Physical disturbance and strike stressors from military expended materials associated with the Proposed Action 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.

The No Action Alternative would lessen the potential for impacts on the marine habitat (including EFH) from physical disturbance and strike stressors, specifically from military expended materials, but would not measurably improve the condition of marine habitat (including EFH) throughout the Study Area because the impacts are so minimal under Alternatives 1 or 2.

3.3.2.2.3 Impacts from Seafloor Devices

Several training and testing activities include the use of seafloor devices (see Table 3.0-18)—items that may contact the ocean bottom temporarily. The activities and the specific seafloor devices are (1) precision anchoring training, where anchors are lowered to the seafloor and recovered; (2) Explosive Ordnance Disposal mine countermeasures training exercises, where some mine targets may be moored to the seafloor; (3) crawler Unmanned Underwater Vehicle tests in which Unmanned Underwater Vehicles "crawl" across the seafloor; and (4) various testing activities where small anchors are placed on the seafloor to hold instrumentation in place.

3.3.2.2.3.1 Impacts from Seafloor Devices Under Alternative 1

<u>Impacts from Seafloor Devices Under Alternative 1 for Training Activities</u>

No training activities with seafloor devices are proposed in the Offshore Area under Alternative 1. Therefore, seafloor devices for training activities would have no effect on marine habitats in the Offshore Area under Alternative 1.

Under Alternative 1, when compared to the 2015 NWTT Final EIS/OEIS, the number of annual training activities that include the use of anchors (as seafloor devices) would increase from 10 to 40. The activity is comprised of a vessel navigating to a precise, pre-determined location and releasing the ship's anchor to the bottom. The anchor is later recovered, and the activity is complete. Training events that include seafloor devices in the Inland Waters portion of the Study Area are infrequent, the percentage of training area affected is small, and the effects are localized within specific training areas, so the soft-bottom substrates of disturbed areas would be expected to recover their previous structure. The effect on marine habitats would not alter the marine habitat's ability to function, but would create a disturbance on the soft-bottom habitat in the vicinity of the activity. However, sand substrate would be expected to shift back following a disturbance through tidal energy or storm-generated waves. Soft sediment covers a large portion within the Inland Waters, with sand and mud prevailing in the eastern regions.

Mine countermeasures training exercises involve non-permanent mine shapes that are laid in various places on the seafloor and recovered using normal assets with diver involvement. The mine shapes vary in size between 1 and 2.5 meters circumference. These activities would be conducted once every other year. Impacts on marine habitats from seafloor devices under Alternative 1 would be minimal and recoverable because they also would be laid in such a way that they would not disturb bottom sediment to an extent beyond temporary impacts; also, for seafloor devices such as mine countermeasures, impacts would occur in previously disturbed locations. The 2015 NWTT EFHA found that seafloor devices have no effect on water column EFH, but may adversely affect substrate EFH. These effects, however, were found to be minimal and temporary.

Mitigation measures, as defined in Appendix K (Geographic Mitigation Assessment), will avoid or reduce potential impacts on live hard bottom. Impacts on EFH in the water column are summarized in corresponding resource sections (e.g., Section 3.8, Marine Invertebrates; and Section 3.9, Fishes).

Impacts from Seafloor Devices Under Alternative 1 for Testing Activities

Under Alternative 1, when compared to the 2015 NWTT Final EIS/OEIS, the number of testing activities that include the use of seafloor devices would decrease in the Offshore Area and increase in the Inland Waters (as shown in Table 3.0-18). The majority of the activities involve the temporary placement of small anchors on the seafloor. These anchors enter the water slowly, reducing any risk of injury to marine habitats. When the test is completed, the anchors are recovered, again at a slow speed. In the Offshore Area and Inland Waters, seafloor devices for testing activities under Alternative 1 have the potential to affect marine habitat structure in the Study Area, but impacts would be local disturbance to the impact area, would not result in local community shift, and the substrate would be expected to shift back following the disturbance.

The testing activities in the Western Behm Canal would include activities where seafloor devices would contact bottom substrates. The effect on marine habitats would not alter the marine habitat's ability to function, but it would create a disturbance on the hard- or soft-bottom habitat in the vicinity of the activity. However, sand substrate would be expected to shift back following a disturbance through tidal energy or storm-generated waves, and seafloor devices are not expected to cause permanent damage to hard-bottom habitat. Therefore, seafloor devices for testing activities under Alternative 1 in the Western Behm Canal have the potential to affect marine habitat structure in the Study Area, but impacts would be local disturbance to the impact area, would not result in local community shift, and the substrate would be expected to shift back following the disturbance.

Seafloor devices were found to have no effect on water column EFH, but may adversely affect substrate EFH. These effects, however, were found to be minimal and temporary.

Mitigation measures, as described in Appendix K (Geographic Mitigation Assessment), will avoid or reduce potential impacts on live hard bottom. Impacts on EFH in the water column are summarized in corresponding resource sections (e.g., Section 3.8, Marine Invertebrates; and Section 3.9, Fishes).

3.3.2.2.3.2 Impacts from Seafloor Devices Under Alternative 2

Impacts from Seafloor Devices Under Alternative 2 for Training Activities

Under Alternative 2, when compared to the 2015 NWTT Final EIS/OEIS, the number of training activities that include the use of seafloor devices would be the same as described under Alternative 1, with the exception of an increase in mine shapes in the inland waters. Because of the nature of the activities, marine habitats may be impacted by seafloor devices temporarily increasing the turbidity (sediment suspended in the water); however, seafloor devices would be used in previously disturbed areas and therefore would not be expected to affect marine habitats. As discussed under Alternative 1, mine countermeasures training exercises involve non-permanent mine shapes that are laid in various places on the seafloor and recovered using normal assets with diver involvement. The mine shapes vary in size between 1 and 2.5 meters circumference. These activities would be conducted once every other year. Impacts on marine habitats from seafloor devices under Alternative 2 would be minimal and recoverable because they also would be laid in such a way that they would not disturb bottom sediment to an extent beyond temporary impacts; also, for seafloor devices such as mine countermeasures, impacts would occur in previously disturbed locations.

Seafloor devices were found to have no effect on water column EFH, but may adversely affect substrate EFH. These effects, however, were found to be minimal and temporary.

Mitigation measures, as defined in Appendix K (Geographic Mitigation Assessment), will avoid or reduce potential impacts on live hard bottom. Impacts on EFH in the water column are summarized in corresponding resource sections (e.g., Section 3.8, Marine Invertebrates; and Section 3.9, Fishes).

Impacts from Seafloor Devices Under Alternative 2 for Testing Activities

Under Alternative 2, when compared to the 2015 NWTT Final EIS/OEIS, the number of testing activities that include the use of seafloor devices would increase from Alternative 1 in the Inland Waters. The majority of the activities involve the temporary placement of small anchors on the seafloor. These anchors enter the water slowly, reducing any risk of injury to marine vegetation. When the test is completed, the anchors are recovered, again at a slow speed. Because of the nature of the activity, marine habitats may be impacted by seafloor devices temporarily increasing the turbidity (sediment suspended in the water); however, seafloor devices would be used in previously disturbed areas and therefore would not be expected to affect marine habitats.

Seafloor devices were found to have no effect on water column EFH, but may adversely affect substrate EFH. These effects, however, were found to be minimal and temporary.

Mitigation measures, as defined in Appendix K (Geographic Mitigation Assessment), will avoid or reduce potential impacts on live hard bottom. Impacts on EFH in the water column are summarized in corresponding resource sections (e.g., Section 3.8, Marine Invertebrates; and Section 3.9, Fishes).

3.3.2.2.3.3 Impacts from Seafloor Devices Under the No Action Alternative

Under the No Action Alternative, the proposed training and testing activities would not occur. Other military activities not associated with this Proposed Action would continue to occur. Physical disturbance and strike stressors from seafloor devices associated with the Proposed Action 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.

The No Action Alternative would lessen the potential for impacts on the marine habitat (including EFH) from physical disturbance and strike stressors, but would not measurably improve the condition of marine habitat (including EFH) throughout the Study Area because the impacts are so minimal under Alternatives 1 or 2.

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3.4 Marine Mammals

3.4.1 Affected Environment

This section (Section 3.4, Marine Mammals) of this Supplemental provides general background information on marine mammals present in the Northwest Training and Testing (NWTT) Study Area and provides the analysis of potential impacts to those marine mammals that may result from Navy training and testing activities using sonar and other transducers and in-water explosives. Section 3.4.1 (Affected Environment) provides an introduction to the species that occur in the NWTT Study Area. The complete analysis and summary of potential impacts of the Proposed Action on marine mammals are found in Sections 3.4.2 (Environmental Consequences), 3.4.3 (Summary of Impacts [Combined Impacts of All Stressors] on Marine Mammals), and 3.4.3.4 (Summary of Monitoring and Observations During Navy Activities Since 2015). For additional information, also see the 2015 NWTT Final EIS/OEIS, Section 3.4 (Marine Mammals) (U.S. Department of the Navy, 2015a).

3.4.1.1 General Background

Marine mammals are a diverse group of approximately 130 species. Most live predominantly in the marine habitat, although some species, such as seals, spend time in terrestrial habitats, and other species such as manatees and certain dolphins spend time in freshwater habitats (Jefferson et al., 2015; Rice, 1998). The exact number of formally recognized marine mammal species changes periodically with new scientific understanding or findings (Rice, 1998). For a list of current species classifications, see the formal list Marine Mammal Species and Subspecies maintained online by the Society for Marine Mammalogy (Committee on Taxonomy, 2017, 2018). In this document, the Navy follows the naming conventions presented by the National Marine Fisheries Service (NMFS) in the applicable annual Stock Assessment Reports (SAR) for the Pacific and Alaska covering the marine mammals present in the Study Area (Carretta et al., 2017c; Carretta et al., 2018a, 2018b; Muto et al., 2017; Muto et al., 2018b).

All marine mammals in the United States are protected under the Marine Mammal Protection Act (MMPA), and some species receive additional protection under the Endangered Species Act (ESA). The MMPA defines a marine mammal "stock" as "a group of marine mammals of the same species or smaller taxon in a common spatial arrangement that interbreed when mature" (16 United States Code [U.S.C.] section 1362; for further details, see Oleson et al. (2013)). As provided by NMFS guidance, "for purposes of management under the MMPA a stock is recognized as being a management unit that identifies a demographically independent biological population" (Carretta et al., 2017c; National Marine Fisheries Service, 2016h). However, in practice, recognized management stocks may fall short of this ideal because of a lack of information or for other reasons and, in some cases, may even include multiple Distinct Population Segments (DPS) in a management unit, such as with the California/Oregon/Washington stock of humpback whale (Bettridge et al., 2015; Titova et al., 2017).

The ESA provides for listing species, subspecies, or DPSs of species, all of which are referred to as "species" under the ESA. The Interagency Policy Regarding the Recognition of Distinct Vertebrate Population Segments Under the ESA defines a DPS as, "any subspecies of fish or wildlife or plants, and any DPS of any species of vertebrate fish or wildlife which interbreeds when mature" (61 Federal Register [FR] 4722; February 7, 1996). If a population meets the criteria to be identified as a DPS, it is eligible for listing under the ESA as a separate species (National Marine Fisheries Service, 2016h). MMPA stocks do not necessarily coincide with DPSs under the ESA (FR 81[174]: 62660-62320, September 8, 2016). For example, in the Study Area there are humpback whales seasonally present from two stocks and three distinct population segments (Bettridge et al., 2015; Carretta et al., 2017c; Carretta et al., 2018a; Muto et al., 2017; National Marine Fisheries Service, 2016e, 2016f; Titova et al., 2017). Central North Pacific stock humpback whales are presented in the Alaska SAR (Muto et al., 2017; Muto et al., 2018b) and that stock includes both the Hawaii and the Mexico DPSs; however, the Mexico DPS is also included in the California, Oregon, Washington stock along with the Central America DPS (Carretta et al., 2017c; Carretta et al., 2018a). Consistent with NMFS determination for the U.S. Exclusive Economic Zones (EEZ) in the Pacific, the fourth humpback whale DPS present in the Pacific (the Western North Pacific DPS) is not recognized as being present in Alaska or U.S. Pacific coast waters, and so is assumed not to be present in the Study Area during Navy training and testing activities. NMFS is in the process of reviewing humpback whale stock structure in light of the 14 DPSs and stock inconsistencies, but revisions to the species stock structure for the Pacific will not occur until the NMFS review is complete (Carretta et al., 2017d; Carretta et al., 2018a; Muto et al., 2018a; Muto et al., 2018b); an estimated date for completion of the review has not been provided. Further details on the stocks and DPSs found in the Study Area are provided in the applicable species specific subsections that follow.

As presented in the 2015 NWTT Final EIS/OEIS in Section 3.4.2.5 (Marine Mammal Density Estimates) and the applicable humpback whale and gray whale discussions, the Navy previously analyzed training and testing activities with regard to locations where cetaceans are known to engage in activities at certain times of the year that are important to individual animals as well as populations of marine mammals (see discussion in (Ferguson et al., 2015b; Van Parijs et al., 2015). As explained in Van Parijs et al. (2015), each such location was identified as a Biologically Important Area. For purposes of the analyses in this Supplemental, that information has been presented in Appendix K (Geographic Mitigation Assessment) and includes any emergent scientific information available since the 2015 analyses. New information in this regard has also been incorporated into the marine mammal distributions and density data presented in the Navy's NWTT Marine Species Density Database Technical Report (U.S. Department of the Navy, 2019).

There are 29 marine mammal species known to exist in the Study Area, including 7 mysticetes (baleen whales), 15 odontocetes (dolphins and toothed whales), 6 pinnipeds (seals and sea lions), and the Northern sea otter. Among these species there are multiple stocks and DPSs managed by NMFS or the U.S. Fish and Wildlife Service in the United States EEZ. The marine mammal species and their occurrence in the Study Area are provided in Table 3.4-1. The information presented in this Supplemental incorporates data from the U.S. Pacific and the Alaska Marine Mammal SARs (Carretta et al., 2017c; Carretta et al., 2018a, 2018b; Muto et al., 2017; Muto et al., 2018b), which cover those species present in the Study Area, and incorporates the best available science, including monitoring data from Navy marine mammal research efforts.

Table 3.4-1: Marine Mammals and Their Occurrence Within the NWTT Study Area

Common Name[1]	*Scientific Name*	*ESA Status*	*Stock[2]*	*Occurrence in Study Area*			
				Offshore Area	*Inland Waters*	*Western Behm Canal*	*Regional Notes*
Order Cetacea							
Suborder Mysticeti (baleen whales)							
Family Balaenidae (right whales)							
North Pacific right whale	*Eubalaena japonica*	Endangered	Eastern North Pacific	Rare	—	—	Extremely unlikely presence in the Offshore Area. Extralimital in Inland Waters and Western Behm Canal.
Family Balaenopteridae (rorquals)							
Blue whale	*Balaenoptera musculus*	Endangered	Eastern North Pacific	Seasonal	—	—	Seasonal occurrence in the Offshore Area. Highest likelihood in summer and fall and detected acoustically August through February. Extralimital in the Inland Waters and Western Behm Canal.
Fin whale	*Balaenoptera physalus*	Endangered	Northeast Pacific	—	—	Rare	This stock is extralimital in the Offshore Area and Inland Waters. Rare occurrence in Western Behm Canal.
		Endangered	California, Oregon, and Washington	Seasonal	Rare	—	Seasonal occurrence in the Offshore Area; high numbers in summer and fall and detected acoustically July through April. Rare in Inland Waters. This stock is extralimital in Western Behm Canal.
Sei whale	*Balaenoptera borealis*	Endangered	Eastern North Pacific	Regular	—	—	Likely occurrence in the Offshore Area. Extralimital in Inland Waters and Western Behm Canal.
Minke whale	*Balaenoptera acutorostrata*	NA	Alaska	—	—	Rare	This stock extralimital in the Offshore Area and Inland Waters. Rare occurrence in Western Behm Canal.

Table 3.4-1: Marine Mammals and Their Occurrence Within the NWTT Study Area (continued)

Common Name[1]	*Scientific Name*	*ESA Status*	*Stock*[2]	*Occurrence in Study Area*			
				Offshore Area	*Inland Waters*	*Western Behm Canal*	*Regional Notes*
Minke whale	*Balaenoptera acutorostrata*	NA	California, Oregon, and Washington	Regular	Seasonal	—	Likely occurrence in the Offshore Area. Seasonal occurrence in Inland Waters; more likely spring to fall. Rare in the Puget Sound. This stock is extralimital in Western Behm Canal.
Humpback whale[3]	*Megaptera novaeangliae*	Hawaii DPS (NA) Mexico DPS (T) Central America DPS (E)[3]	Central North Pacific	Regular	Regular	Regular	Likely with highest numbers in summer and fall but subset of populations may be present year-round.
			California, Oregon, and Washington	Regular	Regular	Regular	Likely with highest numbers in summer and fall but subset of populations may be present year-round.
Family Eschrichtiidae (gray whale)							
Gray whale	*Eschrichtius robustus*	NA	Eastern North Pacific	Seasonal	Seasonal	—	Likely occurrence in the Offshore Area and Inland Waters; not expected in Western Behm Canal.
		Endangered	Western North Pacific	Rare	Rare	—	Rare possible occurrence in the Offshore Area or Inland Waters; not expected in Western Behm Canal.
Suborder Odontoceti (toothed whales)							
Family Delphinidae (dolphins)							
Common bottlenose dolphin	*Tursiops truncatus*	NA	California, Oregon, and Washington	Regular	—	—	Regular occurrence in the Offshore Area. Extralimital in the Inland waters and Western Behm Canal.
Killer whale	*Orcinus orca*	NA	Eastern North Pacific Alaskan Resident	—	—	Regular	This stock is extralimital outside of Alaska waters. Likely occurrence in Western Behm Canal.

Table 3.4-1: Marine Mammals and Their Occurrence Within the NWTT Study Area (continued)

Common Name[1]	*Scientific Name*	*ESA Status*	*Stock*[2]	*Occurrence in Study Area*			
				Offshore Area	*Inland Waters*	*Western Behm Canal*	*Regional Notes*
Killer whale	*Orcinus orca*	NA	Eastern North Pacific Northern Resident	Seasonal	Seasonal	—	Seasonal rare presence in the Offshore Area and the Strait of Juan de Fuca portion of the Inland Waters. Not expected in Western Behm Canal.
		NA	West Coast Transient	Regular	Regular	Regular	Regular occurrence in all portions of the Study Area.
		NA	Eastern North Pacific Offshore	Regular	—	Regular	Likely occurrence in the Offshore Area and Western Behm Canal.
		Endangered	Eastern North Pacific Southern Resident	Seasonal	Regular	—	Seasonal occurrence in the Offshore Area and regular in the Inland Waters. Extralimital in Western Behm Canal.
Northern right whale dolphin	*Lissodelphis borealis*	NA	California, Oregon, and Washington	Regular	—	—	Likely occurrence in the Offshore Area. Extralimital in the Inland Waters and Western Behm Canal.
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	NA	North Pacific	—	—	Regular	This stock is extralimital to the Offshore Area and Inland Waters. Likely occurrence in Western Behm Canal; higher numbers in the spring.
		NA	California, Oregon, and Washington	Regular	Regular	—	Likely occurrence in the Offshore Area. Occurrence in the Inland Waters varies. Seasonal in Strait of Juan de Fuca and San Juan Islands, but extralimital in the Puget Sound. Likely present in Western Behm Canal.
Risso's dolphin	*Grampus griseus*	NA	California, Oregon, and Washington	Regular	Rare	—	Likely occurrence in the Offshore Area; rare occurrence in the Inland Waters; extralimital in Western Behm Canal.

Table 3.4-1: Marine Mammals and Their Occurrence Within the NWTT Study Area (continued)

Common Name[1]	*Scientific Name*	*ESA Status*	*Stock*[2]	*Occurrence in Study Area*			
				Offshore Area	*Inland Waters*	*Western Behm Canal*	*Regional Notes*
Short-beaked common dolphin	*Delphinus delphis*	NA	California, Oregon, and Washington	Regular	Rare	—	Likely occurrence in the Offshore area; more likely off of California coast. Rare occurrence in the Inland Waters; extralimital in Western Behm Canal.
Short-finned pilot whale	*Globicephala macrorhynchus*	NA	California, Oregon, and Washington	Regular	Rare	—	Likely occurrence but few in numbers in the Offshore Area. Rare possible presence in the Inland Waters; extralimital in Western Behm Canal.
Striped dolphin	*Stenella coeruleoalba*	NA	California, Oregon, and Washington	Regular	—	—	Likely occurrence in the deep ocean portion of the Offshore Area. Extralimital in the Inland Waters and Western Behm Canal.
Family Kogiidae (*Kogia* spp.)							
Dwarf sperm whale	*Kogia*	NA	California, Oregon, and Washington	Rare	—	—	There is a possibility the species is present in the Offshore Area extralimital in the Inland Waters and Western Behm Canal.
Pygmy sperm whale	*Kogia breviceps*	NA	California, Oregon, and Washington	Regular	—	—	Likely occurrence in the Offshore Area. Extralimital in the Inland Waters and Western Behm Canal.
Family Phocoenidae (porpoises)							
Dall's porpoise	*Phocoenoides dalli*	NA	Alaska	—	—	Regular	Likely year-round occurrence in Western Behm Canal.
		NA	California, Oregon, and Washington	Regular	Regular	—	Likely occurrence in the Offshore Area; fewer sightings in recent years in the Inland Waters.

Table 3.4-1: Marine Mammals and Their Occurrence Within the NWTT Study Area (continued)

Common Name[1]	*Scientific Name*	*ESA Status*	*Stock*[2]	*Occurrence in Study Area*			
				Offshore Area	*Inland Waters*	*Western Behm Canal*	*Regional Notes*
Harbor porpoise	*Phocoena phocena*	NA	Southeast Alaska[5]	—	—	Regular	Likely year-round occurrence in Western Behm Canal.
		NA	Northern Oregon/ Washington Coast	Regular	—	—	Likely occurrence in the Offshore Area of Northern Oregon and Washington.
		NA	Northern California/ Southern Oregon	Regular	—	—	Likely occurrence in the Offshore Area of Northern California and Southern Oregon.
		NA	Washington Inland Waters	—	Regular	—	Likely occurrence in the Inland Waters.
Family Physeteridae (sperm whale)							
Sperm whale	*Physeter macrocephalus*	Endangered	North Pacific	—	—	—	Not expected in Western Behm Canal due to pelagic nature, and no sightings in Southeast Alaska interior waters.
		Endangered	California, Oregon, and Washington	Regular	—	—	Likely occurrence in the Offshore Area. More likely in waters > 1,000 m depth, most often > 2,000 m.
Family Ziphiidae (beaked whales)							
Baird's beaked whale	*Berardius bairdii*	NA	Alaska	—	—	—	Alaska stock not in NWTT Offshore waters. Not expected in Western Behm Canal due to preferred deep water habitat.
		NA	California, Oregon, and Washington	Regular	—	—	Likely occurrence in the Offshore Area. Extralimital in Inland waters and Western Behm Canal.

Table 3.4-1: Marine Mammals and Their Occurrence Within the NWTT Study Area (continued)

Common Name[1]	*Scientific Name*	*ESA Status*	*Stock[2]*	*Occurrence in Study Area*			
				Offshore Area	*Inland Waters*	*Western Behm Canal*	*Regional Notes*
Cuvier's beaked whale	*Ziphius cavirostris*	NA	Alaska	—	—	—	Alaska stock not in NWTT Offshore Area or Inland Waters; extralimital in Western Behm Canal.
		NA	California, Oregon, and Washington	Regular	—	—	Likely occurrence in Offshore Area. Extralimital in Inland Waters and Western Behm Canal.
Mesoplodont beaked whales[4]	*Mesoplodon spp.*	NA	California, Oregon, and Washington	Regular	—	—	Likely occurrence in Offshore Area. Extralimital in Inland Waters and Western Behm Canal.
Suborder Pinnipedia							
Family Otariidae (sea lions and fur seals)							
California sea lion	*Zalophus californianus*	NA	U.S. Stock	Seasonal	Regular	—	Likely occurrence Offshore Area and in Inland Waters. This stock is not expected to be present in Western Behm Canal.
Steller sea lion	*Eumetopias jubatus*	NA	Eastern U.S.	Regular	Seasonal	Regular	Likely present in the Offshore Area and a seasonal presence in the Inland Waters. Likely present in Western Behm Canal.
		Endangered	Western U.S.	Rare	—	Rare	Rare presence in the Offshore Area. Not expected in the Inland Waters. In Western Behm Canal, possible presence of a few juveniles on occasion.
Guadalupe fur seal	*Arctocephalus townsendi*	Threatened	Mexico to California	Seasonal	—	—	Likely occurrence in the Offshore Area; not expected in Inland Waters or Western Behm Canal.

Table 3.4-1: Marine Mammals and Their Occurrence Within the NWTT Study Area (continued)

Common Name[1]	*Scientific Name*	*ESA Status*	*Stock*[2]	*Occurrence in Study Area*			
				Offshore Area	*Inland Waters*	*Western Behm Canal*	*Regional Notes*
Northern fur seal	*Callorhinus ursinus*	NA	Eastern Pacific	Regular	—	Seasonal	Likely occurrence in the Offshore Area and not expected to occur in Inland Waters. This stock is seasonal in Western Behm Canal.
		NA	California	Regular	—	—	Likely occurrence in the Offshore Area and not expected to occur in Inland Waters. This stock is extralimital in Western Behm Canal.
Family Phocidae (true seals)							
Harbor seal	*Phoca vitulina*	NA	Southeast Alaska (Clarence Strait)	—	—	Regular	Likely occurrence in Western Behm Canal.
		NA	Oregon/ Washington Coast	Regular	Seasonal	—	Likely occurrence in the nearshore waters off Oregon and Washington Pacific Coast and some seasonal presence possible in the Inland Waters.
		NA	California	Regular	—	—	Likely in the nearshore waters off California's Pacific Coast.
		NA	Washington Northern Inland Waters	Seasonal	Regular	—	Seasonal occurrence in the Offshore Area's coastal waters and regular presence in the northern portion of the Inland Waters.
		NA	Hood Canal	Seasonal	Regular	—	Seasonal occurrence in the Offshore Area and regular presence in the Hood Canal portion of the Inland Waters.
		NA	Southern Puget Sound	Seasonal	Regular	—	Seasonal occurrence in the Offshore Area and regular presence in the Inland Waters of Southern Puget Sound.

Table 3.4-1: Marine Mammals and Their Occurrence Within the NWTT Study Area (continued)

Common Name[1]	*Scientific Name*	*ESA Status*	*Stock*[2]	*Occurrence in Study Area*			
				Offshore Area	*Inland Waters*	*Western Behm Canal*	*Regional Notes*
Northern elephant seal	*Mirounga angustirostris*	NA	California	Regular	Regular	Seasonal	Regular occurrence in the Offshore Area with higher at-sea seasonal presence. Seasonal presence of a few individuals in some areas of the Strait of Juan de Fuca; Infrequent and generally lone individuals in Puget Sound.
Order Carnivora							
Family Mustelidae							
Northern sea otter	*Enhydra lutris kenyoni*	NA	Southeast Alaska	—	—	—	This stock not expected in Western Behm Canal.
			Washington	Regular	—	—	Likely in the Offshore Area in northern Washington, but in nearshore shallow water areas.

[1] Taxonomy follows the naming conventions of the Society for Marine Mammalogy Committee on Taxonomy (2017); (Committee on Taxonomy, 2018) and the NMFS stock assessment reports (Carretta et al., 2017c; Carretta et al., 2018a; Muto et al., 2017; Muto et al., 2018b)
[2] Stock names and designations for the U.S. Exclusive Economic Zones are from the Pacific (Carretta et al., 2017c; Carretta et al., 2018a, 2018b) and Alaska (Muto et al., 2017; Muto et al., 2018b) Stock Assessment Reports prepared by National Marine Fisheries Service
[3] Humpback whales in the Central North Pacific stock and the California, Oregon, and Washington stock are from three Distinct Population Segments based on animals identified in breeding areas in Hawaii, Mexico, and Central America (Carretta et al., 2017c; Carretta et al., 2018a, 2018b; Muto et al., 2017; Muto et al., 2018b; National Marine Fisheries Service, 2016i, 2016j, 2016k; Titova et al., 2017; Wade et al., 2016). Both stocks and all three DPSs co-occur in the NWTT Study Area (National Marine Fisheries Service, 2016f, 2016i).
[4] Due to the difficulty in distinguishing different Mesoplodon species from one another at sea during visual surveys off the U.S. Pacific Coast, the United States management unit for waters off California, Oregon, and Washington pursuant to MMPA has been defined by NMFS to include all Mesoplodon species that occur in an area. This is the case for the six Mesoplodont beaked whale species in the California, Oregon, and Washington stock (*M. densirostris*, *M. carlhubbsi*, *M. ginkgodens*, *M. perrini*, *M. peruvianus*, *M. stejnegeri*).
[5] At this time, no data are available to define stock structure for harbor porpoise on a finer scale in Alaska. However, based on comparisons with other regions, it is likely that several regional and sub-regional populations exist.
Notes: DPS = Distinct Population Segment; ESA = Endangered Species Act; NA = status is not applicable for those species that are not listed under ESA; T = Threatened; E = Endangered; U.S. = United States; Regular = a species that occurs as a regular or usual part of the fauna of the area, regardless of how abundant or common it is; Seasonal = species is only seasonally present in the NWTT Study Area; Rare = a species that occurs in the area only sporadically numbering only a few individuals; Extralimital = a species not expected to be in the designated area. Additional details regarding presence in the NWTT Study Area are provided in the species specific subsections.

3.4.1.2 Species Unlikely to Be Present in Northwest Training and Testing Study Area

3.4.1.2.1 Bryde's Whale (*Balaenoptera edeni*)

Bryde's whales occur primarily in offshore oceanic waters of the north Pacific (Barlow et al., 2006; Bradford et al., 2017). Data suggest that winter and summer grounds partially overlap in the central north Pacific (Murase et al., 2015; Ohizumi, 2002; Ohizumi et al., 2002). Bryde's whales are distributed in the central north Pacific in summer; the southernmost summer distribution of Bryde's whales inhabiting the central north Pacific is about 20° north (N) (Kishiro, 1996). Some whales remain in higher latitudes (around 25° N) in both winter and summer, but are not likely to move poleward of 40° N (Jefferson et al., 2015; Kishiro, 1996). Bryde's whales in some areas of the world are sometimes seen very close to shore and even inside enclosed bays (Baker & Madon, 2007; Best, 1996). There is some evidence that Bryde's whales migrate, although limited shifts in distribution toward and away from the equator, in winter and summer, have been observed (Best, 1996; Cummings, 1985). They appear to have a preference for water temperatures between approximately 59° and 68° Fahrenheit (F) [15° and 20° Celsius (C)] (Yoshida & Kato, 1999), much warmer than those of the Study Area. Based on sighting data collected by Southwest Fisheries Science Center during systematic ship surveys in the northeast Pacific between 1986 and 2014, there were no sightings of Bryde's whales north of approximately 41°N (Barlow, 2016; Hamilton et al., 2009). There have not been Bryde's whale calls detected in any of the various acoustic monitoring efforts off the coast of Washington (Debich et al., 2014; Emmons et al., 2017; Kerosky et al., 2013; Širović et al., 2012a; Trickey et al., 2015). Unprecedented strandings of Bryde's whale occurred in Puget Sound with one in January and one in December 2010 (Cascadia Research Collective, 2011a). Both animals were immature and in poor nutritional condition, suggesting that they were beyond the species' normal range. The occurrence of Bryde's whale within the Study Area is considered extralimital as all regions within the Study Area are outside the normal range of this species' distribution.

3.4.1.2.2 False Killer Whale (*Pseudorca crassidens*)

False killer whales are found in tropical and temperate waters, and there have been no sightings of false killer whales north of about 30°N during systematic ship surveys conducted by NMFS in the northeast Pacific between 1986 and 2014 (Barlow, 2016; Hamilton et al., 2009). A mixed-species group of approximately 70 false killer whales and 200 common bottlenose dolphins was observed 500 kilometers (km) north of the Strait of Juan de Fuca (at 50°N), 180 km off the coast of British Columbia, in July 2017 and is the most northerly record for this false killer whales in the eastern North Pacific (Halpin et al., 2018). The researchers who made this observation suggested the presence of these species should be considered vagrant, accidental, or otherwise associated with the prolonged period of ocean warming along the Pacific Coast (Halpin et al., 2018). Norman et al. (2004) observed that most strandings for false killer whales in Washington and Oregon occurred during or within a year of an El Niño event. In the 1990s, a pod of nine false killer whales was recorded in Puget Sound south of the Tacoma Narrows for several months and then left (McLean & Persselin, 2003; Stacey & Baird, 1991), and there are reports of an individual false killer whale sighted in the 1990s in the waters of Juneau, British Columbia, and Tacoma (McLean & Persselin, 2003; U.S. Department of the Navy, 2017e). For the MMPA stock assessment reports, there are five management stocks of false killer whale within the U.S. EEZ around the Pacific islands of Hawaii, Palmyra, and American Samoa (Carretta et al., 2017c); there are no management stocks recognized for the U.S. West Coast or Alaska waters. The occurrence of false killer whale within the Study Area is considered extralimital as all regions within the Study Area are outside the normal range of this species' distribution.

3.4.1.2.3 Long-Beaked Common Dolphin (*Delphinus capensis*)

Common dolphins are represented by two species for management purposes in NMFS Pacific SAR (Carretta et al., 2017c), the long-beaked common dolphin (*Delphinus capensis*) and the short-beaked common dolphin (*Delphinus delphis*). There is scientific disagreement regarding the common dolphin taxonomy (Committee on Taxonomy, 2016), but the Navy is following NMFS naming conventions as presented in the Pacific SAR (Carretta et al., 2017c).

Waters off the central and Southern California coast are considered the northern range limit of long-beaked common dolphin distribution (Carretta et al., 2017c) and seasonal and inter-annual changes in abundance off California are assumed to reflect shifts in the movements of animals between U.S. and Mexican waters (Gerrodette & Eguchi, 2011). The population extends south into Mexico, and they are commonly found within 50 nautical miles (NM) of the coast (Carretta et al., 2017c; Gerrodette & Eguchi, 2011). There have been no sightings of long-beaked common dolphins north of about 38°N during systematic ship surveys conducted by the National Oceanic and Atmospheric Administration (NOAA) Southwest Fisheries Science Center in the northeast Pacific between 1986 and 2014 (Barlow, 2016; Hamilton et al., 2009). Based on habitat models derived from line-transect survey data collected between 1991 and 2009 off the U.S. West Coast, long-beaked common dolphins are distributed in nearshore waters south of about 37°N (Becker et al., 2016). Long-beaked common dolphins have been found stranded dead in the Pacific Northwest occasionally over the years (1953, 1993, 2002, 2003, and 2012). Two individual long-beaked common dolphins were observed during the summer of 2011 in the Puget Sound and again over 18 months in 2012–2013, but their presence was considered highly unusual (Cascadia Research, 2012a; Ford, 2005; Shuster et al., 2017). Between June 2016 and September 2017, 4–12 dolphins were regularly sighted in central and south Puget Sound in the summer, with aggregations of approximately 30 animals occurring on occasion (Shuster et al., 2017). Despite these recent sightings, the occurrence of long-beaked common dolphin within the Study Area is considered extralimital given that all regions within the Study Area are outside the normal range of this species' distribution according to the most recent NMFS stock assessment report concerning the species (Carretta et al., 2017d).

3.4.1.3 Group Size

Many species of marine mammals, particularly odontocetes, are highly social animals that spend much of their lives living in groups called "pods." The size and structures of these groups are dynamic and can range from several to several thousand individuals, depending on the species. For example, large pods numbering in the hundreds of individuals have been observed off the coast of Washington for both Pacific white-sided dolphins and Northern right whale dolphins (Adams et al., 2014). Similarly, aggregations of mysticete whales may form during particular breeding or foraging seasons, although they do not persist through time as a social unit. Marine mammals that live or travel in groups are more likely to be detected by observers, and group size characteristics are incorporated into the many density and abundance calculations. Group size characteristics are also incorporated into the Navy Acoustic Effects Model to represent a more realistic patchy distribution for the given density. The behavior of aggregating into groups is also important for the purposes of mitigation and monitoring since animals that occur in larger groups have an increased probability of being detected. A comprehensive and systematic review of relevant literature and data was conducted for available published and unpublished literature, including journals, books, technical reports, cruise reports, and raw data from cruises, theses, and dissertations. The results of this review were compiled into a Technical Report and include tables of group size information by species along with relevant citations (U.S. Department of the Navy, 2017d).

3.4.1.4 Habitat Use

Marine mammals occur in every marine environment in the Study Area including the narrow passage found in Alaska's Behm Canal, the inland water area of the Salish Sea, and the coastal waters to open ocean environments of the Pacific offshore of Washington, Oregon, and Northern California. Their distribution is influenced by many factors, primarily patterns of major ocean currents, bottom relief, and water temperature, which, in turn, affect prey distribution and productivity. The continuous movement of water from the ocean bottom to the surface creates a nutrient-rich, highly productive environment for marine mammal prey (Jefferson et al., 2015) and especially in zones such as the semi-permanent eddy offshore of the Strait of Juan de Fuca (Hickey & Banas, 2003; MacFadyen et al., 2008; Tolimieri et al., 2015). This oceanographic feature makes it one of the most productive habitats in the Northeastern Pacific (Menza et al., 2016).

While most baleen whales are migratory, some species such as gray whales have been documented with an undetermined small number present within the Study Area year round (Cogan, 2015; Emmons et al., 2017). Many of the toothed whales do not migrate in the strictest sense, but some do undergo seasonal shifts in distribution both within and outside of the Study Area. Pinnipeds in the Study Area occur in coastal habitats, in waters over the continental shelves, and some migrate through the mid-ocean as far north as islands in the Bering Sea or as far south Guadalupe Island off Mexico. Sea otters are generally found nearshore and require land or very shallow coastal waters as habitat for reproducing, resting, and feeding.

In 2011, NOAA convened a working group to map cetacean density and distribution within U.S. waters (Ferguson et al., 2015b). The specific objective of the Cetacean Density and Distribution Mapping Working Group was to create comprehensive and easily accessible regional cetacean density and distribution maps that are time and species specific. Separately, to augment this more quantitative density and distribution mapping and provide additional context for marine mammal impact analyses, the Cetacean Density and Distribution Mapping Working Group also identified (through literature search, using data from surveys, habitat modeling, compilation of the best available science, and expert elicitation) areas of importance for cetaceans, such as reproductive areas, feeding areas, migratory corridors, and areas in which small or resident populations are located. Areas identified through this process have been termed biologically important areas (Ferguson et al., 2015b; Van Parijs, 2015; Van Parijs et al., 2015). The stated intention is to serve as a resource management tool. These biologically important areas were not meant to define exclusionary zones or serve as sanctuaries or marine protected areas, and have no direct or immediate regulatory consequences (see Ferguson et al. (2015b)) regarding the envisioned purpose for the biologically important area designations). The identification of biologically important areas is intended to be a "living" reference based on the best available science at the time, which will be maintained and updated as new information becomes available. As new empirical data are gathered, these referenced areas can be calibrated to determine how closely they correspond to reality of the species' habitat uses and updated as necessary (see for example Harvey et al. (2017) and Dalla-Rosa et al. (2012)). Additionally, biologically important areas identified in the Study Area (Calambokidis et al., 2015) do not represent the totality of important habitat throughout the marine mammals' full range. The currently identified boundaries should be considered dynamic and subject to change based on new information, as well as "existing density estimates, range-wide distribution data, information on population trends and life history parameters, known threats to the population, and other relevant information" (Van Parijs, 2015).

Products of the initial assessment process, including Alaska and the U.S. West Coast biologically important areas, were compiled and published in March 2015 (Aquatic Mammals, 2015; Calambokidis et al., 2015; Ferguson et al., 2015b; Ferguson et al., 2015c). Analysis and review of these biologically important areas within the Study Area were previously reviewed and assessed by the Navy in the 2015 NWTT Final EIS/OEIS (U.S. Department of the Navy, 2015a), evaluated by NMFS in the issuance of the current Letter of Authorization pursuant to the MMPA (National Oceanic and Atmospheric Administration, 2015b), and reviewed by NMFS pursuant to ESA for listed species in the NWTT Study Area (National Marine Fisheries Service, 2014). Additional details regarding the designated biologically important areas in the Study Area are provided in the applicable species subsections that follow.

3.4.1.5 Dive Behavior

All marine mammals, with the exception of polar bears, spend part of their lives underwater while traveling or feeding. Some species of marine mammals have developed specialized adaptations to allow them to make deep dives lasting over an hour, primarily for the purpose of foraging on deep-water prey such as squid. Other species spend the majority of their lives close to the surface, and make relatively shallow dives. The diving behavior of a particular species or individual has implications for the ability to visually detect them for mitigation and monitoring. In addition, their relative distribution through the water column based on diving behavior is an important consideration when conducting acoustic effects modeling. Information and data on diving behavior for each species of marine mammal were compiled and summarized in a technical report (U.S. Department of the Navy, 2017d) that provides the detailed summary of time at depth.

3.4.1.6 Hearing and Vocalization

The typical terrestrial mammalian ear (which is ancestral to that of marine mammals) consists of an outer ear that collects and transfers sound to the tympanic membrane and then to the middle ear (Fay & Popper, 1994; Rosowski, 1994). The middle ear contains ossicles that amplify and transfer acoustic energy to the sensory cells (called hair cells) in the cochlea, which transforms acoustic energy into electrical neural impulses that are transferred by the auditory nerve to high levels in the brain (Møller, 2013). All marine mammals display some degree of modification to the terrestrial ear; however, there are differences in the hearing mechanisms of marine mammals with an amphibious ear versus those with a fully aquatic ear (Wartzok & Ketten, 1999). Marine mammals with an amphibious ear include the marine carnivores: pinnipeds, sea otters, and polar bears (Ghoul & Reichmuth, 2014a; Owen & Bowles, 2011; Reichmuth et al., 2013). Outer ear adaptations in this group include external pinnae (ears) that are reduced or absent, and in the pinnipeds, cavernous tissue, muscle, and cartilaginous valves seal off water from entering the auditory canal when submerged (Wartzok & Ketten, 1999). Marine mammals with the fully aquatic ear (cetaceans and sirenians) use bone and fat channels in the head to conduct sound to the ear; while the auditory canal still exists, it is narrow and sealed with wax and debris, and external pinnae are absent (Houser & Mulsow, 2016; Ketten, 1998).

The most accurate means of determining the hearing capabilities of marine mammal species are direct measures that assess the sensitivity of the auditory system (Nachtigall et al., 2000; Supin et al., 2001). Studies using these methods produce audiograms—plots describing hearing threshold (the quietest sound a listener can hear) as a function of frequency. Marine mammal audiograms, like those of terrestrial mammals, typically have a "U-shape," with a frequency region of best hearing sensitivity and a progressive decrease in sensitivity outside of the range of best hearing (Fay, 1988; Mooney et al., 2012; Nedwell et al., 2004; Reichmuth et al., 2013). The "gold standard" for producing audiograms is the use of behavioral (psychophysical) methods, where marine mammals are trained to respond to acoustic stimuli (Nachtigall et al., 2000). For species that are untrained for behavioral psychophysical procedures, those that are difficult to house under human care, or in stranding rehabilitation and temporary capture contexts, auditory evoked potential methods are increasingly used to measure hearing sensitivity (e.g., Castellote et al., 2014; Finneran et al., 2009; Montie et al., 2011; Mulsow et al., 2011; Nachtigall et al., 2007; Nachtigall et al., 2008; Supin et al., 2001).

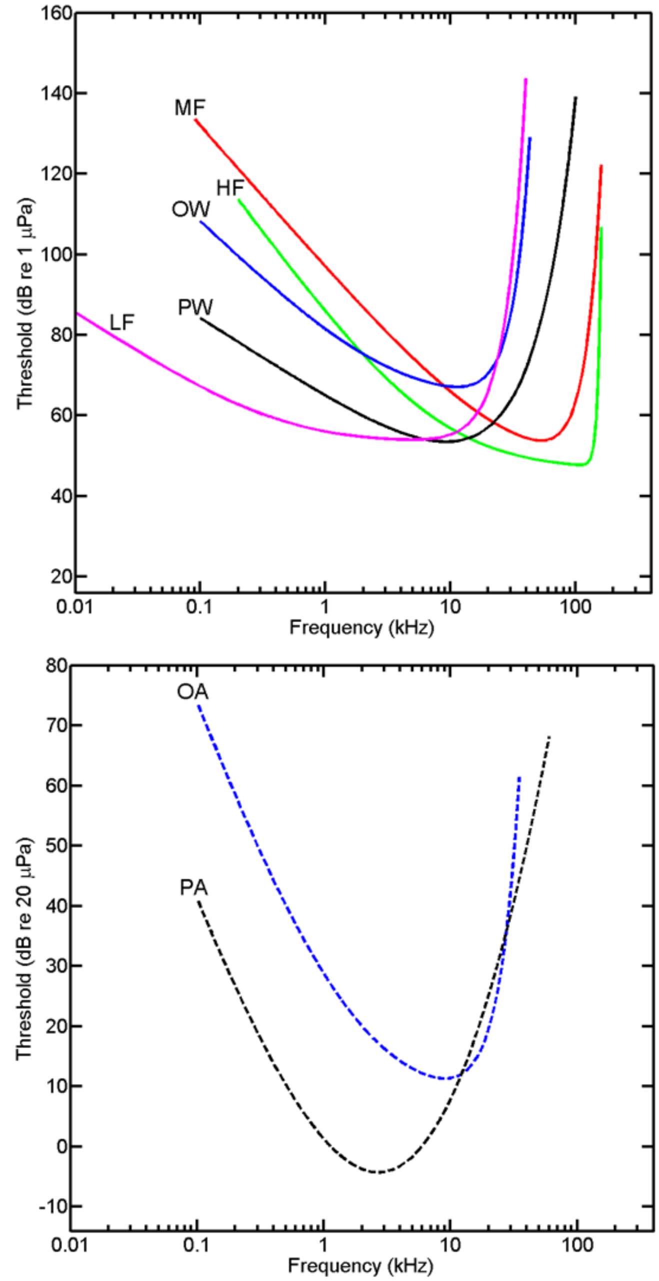
These auditory evoked potential methods, which measure electrical potentials generated by the auditory system in response to sound and do not require the extensive training of psychophysical methods, can provide an efficient estimate of behaviorally measured sensitivity (Finneran & Houser, 2006; Schlundt et al., 2007; Yuen et al., 2005). The thresholds provided by auditory evoked potential methods are, however, typically elevated above behaviorally measured thresholds, and auditory evoked potential methods are not appropriate for estimating hearing sensitivity at frequencies much lower than the region of best hearing sensitivity (Finneran, 2015; Finneran et al., 2016). For marine mammal species for which access is limited and therefore psychophysical or auditory evoked potential testing is impractical (e.g., mysticete whales and rare species), some aspects of hearing can be estimated from anatomical structures, frequency content of vocalizations, and extrapolations from related species.

Direct measurements of hearing sensitivity exist for approximately 25 of the nearly 130 species of marine mammals. Table 3.4-2 summarizes hearing capabilities for marine mammal species in the study area. For this analysis, marine mammals are arranged into the following functional hearing groups based on their generalized hearing sensitivities: high-frequency cetaceans (HF group: porpoises, Kogia spp.), mid-frequency cetaceans (MF group: delphinids, beaked whales, sperm whales), low-frequency cetaceans (LF group: mysticetes), otariids and other non-phocid marine carnivores in water and air (OW and OA groups: sea lions, walruses, otters, polar bears), and phocids in water and air (PW and PA groups: true seals). Note that the designations of high-, mid-, and low-frequency cetaceans are based on relative differences of sensitivity between groups, as opposed to conventions used to describe active sonar systems.

For Phase III analyses, a single representative composite audiogram (Figure 3.4-1) was created for each functional hearing group using audiograms from published literature. For discussion of all marine mammal functional hearing groups and their derivation see technical report *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects (Phase III)* (U.S. Department of the Navy, 2017a). The mid-frequency cetacean composite audiogram is consistent with recently published behavioral audiograms of killer whales (Branstetter et al., 2017a). The otariid and phocid composite audiograms are consistent with recently published behavioral audiograms of pinnipeds; these behavioral audiograms also show that pinniped hearing sensitivity at frequencies and thresholds far above the range of best hearing may drop off at a slower rate than previously predicted (Cunningham & Reichmuth, 2015).

Table 3.4-2: Species Within Marine Mammal Hearing Groups Likely Found in the Study Area

Hearing Group	***Species within the Study Area***
High-frequency cetaceans	Dall's porpoise
	Dwarf sperm whale
	Harbor porpoise
	Pygmy sperm whale
Mid-frequency cetaceans	Baird's beaked whale
	Common bottlenose dolphin
	Cuvier's beaked whale
	Killer whale
	Mesoplodont beaked whales
	Northern right whale dolphin
	Pacific white-sided dolphin
	Risso's dolphin
	Short-beaked common dolphin
	Short-finned pilot whale
	Sperm whale
	Striped dolphin
Low-frequency cetaceans	Blue whale
	Fin whale
	Gray whale
	Humpback whale
	Minke whale
	North Pacific right whale
	Sei whale
Otariids and other non-phocid marine carnivores	California sea lion
	Guadalupe fur seal
	Northern fur seal
	Northern sea otter
	Steller sea lion
Phocids	Harbor seal
	Northern elephant seal



Source: *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (U.S. Department of the Navy, 2017)

Notes: For hearing in water (top) and in air (bottom, phocids and otariids only). LF = low-frequency, MF = mid-frequency, HF = high-frequency, OW = otariids and other non-phocid marine carnivores in water, PW = phocids in water, OA = otariids and other non-phocid marine carnivores in air, PA = phocids in air

Figure 3.4-1: Composite Audiograms for Hearing Groups Likely Found in the Study Area

Similar to the diversity of hearing capabilities among species, the wide variety of acoustic signals used in marine mammal communication (including biosonar or echolocation) is reflective of the diverse ecological characteristics of cetacean, sirenian, and carnivore species (see Avens, 2003; Richardson et al., 1995b). This makes a succinct summary difficult (see Richardson et al., 1995b; Wartzok & Ketten, 1999 for thorough reviews); however, a division can be drawn between lower frequency communication signals that are used by marine mammals in general, and the specific, high-frequency biosonar signals that are used by odontocetes to sense their environment.

Non-biosonar communication signals span a wide frequency range, primarily having energy up into the tens of kilohertz (kHz) range. Of particular note are the very low-frequency calls of mysticete whales that range from tens of hertz (Hz) to several kilohertz, and have source levels of 150–200 decibels referenced to 1 micropascal (dB re 1 µPa) (Cummings & Thompson, 1971; Edds-Walton, 1997; Širović et al., 2007; Stimpert et al., 2007; Wartzok & Ketten, 1999). These calls most likely serve social functions such as mate attraction, but may serve an orientation function as well (Green, 1994; Green et al., 1994; Richardson et al., 1995b). Humpback whales are a notable exception within the mysticetes, with some calls exceeding 10 kHz (Zoidis et al., 2008).

Odontocete cetaceans and marine carnivores use underwater communicative signals that, while not as low in frequency as those of many mysticetes, likely serve similar functions. These include tonal whistles in some odontocetes and the wide variety of barks, grunts, clicks, sweeps, and pulses of pinnipeds. Of additional note are the aerial vocalizations that are produced by pinnipeds, otters, and polar bears. Again, the acoustic characteristics of these signals are quite diverse among species, but can be generally classified as having dominant energy at frequencies below 20 kHz (Richardson et al., 1995b; Wartzok & Ketten, 1999).

Odontocete cetaceans generate short-duration (50–200 microseconds), specialized clicks used in biosonar with peak frequencies between 10 and 200 kHz to detect, localize, and characterize underwater objects such as prey (Au, 1993; Wartzok & Ketten, 1999). These clicks are often more intense than other communicative signals, with reported source levels as high as 229 dB re 1 µPa peak-to-peak (Au et al., 1974). The echolocation clicks of high-frequency cetaceans (e.g., porpoises) are narrower in bandwidth (i.e., the difference between the upper and lower frequencies in a sound) and higher in frequency than those of mid-frequency cetaceans (Madsen et al., 2005; Villadsgaard et al., 2007).

In general, frequency ranges of vocalization lie within the audible frequency range for an animal (i.e., animals vocalize within their audible frequency range); however, auditory frequency range and vocalization frequencies do not perfectly align. The frequency range of vocalization in a species can therefore be used to infer some characteristics of their auditory system; however, caution must be taken when considering vocalization frequencies alone in predicting the hearing capabilities of species for which no data exist (i.e., mysticetes). It is important to note that aspects of vocalization and hearing sensitivity are subject to evolutionary pressures that are not solely related to detecting communication signals. For example, hearing plays an important role in detecting threats (e.g., Deecke et al., 2002), and high-frequency hearing is advantageous to animals with small heads in that it facilitates sound localization based on differences in sound levels at each ear (Heffner & Heffner, 1982). This may be partially responsible for the difference in best hearing thresholds and dominant vocalization frequencies in some species of marine mammals (e.g., Steller sea lions, Mulsow & Reichmuth, 2010).

3.4.1.7 General Threats

Marine mammal populations can be influenced by various natural factors as well as human activities. There can be direct effects, such as from disease, hunting, and whale watching, or indirect effects such as through reduced prey availability or lowered reproductive success of individuals. Research presented in Twiss and Reeves (1999) and National Marine Fisheries Service (2011a, 2011b, 2011c, 2011e) provides a general discussion of marine mammal conservation and the threats they face. As detailed in National

Marine Fisheries Service (2011d), investigations of stranded marine mammals are undertaken to monitor threats to marine mammals and out of concerns for animal welfare and ocean stewardship. Investigations into the cause of death for stranded animals can also provide indications of the general threats to marine mammals in a given location (Barcenas De La Cruz et al., 2017; Bradford & Lyman, 2015; Carretta et al., 2016b; Helker et al., 2015). The causes for strandings include infectious disease, parasite infestation, reduced prey availability leading to starvation, pollution exposure, trauma (e.g., injuries from ship strikes or fishery entanglements), sound (human-generated or natural), harmful algal blooms and associated biotoxins, and ingestion or interaction with marine debris (for more information see NMFS Marine Mammal Stranding Response Fact Sheet; (National Marine Fisheries Service, 2016a). For a general discussion of strandings and their causes as well as strandings in association with U.S. Navy activity, see the technical report titled *Strandings Associated with U.S. Navy Activity* (U.S. Department of the Navy, 2017c).

3.4.1.7.1 Water Quality

Chemical pollution and impacts on ocean water quality is of great concern, although its effects on marine mammals are just starting to be understood (Bachman et al., 2014; Bachman et al., 2015; Desforges et al., 2016; Foltz et al., 2014; Godard-Codding et al., 2011; Hansen et al., 2015; Jepson & Law, 2016; Law, 2014; Peterson et al., 2014; Peterson et al., 2015; Ylitalo et al., 2005; Ylitalo et al., 2009). Oil and other chemical spills are a specific type of ocean contamination that can have damaging effects on some marine mammal species directly through exposure to oil or chemicals and indirectly due to pollutants' impacts on prey and habitat quality (Engelhardt, 1983; Marine Mammal Commission, 2010; Matkin et al., 2008).

On a broader scale ocean contamination resulting from chemical pollutants inadvertently introduced into the environment by industrial, urban, and agricultural use is also a concern for marine mammal conservation and has been the subject of numerous studies (Desforges et al., 2016; Fair et al., 2010; Krahn et al., 2007; Krahn et al., 2009; Moon et al., 2010; Ocean Alliance, 2010). For example, the chemical components of pesticides used on land flow as runoff into the marine environment, which can accumulate in the bodies of marine mammals, and be transferred to their nursing young through mother's milk (Fair et al., 2010). The presence of these chemicals in marine mammals has been assumed to put those animals at greater risk for adverse health effects and potential impact on their reproductive success given toxicology studies and results from laboratory animals (Fair et al., 2010; Godard-Codding et al., 2011; Krahn et al., 2007; Krahn et al., 2009; Peterson et al., 2014; Peterson et al., 2015). Desforges et al. (2016) have suggested that exposure to chemical pollutants may act in an additive or synergistic manner with other stressors, resulting in significant population-level consequences. Although the general trend has been a decrease in chemical pollutants in the environment following their regulation, chemical pollutants remain important given their potential to impact marine mammals and marine life in general (Bonito et al., 2016; Jepson & Law, 2016; Law, 2014).

3.4.1.7.2 Bycatch

Fishery bycatch is likely the most impactful threat to marine mammal individuals and populations and may account for the deaths of more marine mammals than any other cause (Carretta et al., 2016b; Carretta et al., 2017a; Geijer & Read, 2013; Hamer et al., 2010; Helker et al., 2017; Lent & Squires, 2017; National Marine Fisheries Service, 2016b; Northridge, 2009; Read, 2008). In 1994, the MMPA was amended to formally address bycatch by U.S. Fisheries. The amendment requires the development of a take reduction plan when bycatch exceeds a level considered unsustainable and will lead to marine mammal population decline. In addition, NMFS develops and implements take reduction plans that help recover and prevent the depletion of strategic stocks of marine mammals that interact with certain fisheries.

At least in part as a result of the amendment, estimates of bycatch in the Pacific declined by a total of 96 percent from 1994 to 2006 (Geijer & Read, 2013). Cetacean bycatch declined by 85 percent from 342 in 1994 to 53 in 2006, and pinniped bycatch declined from 1,332 to 53 over the same time period.

3.4.1.7.3 Entanglement and Other Fishery Interactions

Fishery interactions other than bycatch include entanglement from abandoned or partial nets, fishing line, hooks, and the ropes and lines connected to fishing gear (Barcenas De La Cruz et al., 2017; California Coastal Commission, 2018; California Ocean Protection Council & National Oceanic and Atmospheric Administration Marine Degree Program, 2018; Carretta et al., 2017b; Currie et al., 2017b; Díaz-Torres et al., 2016; Helker et al., 2017; Lowry et al., 2018; National Marine Fisheries Service, 2018a; National Oceanic and Atmospheric Administration, 2016b; National Oceanic and Atmospheric Administration Fisheries, 2018; National Oceanic and Atmospheric Administration Marine Debris Program, 2014a; Polasek et al., 2017; Saez, 2018). The National Oceanic and Atmospheric Administration Marine Debris Program (2014b) reports that abandoned, lost, or otherwise discarded fishing gear constitutes the vast majority of mysticete entanglements. For Alaska between 2010 and 2014, there were 419 entanglement-related serious injuries or mortalities (Helker et al., 2015) and for the U.S. West Coast during the same period, there were 85 cases of fishery-related entanglements (Carretta et al., 2016b). In 2014 off Grays Harbor, a humpback whale was successfully dis-entangled from crab pot fishing gear (Calambokidis, 2014). In May 2017, a gray whale calf was discovered dead onshore near the mouth of the Columbia River after becoming entangled in crab pot fishing gear (Cascadia Research, 2017a). NMFS has identified incidental catches in coastal net fisheries off Japan, Korea, and northeastern Sakhalin Island as a significant threat to endangered Western North Pacific gray whales (Carretta et al., 2018a; Lowry et al., 2018). Species or large whales found entangled off the U.S. West Coast in 2015 and 2016 included stocks that are present in the Study Area such as humpback, gray, blue, fin, and killer whales, with a total of 133 entanglements in the two-year period (National Marine Fisheries Service, 2018a; National Oceanic and Atmospheric Administration, 2017). For the identified sources of entanglement, none included Navy expended materials.

Along the U.S. West Coast, hook and line entanglements and gunshot wounds are two of the primary causes of pinniped injuries found in strandings (Barcenas De La Cruz et al., 2017; Carretta et al., 2013b; Carretta et al., 2016b; Seal Sitters Marine Mammal Stranding Network, 2018; Warlick et al., 2018). In Alaska between 2011 and 2015, the ingestion of fishery gear resulted in a total of 128 serious injuries to Steller sea lions (Helker et al., 2017). In Washington and Oregon between 2002 and 2016, gunshot wounds, fisheries entanglements, and boat collisions were the leading causes of identified human interactions with pinnipeds found stranded (Warlick et al., 2018); these interactions involved all pinniped species that are present in the NWTT Study Area. Along the coast (Warlick et al., 2018), most of the reported pinniped strandings were centered at the Columbia River or Newport, Oregon, which are both far to the south of where most Navy training and testing occurs. In December 2018, due to the prevalence of known pinniped shootings, NOAA Fisheries was working on publishing guidelines for fishermen who take actions to deter pinnipeds and other marine mammals from their catch (National Oceanic and Atmospheric Administration, 2018c).

In waters off Alaska, Washington, and California, passive acoustic monitoring efforts since 2009 have documented the routine use of non-military explosives at-sea (Baumann-Pickering et al., 2013; Debich et al., 2014; Kerosky et al., 2013; Rice et al., 2015b; Trickey et al., 2015). Based on the spectral properties of the recorded sounds and their correspondence with known fishing seasons or activity, the source of these explosions has been linked to the use of explosive marine mammal deterrents, which as a group are commonly known as 'seal bombs' (Baumann-Pickering et al., 2013; Bland, 2017). Seal bombs are intended to be used by commercial fishers to deter marine mammals, particularly pinnipeds, from preying upon their catch and to prevent marine mammals from interacting and potentially becoming entangled with fishing gear (National Marine Fisheries Service, 2015a).

Based on the number of explosions recorded over the past several years in Alaska, Washington, and Southern California (Baumann-Pickering et al., 2013; Bland, 2017; Oleson & Hildebrand, 2012; Trickey et al., 2015), the use of seal bombs is much more prevalent than might be expected. For example, in mid-late June 2012 at one monitoring site adjacent to Quinault Canyon (off the coast of Washington) these explosions identified as seal bombs were present during daylight hours 68 percent of the cumulative hours per week (Wiggins et al., 2017). The prevalent and continued use of seal bombs seems to indicate that, while a potential threat, their use has had no significant effect on populations of marine mammals given that it is likely at least some individuals, if not larger groups of marine mammals, have been repeatedly exposed to this explosive stressor.

Since 2010, the Oregon Department of Fish & Wildlife and Washington Department of Fish & Wildlife have conducted a removal program for California sea lions that prey on ESA-listed Chinook salmon and steelhead stocks at Bonneville Dam (Schakner et al., 2016). Although non-lethal pyrotechnic and rubber buckshot are used as short-term deterrents, in 2016 (for example), they lethally removed (i.e., euthanized) 59 California sea lions (Madson et al., 2017). In December 2018, Congress signed into law the Endangered Salmon Predation Prevention Act that allows NMFS to authorize the intentional lethal taking of California sea lions on the waters of the Columbia River and its tributaries for the protection of endangered salmon.

3.4.1.7.4 Noise

In some locations, especially like the Study Area where urban or industrial activities or commercial shipping is intense, anthropogenic noise can be a potential habitat-level stressor (Cominellli et al., 2018; Dunlop, 2016; Dyndo et al., 2015; Erbe et al., 2014; Frisk, 2012; Gedamke et al., 2016; Hermannsen et al., 2014; Li et al., 2015; McKenna et al., 2012; Melcón et al., 2012; Miksis-Olds & Nichols, 2015; Nowacek et al., 2015; Pine et al., 2016; Southall et al., 2018; Sullivan & Torres, 2018; Williams et al., 2014c; Williams et al., In press; Wisniewska et al., 2018). Noise is of particular concern to marine mammals because many species use sound as a primary sense for navigating, finding prey, avoiding predators, and communicating with other individuals. Noise may cause marine mammals to leave a habitat, impair their ability to communicate, or cause physiological stress (Cholewiak et al., 2018; Courbis & Timmel, 2008; Erbe, 2002; Erbe et al., 2016; Hildebrand, 2009; Holt et al., 2017; Putland et al., 2018; Rolland et al., 2012; Southall et al., 2018; Tyack et al., 2011; Tyne et al., 2017; Williams et al., 2014b). Noise can cause behavioral disturbances, mask other sounds including their own vocalizations, may result in injury, and in some cases may result in behaviors that ultimately lead to death (Erbe et al., 2014; Erbe et al., 2016; National Research Council, 2003, 2005; Nowacek et al., 2007; Southall et al., 2009; Tsujii et al., 2018; Tyack, 2009; Würsig & Richardson, 2009). Anthropogenic noise is generated from a variety of sources including commercial shipping, oil and gas exploration and production activities, commercial and recreational fishing (including fish-finding sonar, fathometers, and acoustic deterrent and harassment devices), foreign navies, recreational boating and whale watching activities, offshore power generation, and research (including sound from air guns, sonar, and telemetry). Whale watching noise and associated disturbance of cetaceans is a growing concern in the waters of the Study

Area and other locations (Cholewiak et al., 2018; Di Clemente et al., 2018; Ferrara et al., 2017; Gabriele et al., 2018; Giles & Koski, 2012; Holt et al., 2017; Houghton et al., 2015b; Lacy et al., 2017; Machernis et al., 2018; National Marine Fisheries Service, 2018b; Putland et al., 2018; Seely et al., 2017; Sullivan & Torres, 2018; Tyne et al., 2018; Veirs et al., 2016; Zapetis et al., 2017).

Commercial vessel noise in particular is a major contributor to noise in the ocean and intensively used inland waters containing major ports, such as the NWTT Study Area (Bassett et al., 2012; Cates & Acevedo-Gutiérrez, 2017; Cominellli et al., 2018; Erbe et al., 2012; Erbe et al., 2014; Erbe et al., 2016; Frisk, 2012; Hildebrand, 2004, 2009; Holt et al., 2017; Miksis-Olds & Nichols, 2015; Oleson & Hildebrand, 2012; Seely et al., 2017; Southall et al., 2018; Williams et al., In press). As provided in more detail in Section 3.12.2.1.1 (Ocean Traffic), there are approximately 6,000 transits to U.S. ports adjacent to the NWTT Study Area (primarily the ports of Seattle and Tacoma) annually, and there are an additional 6,000 transits through the Strait of Juan de Fuca to and from the Port of Vancouver, Canada (Office of the Washington Governor, 2018; The Northwest Seaport Alliance, 2018; U.S. Maritime Administration, 2016; Van Dorp & Merrick, 2017; Vancouver Fraser Port Authority, 2017).

For the Inland Waters portion of the Study Area, in 2008 there was a 24-hour average of three vessels per hour present in the Strait of Juan de Fuca and Haro Strait (Erbe et al., 2014). At Ketchikan to the south of Behm Canal, there were 427 port visits in 2012, with approximately 20 percent of the time per visit spent at a wilderness fjord location such as Behm Canal during a cruise season that runs between April and September (Webb & Gende, 2015). Frankel and Gabriele (2017) have noted that broadband cruise ship vessel noise in Glacier Bay, Alaska (where vessel traffic is similar to that from Ketchikan near Behm Canal), is present with sound levels (Root Mean Square) between approximately 172 and 192 dB (re 1 µPa at 1 m); the associated twice-daily cruise ship passages have been shown to impact communication between humpback whales in the area (Fournet et al., 2018). The authors note that NMFS requires ocean users elsewhere to obtain permits for activities exposing marine mammals to the sound exposure levels estimated from those cruise ships in Glacier Bay (Gabriele et al., 2018). In other locations and based on observed behavioral responses, it has been suggested that whale watching of humpback mother-calf groups should be avoided given whale watching vessels disturb nursing and calving activities (Garcia-Cegarra et al., 2018).

In a similar manner for offshore areas, Redfern et al. (2017) found that shipping channels leading to and from the ports of Los Angeles and Long Beach may have degraded the habitat for blue, fin, and humpback whales due to the loss of communication space where important habitat for these species overlaps with elevated noise from commercial vessel traffic (these whales in Southern California are the same present in the Study Area). The Strait of Juan de Fuca and its offshore approaches can be assumed to have a similar frequency of commercial vessel traffic moving into and out of the various ports of call in Canada and the Inland Waters portion of the Study Area and therefore is also likely to impact marine mammal communication space. Acoustic monitoring at a site off Quinault has indicated boat and ship noise present as much as approximately 65–75 percent of the days monitored (Oleson & Hildebrand, 2012; Trickey et al., 2015). Modeling of vessel traffic in the Inland Waters portion of the NWTT Study Area indicated that the presence of ferries, tugboats, recreational vessels, and commercial shipping vessels carrying vehicles, containers, and bulk cargo is predicted to result in high levels of noise exposure within the Southern Resident killer whale core areas (Cominellli et al., 2018). The Washington State Governor's Southern Resident Orca Task Force has noted that Washington state ferries are by far the largest contributor to the underwater noise levels across Puget Sound because of the sheer volume of multi-daily transits throughout the Inland Waters portion of the NWTT Study Area (Office of the Washington Governor, 2018).

In many areas of the world, oil and gas seismic exploration in the ocean is undertaken using a group of air guns towed behind large research vessels. The airguns convert high pressure air into very strong shock wave impulses that are designed to return information off the various buried layers of sediment under the seafloor. Seismic exploration surveys last many days and cover vast overlapping swaths of the ocean area being explored. Most of the impulse energy produced by these airguns is heard as low-frequency sound, which can travel long distances and has the potential to impact marine mammals. Acoustic monitoring in Study Area off the Washington coast between June 11 and July 12, 2012 recorded seismic airgun pulses (the sounds from seismic airguns) on most days of the survey (Klinck et al., 2015). NMFS routinely issues permits for the taking of marine mammals associated with these commercial activities.

3.4.1.7.5 Hunting

Commercial hunting, as in whaling and sealing operations, provided the original impetus for marine mammal management efforts and has driven much of the early research on cetaceans and pinnipeds (Twiss & Reeves, 1999). With the enactment of the MMPA and the 1946 International Convention for the Regulation of Whaling, hunting-related mortality has decreased over the last 40 years. Unregulated harvests are still considered as direct threats; however, since passage of the MMPA, there have been relatively few serious calls for culls of marine mammals in the United States compared to other countries, including Canada (Roman et al., 2013). Review of uncovered Union of Soviet Socialist Republics catch records in the North Pacific Ocean indicate extensive illegal whaling activity between 1948 and 1979, with a harvest totaling 195,783 whales. Of these, only 169,638 were reported by the Union of Soviet Socialist Republics to the International Whaling Commission (Ilyashenko et al., 2013; Ilyashenko et al., 2014; Ilyashenko & Chapham, 2014; Ilyashenko et al., 2015).

For U.S. waters, there is a provision in the MMPA that allows for subsistence harvest of marine mammals, primarily by Alaska Natives. Subsistence hunting by Russia and Alaska Natives also occurs in the North Pacific, Chukchi Sea, and Bering Sea, affecting marine mammal stocks that may be present in the Study Area. For example, in Russian waters in 2013, there were a total of 127 gray whales “struck” during subsistence whaling by the inhabitants of the Chukchi Peninsula between the Bering and Chukchi Sea (Ilyashenko & Zharikov, 2014). These gray whales harvested in Russian waters may be individuals from either the endangered Western North Pacific stock or the non-ESA listed Eastern North Pacific stock that may migrate through the Study Area. In February 2010 near Humboldt, California (inshore of the Study Area), a stranded gray whale was found to have parts of two harpoons embedded in its body, which likely resulted from a failed hunt in Russian or Alaskan waters (Carretta et al., 2017c).

3.4.1.7.6 Vessel Strike

Ship strikes are also a growing issue for most marine mammals, although mortality may be a more significant concern for species that occupy areas with high levels of vessel traffic, because the likelihood of encounter would be greater (Cascadia Research, 2017b; Douglas et al., 2008; Nichol et al., 2017; Rockwood et al., 2017; Van der Hoop et al., 2013; Van der Hoop et al., 2015). Vessel strikes from boats and other smaller vessels can also be an issue for marine mammals in some locations (Lomac-MacNair et al., 2018).

Since 1995, the U.S. Navy and U.S. Coast Guard have reported all known or suspected vessel collisions with whales to NMFS. The assumed under-reporting of whale collisions by vessels other than U.S. Navy or U.S. Coast Guard makes any comparison of data involving vessel strikes between Navy vessels and other vessels heavily biased. This under-reporting is recognized by NMFS; for example, in the Technical Memorandum providing the analysis of the impacts from vessel collisions with whales in Hawaii (Bradford & Lyman, 2015), NMFS takes into account unreported vessel strikes by civilian vessels. Within Alaska waters, there were 17 reported marine mammal vessel strikes between 2010 and 2014 (Helker et al., 2015), and for the U.S. West Coast in the same period there were 68 reported vessel strikes to marine mammals (Carretta et al., 2016b). Strandings in Washington between 1980 and 2006 included 19 stranded large whales with signs of blunt force trauma or propeller wounds indicative of a vessel strike and involving fin, grey, blue, humpback, and Baird's beaked whales (Douglas et al., 2008). Since 2002, 10 out of the 12 stranded fin whales in Washington have showed evidence attributed to a large ship strike (Cascadia Research, 2017b).

3.4.1.7.7 Power Plant Entrainment

Coastal power plants use seawater as a coolant during power plant operation. Intakes into these plants can sometimes trap (i.e., entrain) pinnipeds that swim too close to the intake pipe. For the U.S. West Coast there were 120 reported pinniped mortalities from power plant entrainment (Carretta et al., 2016b) between 2010 and 2014.

3.4.1.7.8 Disease and Parasites

Just as in humans, disease affects marine mammal health and especially older animals. Occasionally disease epidemics can also injure or kill a large percentage of a marine mammal population (Keck et al., 2010; Paniz-Mondolfi & Sander-Hoffmann, 2009; Simeone et al., 2015). Recent review of odontocetes stranded along the California coast from 2000 to 2015 found evidence for morbilliviral infection in 9 of the 212 animals examined, therefore indicating this disease may be a contributor to mortality in cetaceans stranding along the California coast (Serrano et al., 2017). Brucellosis is an infectious disease caused by bacteria and Northern fur seals, Steller sea lions, and harbor seals in Alaska have been found carrying the antibodies indicative of this disease (Nymo et al., 2018). Examination of southern sea otter tissue samples have detected polyomavirus, parvovirus, and adenovirus infections in 80 percent of tested animals, suggesting endemic infection is present in the population (Siqueira et al., 2017). Infectious diseases are the primary cause of death for stranded sea otters found along the coasts of Washington and Oregon (Sato, 2018; White et al., 2018).

Mass die-offs of some marine mammal species have been linked to toxic algal blooms, which occurs as larger organisms consume multiple prey containing those toxins and thereby accumulating fatal doses (Lefebvre et al., 2010; Lefebvre et al., 2016; Summers, 2017). An example is domoic acid poisoning of California sea lions and northern fur seals from the diatom Pseudo-nitzschia spp. (Doucette et al., 2006; Fire et al., 2008; Lefebvre et al., 2010; Lefebvre et al., 2016; Torres de la Riva et al., 2009). A comprehensive study that sampled over 900 marine mammals across 13 species, including several mysticetes, odontocetes, pinnipeds, and mustelids in Alaska, found detectable concentrations of domoic acid in all 13 species and saxitoxin, a toxin absorbed from ingesting dinoflagellates, in 10 of the 13 species (Lefebvre et al., 2016). Algal toxins may have contributed to the stranding and mortality of 34 whales found around the islands in the western Gulf of Alaska and the southern shoreline of the Alaska Peninsula and another 16 stranded whales in British Columbia starting in May 2015–2016 (National Oceanic and Atmospheric Administration, 2016a; Rosen, 2015; Savage et al., 2017; Summers, 2017). These findings are relevant given that many of the whales in the Study Area migrate to the Gulf of Alaska and beyond to feed.

Additionally, all marine mammals have parasites that, under normal circumstances, probably do little overall harm, but under certain conditions can cause serious health problems or even death (Bull et al., 2006; Fauquier et al., 2009; Jepson et al., 2005). The most commonly reported parasitic infections were in sea otters from the protozoans *Sarcocystis neurona* and *Toxoplasma gondii* (Simeone et al., 2015). Other parasites known to cause disease in pinnipeds and sea otters include hookworms, lungworm, and thorny-headed worms (Simeone et al., 2015).

3.4.1.7.9 Climate Change

The global climate is warming and is having impacts on some populations of marine mammals (Ban et al., 2016; MacFadyen et al., 2008; National Marine Fisheries Service, 2015b, 2018d; National Oceanic and Atmospheric Administration, 2018a; Salvadeo et al., 2010; Shirasago-Germán et al., 2015; Simmonds & Eliott, 2009). Climate change can affect marine mammal species directly or indirectly, resulting in population-level shifts of distribution and range, shifting prey base, or harmful algal blooms that can lead to toxicity. Climate change can affect marine mammal species directly through shifts in the population distribution (Doney et al., 2012; National Marine Fisheries Service, 2018d), which may or may not result in net habitat loss (some can experience habitat gains). In contrast, for the Pacific Northwest, Pelland et al. (2015) described general oceanographic characteristics that are thought to limit climate change exposure and provide potential climate refugia, which in the Study Area include the productive the Strait of Juan de Fuca eddy and a shelf area protected by coastal buoyancy current.

Climate change can also affect marine mammals indirectly via impacts on prey, changing prey distributions and locations, and changes in water temperature (Giorli & Au, 2017). The recovery of the endangered Southern Resident killer whale is likely dependent on the availability of Chinook salmon as their primary prey (Fearnbach et al., 2018; Wasser et al., 2017). A study of Northern elephant seals suggested that the tendency to revisit sites for foraging, breeding, or shelter may be of less evolutionary benefit in anomalous climate conditions and increasing environmental variability (Abrahms et al., 2017). Changes in prey can impact marine mammal foraging success, which in turn affects reproduction success and survival. Starting in January 2013, an elevated number of strandings of California sea lion pups were observed in five Southern California counties. These strandings, continuing into 2017, were declared an Unusual Mortality Event by NMFS (National Oceanic and Atmospheric Administration, 2018a, 2018b). This was the sixth Unusual Mortality Event involving California sea lions that has occurred in California since 1991. For the 2013-2017 event, NMFS biologists indicated that warmer ocean temperatures have shifted the location of prey species that are no longer adjacent to the rookeries, which thereby impacted the female sea lions' ability to find food for their pups (National Marine Fisheries Service, 2018d; National Oceanic and Atmospheric Administration, 2018b). As a result, this confluence of natural events causes the pups to leave the rookeries on their own, and many are subsequently found stranded dead or emaciated due to starvation. From 2015-2018, an Unusual Mortality Event was declared for Guadalupe fur seals along the entire California coast because of an eight-fold increase over the average historical number of strandings (National Oceanic and Atmospheric Administration, 2018a). The cause for the increase in strandings was the change in the prey base due to warming conditions (National Oceanic and Atmospheric Administration, 2018a). The California sea lion and Guadalupe fur seal populations that are present in the Study Area would have been affected by these events occurring in that seasonal southern part of their ranges.

Reduced rainfall associated with periodic drought has, on occasion, affected all of the Pacific Northwest (Xiao et al., 2016), resulting in streams with a reduced water flow and an increase in water temperature. Both those changing conditions impact salmon, which are the prey species for the endangered Southern

Resident killer whales and critical to the species recovery (Fearnbach et al., 2018; Lacy et al., 2017). As a result, foraging during the spring in Salish Sea by Southern Resident killer whales has declined in recent years as they shift their range and forage for Chinook salmon or other prey species elsewhere in response to reduced prey availability in that historically used inland waters foraging area (Shields et al., 2018b).

Harmful algal blooms may become more prevalent in warmer ocean temperatures with increased salinity levels such that blooms will begin earlier, last longer, and cover a larger geographical range (Edwards, 2013; Moore, 2008). Warming ocean waters have been linked to the spread of harmful algal blooms into the North Pacific where waters had previously been too cold for most of these algae to thrive. The spread of the algae and associated blooms has led to disease in marine mammals in locations where algae caused diseases had not been previously known (Lefebvre et al., 2016). In 2015, a California sea lion was found to be suffering from brain damage caused by domoic acid produced by the harmful algal blooms. Animals have been found in California, Oregon, and Washington suffering from domoic acid poisoning. Ultimately impacts from global climate change may result in an intensification of current and on-going threats to marine mammals (Edwards, 2013).

Decadal fluctuations of the ocean and atmosphere over the North Pacific Ocean changes in the productivity of marine ecosystems across the Pacific Ocean (Di Lorenzo et al., 2010), and thereby affect the distribution of marine mammals. Marine mammals are also influenced on a more local level by climate-related phenomena, such as storms and other extreme weather patterns such as the 2015–2016 El Niño in the ocean off the U.S. West Coast. Indirect impacts may include altered water chemistry in estuaries (low dissolved oxygen or increased nutrient loading) causing massive fish kills (Burkholder et al., 2004), which changes prey distribution and availability for cetaceans (Stevens et al., 2006).

Habitat deterioration and loss is a major factor for almost all coastal and inshore species of marine mammals and may include such factors as depleting a habitat’s prey base and the complete loss of habitat (Ayres et al., 2012; Kemp, 1996; Pine et al., 2016; Rolland et al., 2012; Smith et al., 2009; Veirs et al., 2015; Williams et al., 2014a). Many researchers predict that if oceanic temperatures continue to rise with an associated effect on marine habitat and prey availability, then either changes in foraging or life history strategies, including poleward shifts in many marine mammal species distributions, should be anticipated (Alter et al., 2010; Fleming et al., 2016; Ramp et al., 2015; Salvadeo et al., 2015; Sydeman & Allen, 1999). Poloczanska et al. (2016) analyzed climate change impact data that integrates multiple climate-influenced changes in ocean conditions (e.g., temperature, acidification, dissolved oxygen, and rainfall) to assess anticipated changes to a number of key ocean fauna across representative areas. Related to the Study Area, Poloczanska et al. (2016) included the California Current Ecosystem in their assessment. Their results predict a northward expansion in the distribution of zooplankton, fish, and squid, all of which are prey for many marine mammal species. This prediction may, for example, have been reflected by tagging efforts in July 2016 focusing on blue and fin whales that had to be shifted north to Central California waters when the majority of blue, fin, and humpback whales encountered were found to be too thin or otherwise in poor body condition in Southern California waters (Oregon State University, 2017). In Central California waters, the researchers identified good numbers of blue, fin, and humpback whales in better condition and indicative of a good feeding area that was likely to be sustained (Oregon State University, 2017).

Concerns over climate change modifying the U.S. West Coast upwelling patterns, increasing levels of hypoxia, and ocean acidification have generated targeted research and monitoring efforts at selected “Sentinel Sites” (Lott et al., 2011); the Olympic Coast National Marine Sanctuary is one of these monitored sites. There remains scientific uncertainty about how or if such changes will affect marine mammals and their prey, but acidification of the ocean could potentially impact the mobility, growth, and reproduction of calcium carbonate-forming organisms such as crustaceans and plankton, which are the direct prey of some marine mammals as well as an important part of the overall food chain in the ocean.

Marine mammals as a whole are subject to the various influences and factors delineated in this section. If specific threats to individual species in the Study Area are known, those threats are described below in individual species accounts.

3.4.1.7.10 Marine Debris

Approximately 80 percent of marine debris in the ocean come from land-based sources (California Ocean Protection Council & National Oceanic and Atmospheric Administration Marine Degree Program, 2018; Thiel et al., 2018). Without improved waste management and infrastructure in underdeveloped coastal countries worldwide, the cumulative quantity of plastic waste available to enter the ocean from land is predicted to increase by an order of magnitude by 2025 (Jambeck et al., 2015). Marine debris is a global threat to marine mammals (National Oceanic and Atmospheric Administration Marine Debris Program, 2014a). A literature review by Baulch and Perry (2014), found that 56 percent of cetacean species are documented as having ingested marine debris. Comparing the Baulch and Perry review with that conducted by (Laist, 1997), the percentage of marine mammal species with documented records of entanglement in or ingestion of marine debris has increased from 43 to 66 percent over the past 18 years (Bergmann et al., 2015). Ingestion of marine debris by marine mammals is a less well-documented cause of mortality than entanglement, but it is a growing concern (Bergmann et al., 2015; Jacobsen et al., 2010; Puig-Lozano et al., 2018). Baulch and Perry (2014) found that ingestion of debris has been documented in 48 cetacean species, with rates of ingestion as high as 31 percent in some populations. Attributing cause of death to marine debris ingestion is difficult (Laist, 1997), but ingestion of plastic bags and Styrofoam has been identified as the cause of injury or death of minke whales (De Pierrepont et al., 2005) and deep-diving odontocetes, including beaked whales (Baulch & Perry, 2014), pygmy sperm whales (Sadove & Morreale, 1989; Stamper et al., 2006; Tarpley & Marwitz, 1993), and sperm whales (Jacobsen et al., 2010; Sadove & Morreale, 1989).

Marine mammals migrating through the Study Area going north to the Gulf of Alaska and beyond and heading south as far as Central America also encounter threats outside the Study Area (Díaz-Torres et al., 2016; Thiel et al., 2018). In Alaska from 2011 through 2015, records of approximately 3,700 human-marine mammal interactions were reviewed by NMFS and determined to have resulted in 440 entanglement/entrapment-related marine mammal serious injury or mortality to various species (Helker et al., 2017). For example, between 2011 and 2015 the most common cause of serious injuries for the Eastern U.S. stock of Steller sea lions was entanglement in marine debris or fishery gear (totaling 146 sea lions) (Helker et al., 2017). In the Northwest Hawaiian Islands where there have been active efforts at marine debris removal since 1996, the NOAA marine debris team has removed 848 metric tons of derelict fishing nets and debris and estimates an additional 52 metric tons of derelict fishing gear collects on the shallow coral reefs and shores there every year (National Oceanic and Atmospheric Administration Fisheries, 2018).

On the U.S. West Coast for the marine mammal stocks that are present in the Study Area, marine debris resulted in mortalities to 90 pinnipeds (the majority California sea lions), two gray whales, and one each of the following species: humpback whale, minke whale, bottlenose dolphin, long-beaked common dolphin, and harbor porpoise (Barcenas De La Cruz et al., 2017; Carretta et al., 2016b). From 2010 through 2014, within the Southern California portion of the Study Area, there were six marine mammal entanglements (one blue whale, four pinnipeds, two dolphins) from marine debris reported off San Diego, California (Carretta et al., 2016b). In a seafloor survey off Southern California where the Navy has routinely trained and tested for decades, urban refuse (beverage cans, bottles, household items, and construction materials) constituted approximately 88 percent of the identified debris observed (Watters et al., 2010).

An estimated 75 percent or more of marine debris consists of plastic (Derraik, 2002; Hardesty & Wilcox, 2017). High concentrations of floating plastic have been reported in the central areas of the North Atlantic and Pacific Oceans (Cozar et al., 2014). Plastic pollution found in the oceans is primarily dominated by particles smaller than 1 centimeter, commonly referred to as microplastics (California Coastal Commission, 2018; Hidalgo-Ruz et al., 2012). Other researchers have defined microplastics as particles with a diameter ranging from a few micrometers up to 5 millimeters (mm) and are not readily visible to the naked eye (Andrady, 2015). Microplastic fragments and fibers found throughout the oceans result from the breakdown of larger items, such as clothing, packaging, and rope and have accumulated in the pelagic zone and sedimentary habitats (Thompson et al., 2004). Results from the investigation by Browne et al. (2011) have also suggested that microplastic fibers are discharged in sewage effluent resulting from the washing of synthetic fiber clothes. DeForges et al. (2014) sampled the Northeast Pacific Ocean in areas in and near the coastal waters of British Columbia, Canada, and found microplastics (those 62–5,000 micrometers in size) were abundant in all samples with elevated concentrations near urban centers, a finding that should be applicable to all urban centers such as those in the Study Area. Besseling et al. (2015) documented the first occurrence of microplastics in the intestines of a humpback whale, and while the primary cause of the stranding was not determined, the researchers found multiple types of microplastics ranging in sizes from 1 mm to 17 centimeters. There is still a large knowledge gap about possible negative effects of microplastics but it remains a concern (Besseling et al., 2015). Specifically, the propensity of plastics to absorb and concentrate dissolved pollutant chemicals, such as persistent organic pollutants, is a concern because microfauna may be able to digest plastic nanoparticles, facilitating the delivery of dissolved pollutant chemicals across trophic levels and making them bioavailable to larger marine organisms, such as marine mammals (Andrady, 2015).

Marine mammals as a whole are subject to the various influences and factors delineated in this section. If specific threats to individual species in the Study Area are known, those threats are described below in individual species accounts. For orientation with the geographic referents (latitude and longitude) in the following species specific sections, refer to the depictions of the Study Area presented in Chapter 2 (Description of Proposed Action and Alternatives) in Figures 2.2-1 through 2.2-4 in this Supplemental.

Mysticetes

3.4.1.8 North Pacific Right Whale (*Eublaena japonica*)

3.4.1.8.1 Status and Management

North Pacific right whales are listed as endangered under the ESA, and this species is currently one of the most endangered whales in the world (Clapham, 2016; National Marine Fisheries Service, 2013a, 2017b; Wade et al., 2010). Critical habitat for the North Pacific right whale is located in the western Gulf of Alaska off Kodiak Island and in the southeastern Bering Sea/Bristol Bay area (Muto et al., 2017); there is no designated critical habitat for this species within the Study Area. In the Alaska SAR, NMFS provides information for a single stock of North Pacific right whale designated as the Eastern North Pacific stock, although they also recognize a Western North Pacific stock that feeds east of Sakhalin Island (Muto et al., 2017).

3.4.1.8.2 Abundance

The most recent abundance estimate for the eastern North Pacific right whale is between 26 and 31 individuals in the population (Muto et al., 2017). Although this estimate may be reflective of a Bering Sea subpopulation, the total eastern North Pacific population is unlikely to be much larger (Muto et al., 2017; Wade et al., 2010). In the North Pacific west of the International Date Line, Matsuoka et al. (2014) documented as many as 55 North Pacific right whale sightings (77 animals) between 1994 and 2013. The stock from which these individuals belong has not been identified but for purposes of this analysis are assumed to belong to the stock of Western North Pacific right whales.

3.4.1.8.3 Distribution

Until recently, historical whaling records provided virtually the only information on North Pacific right whale distribution (Gregr et al., 2000; National Marine Fisheries Service, 2013a; Wright et al., 2018; Wright et al., In press). This species historically occurred across the Pacific Ocean north of 35°N, with concentrations in the Gulf of Alaska, eastern Aleutian Islands, south-central Bering Sea, Okhotsk Sea, and the Sea of Japan (Gregr et al., 2000; Ivashchenko & Chapham, 2012; Ivashchenko et al., 2015; Scarff, 1991, 2001; Shelden et al., 2005). Right whales were probably never common along the west coast of North America (Brownell et al., 2001; Reeves & Smith, 2010; Scammon, 1874; Scarff, 1991, 2001). They are generally migratory, with at least a portion of the population moving between summer feeding grounds in temperate or high latitudes and winter calving areas in warmer waters (National Marine Fisheries Service, 2013a, 2017b). In recent years, this species has generally only been observed or acoustically detected in the Bering Sea/Bristol Bay Alaska area (Brownell et al., 2001; Shelden et al., 2005; U.S. Department of the Navy, 2017g; Wade et al., 2010; Wade et al., 2011; Wright et al., 2018; Wright et al., In press; Zerbini et al., 2010; Zerbini et al., 2015), with occasional sightings in the western Gulf of Alaska area (Matsuoka et al., 2014; Širović et al., 2015a; U.S. Department of the Navy, 2017g; Wade et al., 2011).

Offshore. The likelihood of an individual Eastern North Pacific right whale being present in the NWTT Study Area is extremely low given that they have rarely being detected south of the waters around Kodiak Alaska, and there is no evidence to suggest that the western coast of the United States was ever highly frequented by this species (Brownell et al., 2001; Reeves & Smith, 2010; Scammon, 1874). As presented in the 2015 NWTT Final EIS/OEIS (U.S. Department of the Navy, 2015a), there have been a few detections of right whales south of Alaska waters in the eastern Pacific in modern times. In June 2013 a single right whale was sighted in the waters off Haida Gwaii. Approximately nine days later and 200 NM to the south, a Navy-funded bottom-mounted passive acoustic monitoring device at Quinault Canyon detected two right whale calls within a two-hour period (Širović et al., 2015a). In October of that same year (2013) off the Strait of Juan de Fuca, another (different) single right whale was seen with a group of humpback whales moving south into the Offshore portion of the Study Area (U.S. Department of the Navy, 2015a). There have also been four sightings, each of a single right whale, in California waters within approximately the last 30 years (in 1988, 1990, 1992, and 2017) (Brownell et al., 2001; Carretta et al., 1994; Price, 2017). In 2017, a lone right whale was briefly observed close to shore off La Jolla Cove in Southern California (Price, 2017) and it is reasonable to assume that this individual and others sighted in California traveled through the Study Area on their way to and from Arctic waters. Based on this data, vagrant individual North Pacific right whales are not expected to be present in the NWTT Study Area. If they are ever present, they are unlikely remain for more than a few days, and therefore are not likely to be present contemporaneous in time or in the vicinity of Navy training and testing activities occurring offshore. As a result, North Pacific right whales are extremely unlikely to be exposed to stressors associated with Navy training and testing activities.

Inland Waters. The rarity of the species and the historical occurrence patterns suggest that right whales would not be present in inland water areas. The occurrence of a North Pacific right whale within the Inland Waters portion of Study Area is considered extralimital.

Western Behm Canal, Alaska. There is no evidence of North Pacific right whale occurrence in waters to the east of the Pacific coast. Given the rarity of the species and the historic occurrence patterns, North Pacific right whales are considered extralimital within the Behm Canal portion of Study Area.

3.4.1.9 Blue Whale (*Balaenoptera musculus*)

3.4.1.9.1 Status and Management

The blue whale is listed as endangered under the ESA, but there is no designated critical habitat for this species. NMFS has determined that more research is still needed to rigorously and specifically define the features that make habitat important to blue whales (National Marine Fisheries Service, 2018c). The world's population of blue whales can be separated into three subspecies, based on geographic location and some morphological differences. In the Study Area, the subspecies *Balaenoptera musculus* is present. As presented in the Pacific SAR, the Eastern North Pacific stock of blue whales includes animals found in the eastern North Pacific from the northern Gulf of Alaska to the eastern tropical Pacific and the stock is considered depleted under the MMPA throughout its range (Carretta et al., 2017c; Carretta et al., 2018b).

3.4.1.9.2 Abundance

Widespread whaling over the last century is believed to have decreased the global blue whale population to approximately 1 percent of its pre-whaling population size (Branch, 2007; Branch et al., 2007; Monnahan, 2013; Monnahan et al., 2014; Rocha et al., 2014; Širović et al., 2004). Off the U.S. West Coast, there has been an increase in the blue whale population size (Barlow, 1994, 1997, 2003), with the highest estimate of abundance in that region in 2014 (Barlow, 2016). A previous suggested decline in the population between 2001 and 2005 (Barlow & Forney, 2007) was likely due to variability in the distribution patterns of blue whales off the coast of North America rather than a true population decline (Barlow, 1997, 2003, 2010; Calambokidis et al., 2009a). Calambokidis et al. (2009a) suggested that when feeding conditions off California are not optimal, blue whales may move to other regions to feed, including waters further north. There has been a northward shift in blue whale distribution within waters off California, Oregon, and Washington (Barlow, 2010, 2016; Carretta et al., 2013a; Širović et al., 2015b). Subsequent mark-recapture estimates reported by Calambokidis et al. (2009a) indicated, "a significant upward trend in abundance of blue whales" at a rate of increase just under 3 percent per year for the U.S. West Coast blue whale population (see also Calambokidis and Barlow (2013)).

The most current information suggests that the Eastern North Pacific population in the Study Area may have recently recovered from commercial whaling, which ended in 1971, despite the impacts of ship strikes, interactions with fishing gear, and increased levels of ambient sound in the Pacific Ocean (Barlow, 1997, 2003, 2016; Calambokidis & Barlow, 2013; Campbell et al., 2015; Carretta et al., 2017c; Carretta et al., 2018a, 2018b; International Whaling Commission, 2016; Monnahan, 2013; Monnahan et al., 2014; Monnahan et al., 2015; Rockwood et al., 2017; Širović et al., 2015b; Valdivia et al., 2019). Findings have suggested that the population of eastern North Pacific blue whales is now near the environment's carrying capacity and that the rate of change of the population size has declined as a result (Carretta et al., 2018a; International Whaling Commission, 2016; Monnahan et al., 2014; Monnahan et al., 2015). Based on NMFS systematic ship surveys from 1991 to 2014, the abundance of blue whales in the area (the combined Oregon/Washington stratum and the Northern California stratum) is estimated at 352 animals (Barlow, 2016).

3.4.1.9.3 Distribution

The Eastern North Pacific Stock of blue whales includes animals found in the eastern north Pacific from the northern Gulf of Alaska to the eastern tropical Pacific (Carretta et al., 2017c). Based on habitat models derived from line-transect survey data collected between 1991 and 2009 off the U.S. West Coast, relatively low densities of blue whales are predicted in the Study Area during the summer and fall (Barlow et al., 2009; Becker et al., 2010; Becker et al., 2016; Forney et al., 2012).

Most blue whale sightings are in nearshore and continental shelf waters; however, blue whales frequently travel through deep oceanic waters during migration and like many mysticetes, spend their summers feeding in productive waters near the higher latitudes and winters in the warmer waters at lower latitudes (Širović et al., 2004). Blue whales in the eastern north Pacific are known to migrate between higher latitude feeding grounds of the Gulf of Alaska and the Aleutian Islands to lower latitudes including Southern California, Baja California, Mexico and the Costa Rica Dome (Calambokidis & Barlow, 2004; Calambokidis et al., 2009a; Calambokidis et al., 2009b; Calambokidis & Barlow, 2013; Mate et al., 2015b; Mate et al., 2016, 2017). Blue whales tagged in Southern California waters along the Pacific coastline have been documented moving south to approximately 7° N latitude (just north of the equator) and north to 50° N latitude off British Columbia, Canada (Mate et al., 2015b; Mate et al., 2016, 2017). Photographs of blue whales off California have been matched to individuals photographed off the Queen Charlotte Islands in northern British Columbia and the northern Gulf of Alaska (Calambokidis et al., 2009b). Parts of the west coast are known to be blue whale feeding areas for the Eastern North Pacific stock during summer and fall (Bailey et al., 2009; Calambokidis et al., 2009a; Calambokidis et al., 2009b; Mate et al., 2017). There have been nine feeding areas identified for blue whales off the U.S. West Coast (Calambokidis et al., 2015), but none of these areas are within the Study Area.

Offshore. In 42 small boat surveys from Grays Harbor out to the 1,000 m isobath off Quinault conducted over a five-year period in the summer between 2004 and 2009, there was one sighting of a blue whale (Oleson & Hildebrand, 2012). In December 2011, six blue whales were sighted off the Washington coast, which was the highest number of blue whales ever sighted off that coast and only the third confirmed sighting in 50 years (Cascadia Research, 2012b). Model predictions based on tagging data indicated the highest blue whale presence off Washington in June and July with a presence into November (Hazen et al., 2016). Aerial surveys conducted in waters off southern Washington, Oregon, and Northern California covering the approximate nearshore half of the Study Area in the spring, summer, and fall of 2011 and 2012, encountered a total of 16 blue whales only during the fall and only off Oregon (Adams et al., 2014). Acoustic monitoring in waters off the coast of Washington suggested a yearly seasonal pattern of blue whale presence from summer through winter (calls were absent from approximately March through July) (Debich et al., 2014; Kerosky et al., 2013; Oleson & Hildebrand, 2012; Trickey et al., 2015; Wiggins et al., 2017). This seasonality is consistent with the data from satellite-tagged blue whales being in the NWTT Study Area from August through November (summer through fall) (U.S. Department of the Navy, 2018a). For purposes of the analysis in this Supplemental, blue whales in the Offshore portion of the Study Area are considered to have a seasonal presence.

Between 2014 and 2017, satellite tags were placed on 63 blue whales from the same stock in the waters off the U.S. West Coast, including in the Offshore portion of the NWTT Study Area (Mate et al., 2017;

U.S. Department of the Navy, 2018a). The NWTT Study Area was used by only nine of the 63 tagged blue whales with an average of approximately 23 days spent in the NWTT Study Area; only one of these 63 blue whales ventured as far north as the W237 Warning Area in waters off Washington (U.S. Department of the Navy, 2018a).

Inland Waters. Blue whales are not expected to occur within the Inland Waters region of the Study Area since it is well inland of the areas normally inhabited by blue whales.

Western Behm Canal, Alaska. Blue whales are not expected to occur within the SEAFAC region of the Study Area since it is well inland of the areas normally inhabited by blue whales.

3.4.1.10 Fin Whale (*Balaenoptera physalus*)

3.4.1.10.1 Status and Management

The fin whale is listed as endangered under the ESA, but there is no designated critical habitat for this species. Fin whale population structure in the Pacific Ocean is not well known. During the 20th century more fin whales were taken by industrialized whaling than any other species (Rocha et al., 2014). In the Study Area, NMFS recognizes two fin whale stocks: (1) the Northeast Pacific stock (Alaska); and (2) the California, Oregon, and Washington stock, and both stocks are considered depleted under the MMPA and (Carretta et al., 2017c; Carretta et al., 2018a; Muto et al., 2017; Muto et al., 2018b).

3.4.1.10.2 Abundance

There are no reliable current or historical population estimates for the Alaska/Northeast Pacific stock of fin whales (Muto et al., 2017). Suggested evidence of an increasing abundance trend for fin whales in Alaskan waters (Zerbini et al., 2006) is consistent with their suggested increase off the U.S. West Coast (Barlow, 2016; Jefferson et al., 2014; Moore & Barlow, 2011; Širović et al., 2015b; Valdivia et al., 2019).

Based on systematic ship survey data collected off the U.S. West Coast from 1991 to 2014, the fin whale is by a large margin the most abundant large whale found in those waters (Barlow, 2016). For the Offshore portion of the Study Area and based on surveys from 1991 to 2014, the abundance for fin whales in the area (the combined Oregon/Washington stratum and the Northern California stratum) is estimated at 2,628 animals (Barlow, 2016). It has been suggested that the increasing number of fin whales seen since 1999 between Vancouver Island and Washington, "… may reflect recovery of the local populations in the North Pacific" (Towers et al., 2018b).

3.4.1.10.3 Distribution

Fin whales prefer temperate and polar waters (Jefferson et al., 2015; Reeves et al., 2002a). This species has been documented from 60° N in Alaska waters, to tropical waters off Hawaii, in Canadian waters both offshore and inland including some fjords, and they have frequently been recorded in waters within the Southern California Bight (Barlow & Forney, 2007; Campbell et al., 2015; Jefferson et al., 2014; Mate et al., 2016, 2017; Mizroch et al., 2009; Širović et al., 2004; Širović et al., 2015b; Širović et al., 2016; Smultea, 2014). As demonstrated by satellite tags and discovery tags[1], fin whales make long-range

[1] As a means of data collection starting in the 1930s, discovery tags having a serial number and return address were shot into the blubber of the whale by scientists and if that whale was later harvested by the whaling industry and the tag "discovered" during flensing, it could be sent back to the researchers providing data on the movement of individual whales.

movements along the entire U.S. West Coast (Falcone et al., 2011; Mate et al., 2015b; Mate et al., 2016, 2017; Mizroch et al., 2009). Locations of breeding and calving grounds are largely unknown. The species is highly adaptable, following prey, typically off the continental shelf (Azzellino et al., 2008; Panigada et al., 2008) and survey data indicate that fin whale distributions shift both seasonally as well as annually (Calambokidis et al., 2015; Douglas et al., 2014; Jefferson et al., 2014). When seasonally present in northern British Columbia waters of Hecate Strait, Queen Charlotte Sound, and Greater Caamaño Sound, satellite tag data and photographic identifications indicated little movement of fin whales between the inshore areas and the offshore regions of the Canadian Pacific (Nichol et al., 2018).

Offshore. In 42 small boat surveys from Grays Harbor out to the 1,000 m isobath off Quinault conducted over a five-year period in the summer between 2004 and 2009, there was one sighting of a group of three fin whales (Oleson & Hildebrand, 2012). During aerial surveys conducted within the 2,000 m isobath off southern Washington, Oregon, and Northern California in the spring, summer, and fall of 2011 and 2012, there were six sightings of 13 fin whales during winter and summer 2012 only in offshore waters over the continental slope (Adams et al., 2014). Between 2014 and 2017, 32 fin whales were instrumented with satellite tags in the waters off the U.S. West Coast (Mate et al., 2017; U.S. Department of the Navy, 2018a); all these whales are from the same stock as present in the NWTT Study Area. Only four of the 32 fin whales ventured into the NWTT Study Area. One of the four traveled only as far north as the California/Oregon border, and another, occurring in waters off Washington, only passed through the NWTT Study Area briefly on its way farther north into Canadian waters. Across the tag data sample years, fin whale use of the NWTT Study Area occurred primarily in late summer and fall (Mate et al., 2017; U.S. Department of the Navy, 2018a). Consistent with sightings from systematic ship surveys out to 300 NM off the U.S. West Coast and satellite tag data, habitat-based density models built with these data indicate that fin whales are more likely to be present seaward of the continental shelf in the offshore portion of the Study Area (Barlow, 2016; Becker et al., 2016).

Acoustic monitoring has indicated a yearly seasonal pattern of fin whale calls in the Study Area off Washington and Canada with the absence of calls from approximately May through July (Debich et al., 2014; Kerosky et al., 2013; Oleson & Hildebrand, 2012; Soule & Wilcock, 2013; Trickey et al., 2015; Wiggins et al., 2017). Consistent with those findings and the satellite tag data, a seafloor seismic network at the Strait of Juan de Fuca was used to study fin whale calls and suggested northward movement of transiting fin whale groups from August to October and a southward movement from November to April (Soule & Wilcock, 2013). For purposes of the analysis in this Supplemental, fin whales in the Offshore portion of the Study Area are considered to have a regular presence.

Inland Waters. Fin whales are not expected to occur within the Inland Waters region of the Study Area since fin whales have seldom been documented in the area. Lone fin whales were sighted in the Strait of Juan de Fuca between September and December 2015, in July 2016, and again in October 2017; these were three of only 10 total fin whale sightings in the Salish Sea since 1930 (Cogan, 2015; Daugherty, 2016; Nichol et al., 2018; Towers et al., 2018b).

Western Behm Canal, Alaska. Surveys in Southeast Alaska between 1991 and 2007 encountered a total of seven fin whales, only in the summer, and only off the southern tip of Prince of Wales Island and the southern end of Clarence Strait in proximity to the open ocean (Dahlheim et al., 2009). The limited number of sightings from those surveys and a documented presence limited to a proximity to the open ocean suggests fin whale presence in Behm Canal would be rare. Based on the sighting of fin whales in Clarence Strait and Dixon Entrance (Dahlheim et al., 2009; Nichol et al., 2018) and for purposes of the present analysis, the Navy assumes fin whales may be present in small numbers within the SEAFAC region of the Study Area.

3.4.1.11 Sei Whale (*Balaenoptera borealis*)

3.4.1.11.1 Status and Management

The sei whale is listed as an endangered under the ESA, but there is no designated critical habitat for this species (Carretta et al., 2017c; Carretta et al., 2018a). A single Eastern North Pacific stock is recognized in the U.S. EEZ and that stock is considered depleted under the MMPA (Carretta et al., 2017c; Carretta et al., 2018a).

3.4.1.11.2 Abundance

There is no estimate of an abundance for sei whales in the Behm Canal given there is no indication that the species is present in the area (Dahlheim et al., 2009); the species is not included in the Alaska SAR (Muto et al., 2017; Muto et al., 2018b).

There has been an increase in sei whales off the Washington and Oregon coast in recent years, with more groups of sei whales sighted in 2014 than in all previous NMFS surveys combined (Barlow, 2016). This increase in the NWTT Study Area is consistent with a significant population trend increase for the Eastern North Pacific stock overall (Valdivia et al., 2019). For the Offshore portion of the Study Area and based on surveys from 1991 to 2014, the abundance of sei whales in the area (the combined Oregon/Washington stratum and the Northern California stratum) is estimated at 212 animals (Barlow, 2016).

3.4.1.11.3 Distribution

Sei whales have a worldwide distribution and are found primarily in cold temperate to subpolar latitudes across the North Pacific where there is steep bathymetric relief, such as the continental shelf break, canyons, or basins between banks and ledges (Best & Lockyer, 2002; Gregr & Trites, 2001; Horwood, 1987; Horwood, 2009). Sei whales are migratory, spending the summer months feeding in the subpolar higher latitudes and returning to the lower latitudes to calve in the winter (Fulling et al., 2011; Horwood, 1987; Horwood, 2009; Olsen et al., 2009; Rone et al., 2017; Smultea, 2014; Smultea et al., 2010). In the winter in the Pacific, sei whales have been detected as far south as the Mariana Islands, Hawaii, and Southern California (Fulling et al., 2011; Smultea, 2014; Smultea et al., 2010). Analysis of sei whale genetic samples from around the Pacific suggests a single stock present in the Pacific ((Baker et al., 2006; Huijser et al., 2018).

Offshore. Sei whales are expected to be present in the Offshore potion of the Study Area (Barlow, 2016; Williams & Thomas, 2007).

Inland Waters. There are no records of sei whales being sighted or otherwise present in the Inland Waters potion of the Study Area (Gregr et al., 2006; U.S. Department of the Navy, 2017e).

Western Behm Canal, Alaska. There are no data to indicate that sei whales ever venture from the Pacific into areas like Behm Canal (see Dahlheim et al. (2009)) and the species is not included in the Alaska SAR (Muto et al., 2017; Muto et al., 2018b).

Odontocetes

3.4.1.12 Minke Whale (*Balaenoptera acutorostrata*)

3.4.1.12.1 Status and Management

Minke whales are not considered a threatened or endangered species under the ESA, and neither stock of minke whales in the Study Area is considered depleted under the MMPA. Minke whales in the Behm Canal portion of the Study Area belong to the Alaska stock (Muto et al., 2017; Muto et al., 2018b), and those in the Offshore and Inland Waters portion belong to the California, Oregon, Washington stock (Carretta et al., 2017c).

3.4.1.12.2 Abundance

There is no estimate of minke whale abundance in the Behm Canal given the area has not been surveyed (Muto et al., 2017; Muto et al., 2018b). For the Offshore and Inland Waters portion of the Study Area and based on surveys from 1996 to 2014, the abundance for minke whales in the area (the combined Oregon/Washington stratum and the Northern California stratum; CV >1.0) is estimated at 506 animals (Barlow, 2016).

3.4.1.12.3 Distribution

Minke whales have a predominant nearshore distribution along the coast of North America (Hamilton et al., 2009). In the eastern North Pacific Ocean including the Study Area, year round observations over multiple years have only visually detected minke whales between March and November (Adams et al., 2014; Cogan, 2015; Debich et al., 2014; Oleson et al., 2009; Smultea et al., 2017; Towers et al., 2013). This spring to fall occurrence includes small numbers of minke whales that feed over or near shallow banks, such as are present in the Cormorant Channel off northeastern Vancouver Island (Nikolich & Towers, in press). This occurrence pattern along with other ecological evidence indicates seasonal migrations to warmer waters during the winter season (Towers et al., 2013). Because there have been sightings of individual minke whales in the Inland Waters portion of the Study Area during winter (December and January) in years past (Everitt et al., 1980), it is conservatively assumed that minke whale are present in the Study Area year round.

In the Behm Canal and Offshore portions of the Study Area, most minke whales are believed to be in constant movement while foraging, given the findings from a seven-year study of the population present at Johnstone Strait (north of Vancouver Island) (Dorsey et al., 1990). In contrast, minke whales around the San Juan Islands in the inland waters of Washington appear to frequent specific home ranges where animals mill about and feed over periods of hours (Dorsey, 1983; Dorsey et al., 1990; Muto et al., 2017; Towers et al., 2013). Photo-identification of individual minke whales has indicated intra-annual movements in excess of approximately 400 km between feeding areas in the coastal waters of northern British Columbia to the inland waters of Washington (Towers et al., 2013).

Offshore. Minke whales are expected to seasonally be present, but minke whale vocalizations have only been detected in passive acoustic monitoring twice in the Offshore portion of the Study Area; in November 2012 and April 2013 (Debich et al., 2014). Minke whale vocalizations have been absent from all other monitoring periods (Kerosky et al., 2013; Širović et al., 2012a; Trickey et al., 2015). Minke whales are relatively infrequently visually detected in the region (Barlow, 2016; Oleson et al., 2009; Williams & Thomas, 2007). During NMFS systematic shipboard surveys of the region, minke whales have been encountered offshore Washington as lone individuals totaling six in 1996, two in 2001, and two in 2014 (Barlow, 2016). During aerial surveys in 2011 and 2012 there were six sightings in summer and fall over the Oregon shelf waters portion of the Study Area (Adams et al., 2014). For purposes of the analysis in this Supplemental, minke whales offshore are considered to have a regular presence.

Inland Waters. Based on the record of opportunistic marine mammal sightings in the Inland Waters portion of the Study Area (Everitt et al., 1980; U.S. Department of the Navy, 2017e), minke whales have been generally observed as lone individuals, with the exception of larger groups occasionally observed in the Strait of Juan de Fuca and in the vicinity of the San Juan Islands (Cogan, 2015; Dorsey et al., 1990; Smultea et al., 2017; Towers et al., 2013). For purposes of the analysis in this Supplemental, minke whales in the Inland Waters portion of the Study Area are considered to have a regular presence.

Western Behm Canal, Alaska. Minke whales were observed infrequently during the spring through fall 1991–2007 surveys of the inland waters of southeast Alaska (Dahlheim et al., 2009). Although surveys have not been conducted in the winter months in southeast Alaska, it is possible that minke whales may be present in the winter, and that is assumed to be the case for this analysis. For purposes of the analysis in this Supplemental, minke whales in the Behm Canal portion of the Study Area are considered to have a regular presence.

3.4.1.13 Humpback Whale (*Megaptera novaeangliae*)

3.4.1.13.1 Status and Management

Humpback whales expected to be present in the Study Area are from three DPSs, given they represent populations that are both discrete from other conspecific populations and significant to the species of humpback whales to which they belong (Carretta et al., 2017c; Carretta et al., 2018b; Muto et al., 2017; Muto et al., 2018b; National Marine Fisheries Service, 2016j; Titova et al., 2017). These DPSs in the Study Area are based on animals identified from breeding areas in Hawaii, Mexico, and Central America (Bettridge et al., 2015; Carretta et al., 2017c; Carretta et al., 2018b; Darling et al., 1996; Muto et al., 2017; National Marine Fisheries Service, 2016j; Titova et al., 2017; Wade et al., 2016). The portion of the humpback whale population in the Study Area that is from the Hawaii DPS was delisted under the ESA given that this population segment is believed to have fully recovered and now has an abundance greater than the pre-whaling estimate (Barlow et al., 2011; Bettridge et al., 2015; Muto et al., 2017; Muto et al., 2018b; National Marine Fisheries Service, 2016j; Wade et al., 2016). Humpback whales in Study Area from the Mexico DPS are listed as threatened, and those from the Central America DPS are listed as endangered under the ESA (National Marine Fisheries Service, 2016j). There is no designated critical habitat for these ESA listed humpback whales in the North Pacific (Carretta et al., 2017c; Carretta et al., 2018b; Muto et al., 2017; Muto et al., 2018b). As of the release date of this draft Supplemental (February 2019), NMFS is still developing Critical Habitat for the listed humpback whale DPSs. The Navy will incorporate analysis of proposed Critical Habitat into the analysis in the Supplemental and consult with NMFS under ESA with regards to any critical habitat once it has been designated for humpback whales.

In the North Pacific Ocean and under the MMPA, the stock structure of humpback whales is defined by NMFS based on the stock's fidelity to feeding grounds (Bettridge et al., 2015; Carretta et al., 2017c; Carretta et al., 2018b; Muto et al., 2017; Muto et al., 2018b; National Marine Fisheries Service, 2016j).

As a result, the stock designations are inconsistent with the DPS designations[2], and although NMFS is evaluating the stock structure of humpback whales under the MMPA, no changes to current stock structure have been provided to date (Carretta et al., 2017c; Carretta et al., 2018b; Muto et al., 2017; Muto et al., 2018b). The majority of the humpback whales present in the Alaska and Washington portions of the Study Area (that are generally feeding), spend the winter and spring in Hawaii breeding, calving, or nursing (National Marine Fisheries Service, 2016f, 2016i). NMFS has designated those animals from Hawaii that are present in Alaska, British Columbia, and Washington in the summer and early fall as being part of the Central North Pacific stock given they migrate to those areas in the Central North Pacific to feed (Muto et al., 2017; Muto et al., 2018b). The stock is not considered depleted under the MMPA. The Central North Pacific stock includes animals that winter in many locations other than Hawaii including, for example, humpback whales from Mexico (Calambokidis et al., 2008; Muto et al., 2018b; National Marine Fisheries Service, 2016i; Wade et al., 2016).

The remainder of humpback whales expected to be present in the Study Area are designated by NMFS as being from the California, Oregon, Washington stock. This stock is defined by NMFS as including only those animals that migrate northward from their winter breeding grounds in Mexico and Central America to feeding areas along the U.S. West Coast off the United States, including the waters of the Study Area (Bettridge et al., 2015; Carretta et al., 2017c; Carretta et al., 2018a; National Marine Fisheries Service, 2016f, 2016i, 2016j). The California, Oregon, Washington stock is considered depleted under the MMPA.

3.4.1.13.2 Abundance

Although there is no site-specific data for Behm Canal, increasing local observations of humpback whales within Behm Canal is consistent with the increasing Central North Pacific stock (Barlow et al., 2011; Bettridge et al., 2015; National Marine Fisheries Service, 2016i; Wade et al., 2016) and from the increasing California, Oregon, Washington stock (Carretta et al., 2018b), it is reasonable to assume that

[2] Between 1990 and 1993 in the Okinawa/Osagawara breeding area of the Western North Pacific DPS, a photographically identified female humpback whale was observed on four occasions (once with a calf) and in 1991, this same individual was observed off La Perouse Bank, in Canadian waters (Darling et al., 1996). La Perouse Bank, is centered approximately 20 NM north of the NWTT Study Area. In 1991, only 24 individual humpback whales had been photo-identified during small boat surveys in waters off Northern Washington/British Columbia (Calambokidis et al., 2004) and a total of 177 had been identified in Japan waters (Darling et al., 1996). Given the small sample sizes of the photo-identification data in 1991 for the Western North Pacific DPS in the two areas involved, this one detection may represent a much more prevalent occurrence of Western North Pacific DPS whales in the vicinity of the NWTT Study Area. In addition data provided by Titova et al. (2017), subsequent to the NMFS reviews cited above, found photo-ID matches between humpbacks in Russian waters with 35 animals in Hawaiian breeding grounds and 11 animals in Mexican breeding grounds. These Russian waters/Western North Pacific stock whales are designated in the Alaska stock assessment report as representing the Okinawa/Osagawara/Philippines or Western North Pacific DPS (Muto et al., 2018a; Muto et al., 2018b). Thus, this new data along with photo-identification data having matches between what are supposed to be separate breeding areas and feeding areas results in further inconsistencies, with the stock structure of Central North Pacific stock whales being the Hawaii DPS, and the California, Oregon, Washington stock being mostly comprised by the Mexico DPS. The Navy's analysis presumes that, due to the Western North Pacific stock/DPS being few in number and the NWTT Study Area outside their main feeding area in the western North Pacific, Western North Pacific DPS/stock humpback whales are not likely to be present in the NWTT Study Area during or in proximity to any of the proposed training or testing activities. Therefore, Western North Pacific DPS/stock humpback whales would not be affected by the Proposed Action.

the abundance of humpback whales in Southeast Alaska is increasing (Muto et al., 2017; Muto et al., 2018b).

In inland waters of Washington including the Strait of Juan de Fuca, Puget Sound, and other parts of the Salish Sea, scientists have noted a trend of increased humpback whale abundance (Cascadia Research, 2017e; Cogan, 2015). This is consistent with the pattern of increasing humpback whale abundance in the Pacific as suggested by data from previous years (Barlow et al., 2011; Calambokidis & Barlow, 2013) and with the highest-yet abundance for the California, Oregon, Washington stock of humpback whale as observed in the NMFS 2014 survey of the U.S. West Coast (Barlow, 2016). For the Offshore and Inland Waters portion of the Study Area and based on surveys from 1991 to 2014, the abundance for humpback whales in the area (the combined Oregon/Washington stratum and the Northern California stratum) is estimated at 834 animals (Barlow, 2016).

3.4.1.13.3 Distribution

Humpback whales are distributed worldwide in all major oceans and most seas. They typically are found during the summer on high-latitude feeding grounds, including inland waters and fjords, and during the winter in the tropics and subtropics around islands, over shallow banks, and along continental coasts, where calving occurs (Barlow et al., 2011; Bettridge et al., 2015; Calambokidis et al., 2010; Calambokidis et al., 2017a; Keen et al., 2018; Wade et al., 2016). Based on sightings and habitat models derived from line-transect survey data collected between 1991 and 2014 off the U.S. West Coast, humpback whales are distributed primarily in nearshore waters during the summer and fall, with a significantly greater proportion of the population found farther offshore during the winter (Barlow et al., 2009; Becker et al., 2010; Becker et al., 2016; Becker et al., 2017; Campbell et al., 2015; Forney & Barlow, 1998; Forney et al., 2012). Visual surveys and acoustic monitoring studies have detected humpbacks along the Washington coast year round, with peak occurrence during the summer and fall (Cogan, 2015; Debich et al., 2014; Emmons et al., 2017; Oleson et al., 2009; Širović et al., 2012a; Trickey et al., 2015).

There have been three locations identified as biologically important humpback whale feeding areas located in or near the offshore portion of the Study Area (Calambokidis et al., 2015). It is important to note there are also other additional important humpback whale feeding areas used by the same stocks of humpback whales, which are outside of the NWTT Study Area (Ashe et al., 2013; Best et al., 2015; Dalla-Rosa et al., 2012; Ferguson et al., 2015a; Keen et al., 2018). As shown in the 2015 NWTT Final EIS/OEIS on Figure 3.4-2 (U.S. Department of the Navy, 2015a), there are three humpback whale feeding areas in U.S. waters in and around the offshore portion of the Study Area. These areas and their seasonal use periods are (1) Point St. George (feeding July to November), (2) Stonewall and Hecta Bank (feeding May–November), and (3) Northern Washington (feeding May–November) (Calambokidis et al., 2015). Each of these areas is primarily used annually during the approximate six-to-seven-month period when humpback whale feeding occurs at those locations. Specifically for the Northern Washington feeding area, shipboard surveys in July 2005 that included both U.S. and Canadian waters found that humpback whale sightings were concentrated around the edge of what appears to be the semi-permanent eddy associated with the outflow from the Strait of Juan de Fuca (Dalla-Rosa et al., 2012). The majority of this semi-permanent eddy and associated feeding area is contiguous with the designated biologically important feeding area, but the northern boundary of the designated feeding area has been drawn as the line between the U.S. and Canadian EEZs. The designated biologically important area was bounded to the north by Canadian waters because the identification of biologically important areas was restricted to only in U.S. waters (Calambokidis et al., 2015; Ferguson et al., 2015b). In the designation of biologically important areas (BIAs) to only locations within U.S. waters, it was made clear that, "…the absence of BIA designations outside U.S. waters should not be interpreted as an absence of BIAs in those waters" (Ferguson et al., 2015b). In addition to feeding areas in Canada, including the inland fjords and Johnstone Strait (Ashe et al., 2013; Best et al., 2015; Ford et al., 2010; Keen et al., 2018), there are consistent concentrated feeding areas in Canadian waters offshore of British Columbia, including off Haida Gwaii, on the continental shelf break between Cape St. James and Cape Scott at Vancouver Island, at the mouth of the Strait of Juan de Fuca, and between Southeast Alaska and Canada at Dixon Entrance (Best et al., 2015; Dalla-Rosa et al., 2012; Ford et al., 2010).

Analyses of Navy training and testing activities in relation to these biologically important feeding areas for humpback whales were previously completed in the 2015 NWTT Final EIS/OEIS (U.S. Department of the Navy, 2015a), evaluated by NMFS in the issuance of the current Letter of Authorization pursuant to the MMPA (National Oceanic and Atmospheric Administration, 2015b), and reviewed by NMFS pursuant to ESA for listed species in the Study Area (National Marine Fisheries Service, 2014).There is no new applicable science that necessitates any changes in those previous analyses. For additional details regarding the analyses, see Section 3.4.2.1 (Acoustic Stressors) and Appendix K (Geographic Mitigation Assessment) in this Supplemental as well as the 2015 NWTT Final EIS/OEIS (U.S. Department of the Navy, 2015a).

Offshore. Humpback whales are expected to be present in the Offshore portion of the Study Area year round. The pattern of increasing humpback whale abundance indicated by previous investigations (Barlow et al., 2011; Calambokidis & Barlow, 2004, 2013; Calambokidis et al., 2017a) appears consistent with the highest-yet abundances of these species in 2014 (Barlow, 2016). Acoustic monitoring over a number of years has demonstrated an overwintering presence of humpback whales and suggests that some portion of the humpback whale population off Washington remain in temperate waters during the winter (Debich et al., 2014; Emmons et al., 2017; Kerosky et al., 2013; Oleson & Hildebrand, 2012; Širović et al., 2012a; Trickey et al., 2015). Satellite tag location data from humpback whales within the Offshore portion of the NWTT Study Area indicate a preference for shallow waters (>200 m depth) consistent with generally known patterns of humpback whale distribution along the Pacific coast (Barlow et al., 2011; Becker et al., 2017; Campbell et al., 2015; Ford et al., 2010; Forney & Barlow, 1998; Mate et al., 2017; U.S. Department of the Navy, 2018a). Five humpback whales have been tracked in the NWTT Study Area using satellite tags (Mate et al., 2017; U.S. Department of the Navy, 2018a). One humpback whale tagged in the waters north of Monterey California was tracked for 85 days moving more than 900 km to waters offshore of Pacific City, Oregon (U.S. Department of the Navy, 2018a). While heading north, this individual took an offshore route as far as 200 km from shore and then returned south along a more inshore route. This whale and two others (one tagged off of Newport, Oregon, and the other off Astoria, Oregon) spent portions of time in nearshore shallow waters (less than 200 m in depth) or in Canadian waters, during which they were outside of the NWTT Study Area and the locations where Navy training and testing activities occur (Mate et al., 2017; U.S. Department of the Navy, 2018a). The remaining two of the five tracked humpback whales were tagged near Cape Blanco, in southern Oregon, and spent most of their time beyond the NWTT Study Area in continental shelf waters off Trinidad Head and Eureka, California (U.S. Department of the Navy, 2017d).

Inland Waters. Data indicate that an increasing number of humpback whales are seasonally present in the Inland Waters portion of the Study Area and that this trend escalated in 2014 (Cascadia Research, 2017e). Based on opportunistic and informal sighting reports in 2015, it was estimated that there were as many as 15–25 whales present in the Inland Waters portion of the Study Area during any given day (Cogan, 2015).

Western Behm Canal, Alaska. Humpback whales are assumed to be present in Behm Canal (U.S. Department of the Navy, 1991). In summer, relatively high densities of humpback whales occur throughout much of Southeast Alaska (Muto et al., 2017; Muto et al., 2018b) and Northern British Columbia (Ashe et al., 2013; Best et al., 2015; Ford et al., 2010; Keen et al., 2018), and they were observed frequently during spring through fall in a series of surveys from 1991 to 2007 in Southeast Alaska (Dahlheim et al., 2009). Although surveys have not been conducted in the winter months in Southeast Alaska, humpback whales have been seen during the winter in Lynn Canal, indicating that some of these animals do not migrate south and remain in Southeast Alaskan waters to feed on herring (Moran et al., 2009). Navy assumes humpback whales may be present in Behm Canal in all seasons.

3.4.1.14 Gray Whale (*Eschrichtius robustus*)

3.4.1.14.1 Status and Management

There are two north Pacific populations of gray whales: the Eastern subpopulation and the Western subpopulation designated in the Pacific SAR (Carretta et al., 2017c; Carretta et al., 2018b; Weller et al., 2013). Both populations could be present in the Study Area during their northward and southward migration (Calambokidis et al., 2015; Calambokidis et al., 2017b; Mate et al., 2015a; Sumich & Show, 2011; Weller et al., 2013).

The Eastern North Pacific subpopulation (also known as the California-Chukchi population) has recovered from whaling exploitation and was delisted under the ESA in 1994 (Swartz et al., 2006). This population has been designated the Eastern North Pacific stock and is not considered depleted (Carretta et al., 2017c; Carretta et al., 2018a).

The Western subpopulation, which was previously also known as the western north Pacific or the Korean-Okhotsk population, has been designated the Western North Pacific stock and is considered depleted (Carretta et al., 2017c; Carretta et al., 2018a; Cooke et al., 2015; Weller et al., 2002; Weller et al., 2013). This subpopulation is listed under the ESA as endangered and there has been no critical habitat designated for Western North Pacific gray whales (Carretta et al., 2018a).

3.4.1.14.2 Abundance

The population size of the Eastern North Pacific gray whales has increased over several decades (Calambokidis et al., 2017a; Carretta et al., 2018a; Durban et al., 2017; Perryman et al., 2017). Monitoring over the last 30 years has provided data that have indicated the Eastern North Pacific population and stock is within range of its optimum sustainable population, which is consistent with a population approaching the carrying capacity of the environment (Carretta et al., 2017c; Carretta et al., 2018a). The current abundance estimate for the Eastern North Pacific stock is 26,960 gray whales (Carretta et al., 2017c; Carretta et al., 2018a).

The Western North Pacific stock of gray whales was once considered extinct but now small numbers (approximately 200) are known to exist (Carretta et al., 2017c; Carretta et al., 2018a; Cooke et al., 2015; International Union for Conservation of Nature (IUCN), 2012; International Whaling Commission, 2014; Mate et al., 2015a; Nakamura et al., 2017; Weller et al., 2013). The documented high prevalence of rake marks from killer whale attacks on gray whales in the western North Pacific may represent an important selective pressure regulating the recovery of the stock (Weller et al., 2018). Current population trend data indicates a positive growth of roughly 2–4 percent per year (Carretta et al., 2018a; Cooke et al., 2015; National Marine Fisheries Service, 2014). A recent increase in the occurrence of gray whales off Japan (Nakamura et al., 2017), is also consistent with a positive population growth for Western North Pacific gray whales. At least 12 members of the Western North Pacific stock have been detected in waters off the Pacific Northwest (Mate et al., 2013; Weller & Brownell, 2012). NMFS reported that 18 Western North Pacific gray whales have been identified in waters far enough south to have passed through Southern California waters (National Marine Fisheries Service, 2014), and although some gray whales have been shown to make mid-ocean migrations (Mate et al., 2015a), the Navy assumes migration to and from Southern California and Mexico would include passage through the NWTT Study Area as well. The current abundance estimate for the Western North Pacific stock is 175 gray whales (Carretta et al., 2017c; Carretta et al., 2018a).

3.4.1.14.3 Distribution

It should be noted that most of the science dealing with gray whale migrations and distribution is not specific to either of the two recognized gray whale sub-populations, but where possible that distinction has been specified in the following sections.

Along the Pacific coast between Alaska and Northern California, there are a few hundred gray whales present throughout the summer and fall that are known as the Pacific Coast Feeding Group, which are assumed to be part of the Eastern population (Calambokidis et al., 2002; Calambokidis et al., 2017b; Carretta et al., 2017c; Mate et al., 2010; Mate, 2013; Weller et al., 2013). The group has been identified as far north as Kodiak Island, Alaska (Gosho et al., 2011), and has generated uncertainty regarding the stock structure of the Eastern North Pacific population (Carretta et al., 2017c; Carretta et al., 2018a; Weller et al., 2012; Weller et al., 2013). Survey and photo-identifications work undertaken along the Washington coast from 1984 to 2011 observed a total of 225 unique gray whales with 49 percent being observed again in a future year (Scordino et al., 2017). Photo-identification, telemetry, and genetic studies suggest that the Pacific Coast Feeding Group is a distinct feeding aggregation from the Eastern North Pacific population (Calambokidis et al., 2010; Calambokidis et al., 2017b; Frasier et al., 2011; International Whaling Commission, 2014; Mate et al., 2010; Weller et al., 2013). In 2012–2013, the Navy funded a satellite tracking study of Pacific Coast Feeding Group gray whales (Mate, 2013). Tags were attached to 11 gray whales near Crescent City, California, in fall 2012. Track histories were received from 9 of the 11 tags, which confirmed an exclusive near shore (< 19 km) distribution and movement along the Northern California, Oregon, and Washington coasts (Mate, 2013). Although the duration of the tags was limited, none of the Pacific Coast Feeding Group whales moved south beyond Northern California. The Pacific Coast Feeding Group is not currently treated as a distinct stock or population segment (Carretta et al., 2015; Carretta et al., 2017c; Carretta et al., 2018a; Mate et al., 2010). Within the Inland Waters portion of the NWTT Study Area, there is also a group of gray whales that feed locally each spring in the inland waters around Whidbey Island and Camano Island (Cascadia Research, 2017d; Cogan, 2015). Five of the photo-identified individuals in this group have been seen over the last 17 years, and three have been sighted over at least 26 years (Cascadia Research, 2017d).

Gray whales of the Western North Pacific stock primarily occur in shallow waters over the U.S. West Coast, Russian, and Asian continental shelves and are considered to be one of the most coastal of the great whales (Jefferson et al., 2015; Jones & Swartz, 2009). Feeding grounds for the population are the Okhotsk Sea off Sakhalin Island, Russia, and in the southeastern Kamchatka Peninsula (in the southwestern Bering Sea) in nearshore waters generally less than 225 feet (ft.) deep (Jones & Swartz, 2009; Weller & Brownell, 2012). The winter breeding grounds for the Western North Pacific stock may be areas in the South China Sea (Weller et al., 2013). The breeding grounds for the Eastern North Pacific stock consist of subtropical lagoons in Baja California, Mexico (Alter et al., 2009; Jones & Swartz, 2009; Mate et al., 2015a; Urban-Ramirez et al., 2003; Weller et al., 2012).

Gray whales are acoustically active while migrating (Burnham et al., 2018; Guazzo et al., 2017), and acoustic and sighting data have indicated gray whales use parts of the Washington coast throughout the year (Burnham et al., 2018; Emmons et al., 2017; Ferguson et al., 2015b). The Cetacean Density and Distribution Mapping Working Group (see Ferguson et al. (2015a)) shows the observed presence of gray whales in the Study Area in every month of the year except February. In aerial surveys conducted in waters off Washington, Oregon, and Northern California covering the approximate nearshore half of the Study Area in the spring, summer, and fall of 2011 and 2012, gray whales were present during all surveys and within 25 km of the coast except for two sightings over deeper water (Adams et al., 2014). In boat surveys between 1984 and 2011 off the Washington coast, gray whales were most commonly observed in very shallow waters with depths ranging from 5 to 15 m over rocky substrates and often near kelp forests (Scordino et al., 2017).

Some gray whales make the longest annual migration of any mammal, 15,000–20,000 km roundtrip (Jones & Swartz, 2009; Mate et al., 2013; Mate et al., 2015a; Weller et al., 2012; Weller et al., 2013). Both the western and eastern populations are now known to overlap in both the northern feeding grounds and in the breeding areas (Weller et al., 2013), so while most gray whales migrating through the Study Area are likely from the eastern population, individuals from the western population may also be present (Carretta et al., 2017c). Long-term studies of radio-tracked whales, improved photographic identification, and genetic studies have detected western population whales along the North American coast from British Columbia, Canada, and as far south as Baja California, Mexico (Mate et al., 2015a; Muir et al., 2016; Weller et al., 2002; Weller et al., 2012; Weller et al., 2013). For purposes of the analysis in this Supplemental, it is assumed that a very small percentage of migrating gray whales could be individuals from the endangered Western North Pacific stock.

Gray whales that migrate do so between October and July (Calambokidis et al., 2015) and the majority of gray whales are only present in the Study Area while migrating through those waters. Gray whale individuals identified and observed along the Washington coast had an average minimum residency time in those waters of approximately 25 days out of a possible 183 days of the feeding season (Scordino et al., 2017).

The gray whale migration corridors, a potential presence migration buffer, and the months they are cumulatively in use (October through July) were identified as biologically important areas that should be considered given the potential for human activities to impact this important seasonal migration behavior (Calambokidis et al., 2015; Ferguson et al., 2015a; Ferguson et al., 2015b; Van Parijs, 2015); see the 2015 NWTT Final EIS/OEIS, Figure 3.4-3. As noted previously, the northern boundary of designated biologically important areas were truncated at a line drawn between the U.S. and Canadian EEZs because the identification of biologically important areas was restricted to locations only in U.S. waters (Calambokidis et al., 2015; Ferguson et al., 2015b). Gray whale migration corridors are contiguous from U.S. waters through Canadian waters (Burnham et al., 2018; Ford et al., 2010), and continue on into waters off Alaska (Ferguson et al., 2015a). In the designation of BIAs to only locations only in U.S. waters, it was made clear that, "…the absence of BIA designations outside U.S. waters should not be interpreted as an absence of BIAs in those waters" (Ferguson et al., 2015b), which is the case for the gray whale migration routes that extend through the NWTT Study Area and northward into Canadian waters, and beyond to Alaska.

Analysis of Navy training and testing activities in relation to these biologically important areas for gray whale migration was previously completed in the 2015 NWTT Final EIS/OEIS (U.S. Department of the Navy, 2015a), evaluated by NMFS in the issuance of the current Letter of Authorization pursuant to the

MMPA (National Oceanic and Atmospheric Administration, 2015b), and reviewed by NMFS pursuant to ESA for listed species in the Study Area (National Marine Fisheries Service, 2014). There is no new applicable science that necessitates any changes in those previous analyses. For additional details regarding these analyses, see Section 3.4.2.1 (Acoustic Stressors) and Appendix K (Geographic Mitigation Assessment) in this Supplemental, as well as the 2015 NWTT Final EIS/OEIS (U.S. Department of the Navy, 2015a).

In addition to the gray whale migration routes, the distribution of gray whales in the Study Area is driven by the presence of known feeding areas. When feeding in Washington waters, gray whales were most often observed in depths between 5 and 15 m in either kelp forests or emergent offshore rocks (Scordino et al., 2017). There are six feeding locations designated as a biologically important area in the Pacific Northwest (Calambokidis et al., 2015). Of those six areas, only the Northwestern Washington and the Northern Puget Sound feeding areas are within the Study Area (see the 2015 NWTT Final EIS/OEIS, Figure 3.4-4). Evaluation of Navy training and testing activities in relation to these biologically important feeding areas for gray whale was previously completed in the 2015 NWTT Final EIS/OEIS (U.S. Department of the Navy, 2015a), evaluated by NMFS in the issuance of the current Letter of Authorization pursuant to the MMPA (National Oceanic and Atmospheric Administration, 2015b), and reviewed by NMFS pursuant to ESA for listed species in the Study Area (National Marine Fisheries Service, 2014). There is no new applicable science that necessitates any changes in those previous analyses. For additional details regarding these analyses, see Section 3.4.2.1 (Acoustic Stressors) and Appendix K (Geographic Mitigation Assessment) in this Supplemental as well as the 2015 NWTT Final EIS/OEIS (U.S. Department of the Navy, 2015a).

Offshore. The occurrence of gray whales is considered seasonal and likely in the offshore portion of the Study Area (Calambokidis et al., 2017b). In 42 small boat surveys from Grays Harbor out to the 1,000 m isobath off Quinault conducted in the summer over a five-year period between 2004 and 2009, there were eight sightings of gray whales (Oleson & Hildebrand, 2012). As noted previously, aerial surveys conducted in waters off Washington, Oregon, and Northern California in the spring, summer, and fall of 2011 and 2012 found gray whales present during all surveys periods (Adams et al., 2014). The seasonal increase in the number of gray whales likely to be present in the area while feeding and migrating have been accounted for in the analysis. Four of the five seasonal gray whale feeding areas located along the West Coast of the United States are near but not within the Offshore portion of the Study Area (Aquatic Mammals, 2015; Calambokidis et al., 2015). The fifth feeding area—the Northwest Washington feeding area—partially overlaps with the Offshore Area, as shown on Figure 3.4-4 in the 2015 NWTT Final EIS/OEIS. This area is identified as important for feeding gray whales from May through November (approximately seven months) (Calambokidis et al., 2015).

Inland Waters. As gray whales migrate between feeding and breeding grounds, a few enter the Strait of Juan de Fuca to feed in Inland Waters (Cascadia Research, 2017d; Cogan, 2015). Based on data collected 1984 to 2011 during the feeding season the observation rate increased to a peak in October in the Strait of Juan de Fuca (Scordino et al., 2017). Gray whales have been detected in Washington inland waters in all months of the year, with peak abundance from March through June (Calambokidis et al., 2010; Calambokidis et al., 2017b). Typically fewer than 20 gray whales are documented annually in the inland waters of Washington and British Columbia, based on a review of Orca Network (Calambokidis et al., 2015; Cogan, 2015; Washington Department of Fish and Wildlife, 2013). For purposes of the analysis in this Supplemental, gray whales in the Inland Waters portion of the Study Area are considered to have a seasonal presence.

The identified a gray whale “Potential Presence” migration area extends into and includes all U.S. waters from the entrance of the Strait of Juan de Fuca landward (Calambokidis et al., 2015). This portion of the Potential Presence migration area therefore overlaps all the Inland Waters portion of the Study Area. As noted previously, this Potential Presence area is identified as seasonally important from January through July, and October through December; approximately 10 months of the year. In addition, a biologically important feeding area also has been identified in northern Puget Sound located south and east of Whidbey Island and east of Camano Island to Everett (Calambokidis et al., 2015). This feeding area is used in the spring for two to three months, typically beginning in March and generally ending by June (Calambokidis et al., 2015). For further detailed discussion of these gray whale biologically important feeding areas in the Inland Waters portion of the Study Area, see Section 3.4.2.1 (Acoustic Stressors) in this Supplemental as well as the 2015 NWTT Final EIS/OEIS (U.S. Department of the Navy, 2015a).

Western Behm Canal, Alaska. Gray whales were not observed during 1991–2007 surveys of the inland waters of southeast Alaska (Dahlheim et al., 2009), and they are considered extralimital in this region of the Study Area. There are no identified gray whale feeding or migration areas near the Western Behm Canal; the closest being approximately 60 NM to the southwest and out along the Pacific Coast of Southeast Alaska near Dixon Entrance (Ferguson et al., 2015a).

Odontocetes

3.4.1.15 Common Bottlenose Dolphin (*Tursiops truncatus*)

3.4.1.15.1 Status and Management

The common bottlenose dolphin is not listed under the ESA. For bottlenose dolphins within the Pacific U.S. EEZ there are seven stocks, but only the California, Oregon, and Washington offshore stock is occasionally present in the Offshore portion of the Study Area as part of their recognized range (Carretta et al., 2017c; Carretta et al., 2018a). The California, Oregon, and Washington stock is not considered depleted under the MMPA.

3.4.1.15.2 Abundance

Based on surveys from 1991 to 2008, the abundance for bottlenose dolphins in the Northern California portion of the Study Area is estimated at 253 animals and is 0 for the more northern Oregon/Washington stratum; the species was not detected in the Study Area in 2014 (Barlow, 2016).

3.4.1.15.3 Distribution

Bottlenose dolphins are found most commonly in coastal and continental shelf waters of tropical and temperate regions of the world; the primary range of the California, Oregon, and Washington stock is south of approximately 38°N (Carretta et al., 2017c; Carretta et al., 2018a). Based on habitat models derived from line-transect survey data collected between 1991 and 2009 off the U.S. West Coast, very low densities of bottlenose dolphins are predicted north of approximately 40°N during the summer and fall (Becker et al., 2016). Bottlenose dolphins are expected to expand their range north into Oregon and Washington waters during El Niño events, when water temperatures increase in the area (Cascadia Research Collective, 2011b). A mixed-species group of approximately 200 bottlenose dolphins and 70 false killer whales was observed 500 km north of the Strait of Juan de Fuca and 180 km off the coast of British Columbia (at approximately 50°N) on July 29, 2017, which was suggested to have been associated with the prolonged period of ocean warming along the Pacific Coast (Halpin et al., 2018).

Offshore. Off the U.S. West Coast, bottlenose dolphins are generally encountered south of approximately 41°N (Adams et al., 2014; Barlow, 2016; Hamilton et al., 2009). In September 2012, a pod of four bottlenose dolphins was encountered during an aerial survey off Grays Harbor (Adams et al., 2014). For purposes of this analysis, bottlenose dolphins are considered to have a regular occurrence in the Offshore portion of the Study Area.

Inland Waters. Bottlenose dolphins are considered extralimital in the Inland Waters portion of the Study Area. Prior to 2017, there had been one bottlenose dolphin stranding and only occasional sightings, generally consisting of lone individuals, within the Salish Sea (Cascadia Research Collective, 2011b; National Marine Fisheries Service, 2017a; U.S. Department of the Navy, 2017e). In the fall of 2017, a group of bottlenose dolphins was sighted repeatedly in Puget Sound, which is unusual given the species tends to be found in areas with warmer temperature as opposed to cold-water areas such as the Pacific northwest (Cascadia Research, 2017c). One animal in the group was photo-identified as a well-known dolphin first sighted in southern California in 1983, belonging to the California Coastal stock of bottlenose dolphins, but which the evidence suggests has been part of a group incrementally expanding the northern range of the stock (Cascadia Research, 2017c). The Navy does not expect the temporary presence of these California Coastal stock animals to reflect a permanent expansion northward for these animals.

Western Behm Canal, Alaska. Given the species preference for warmer water habitat, bottlenose dolphins are not expected to occur within the Behm Canal portion of the Study Area.

3.4.1.16 Killer Whale (*Orcinus orca*)

3.4.1.16.1 Status and Management

For the populations of killer whales present in the Study Area, only the Southern Resident population is listed as endangered under the ESA; the remaining populations are not listed under the ESA (Carretta et al., 2018b). NMFS designated critical habitat for Southern Resident killer whales totals 2,560 square miles that includes Haro Strait and the waters around the San Juan Islands, Puget Sound, and the Strait of Juan de Fuca, but does not include any of Hood Canal or locations where the water depth is less than 20 ft. (6.1 m) (National Marine Fisheries Service, 2016c; National Marine Fisheries Service: Northwest Region, 2006; National Oceanic and Atmospheric Administration, 2014). Eighteen sites[3] owned or controlled by the Department of Defense are excluded from this critical habitat designation, including Navy installations within Puget Sound. The NMFS identified primary constituent elements essential for conservation of the Southern Resident killer whale critical habitat as (1) water quality to support growth and development; (2) prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth; and (3) passage

[3] As provided in the final rule establishing the critical habitat for Southern Resident killer whales, the designated critical habitat does not include the following 18 areas owned or controlled by the Department of Defense, or designated for its use, in the State of Washington, including shoreline, nearshore areas around structures such as docks and piers, and marine areas: (1) Naval Undersea Warfare Center, Keyport; (2) Naval Ordnance Center, Port Hadlock (Indian Island); (3) Naval Fuel Depot, Manchester; (4) Naval Air Station, Whidbey Island; (5) Naval Station Everett; (6) Naval Hospital Bremerton; (7) Fort Lewis (Army); (8) Pier 23 (Army); (9) Puget Sound Naval Ship Yard; (10) Strait of Juan de Fuca naval air-to-surface weapon range, restricted area; (11) Strait of Juan de Fuca and Whidbey Island naval restricted areas; (12) Admiralty Inlet naval restricted area; (13) Port Gardner Naval Base restricted area; (14) Port Orchard Passage naval restricted area; (15) Sinclair Inlet naval restricted area; (16) Carr Inlet naval restricted area; (17) Port Townsend/Indian Island/Walan Point naval restricted area; and (18) Crescent Harbor Explosive Ordnance Units Training Area.

conditions to allow for migration, resting, and foraging (National Marine Fisheries Service: Northwest Region, 2006). There have been concerns over impacts to Southern Resident killer whales in this critical habitat resulting from whale watching vessel disturbance (Ferrara et al., 2017; Holt et al., 2017; Lacy et al., 2017; National Marine Fisheries Service, 2016c, 2018b; Seely et al., 2017), commercial shipping noise (Cominellli et al., 2018; Veirs et al., 2016; Williams et al., In press), and prey availability (Shields et al., 2018b; Wasser et al., 2017). The use of the Inland Waters portion of the NWTT Study Area by Southern Resident killer whales has declined in recent years as they shift their range and forage for Chinook salmon or other prey species elsewhere and outside the currently designated critical habitat in response to prey availability (Shields et al., 2018b). In 2014, NMFS received a petition to revise the existing Southern Resident killer whale critical habitat (National Oceanic and Atmospheric Administration, 2014). NMFS found the revision may be warranted given tag data demonstrating the species also spends considerable time outside the inland waters of the Pacific Northwest while inhabiting nearshore areas along the Washington/Oregon/California coastline (National Oceanic and Atmospheric Administration, 2014). A review of the currently designated critical habitat by NMFS, to determine whether the areas designated for this species need to be revised, is still underway as of February 2019, although NMFS had previously anticipated developing a proposed rule for publication in the Federal Register sometime in 2017 (80 FR 9682; February 24, 2015). The Navy will incorporate analysis of proposed changes to critical habitat into the analysis in this Supplemental and consult with NMFS under ESA once changes to critical habitat have been published. The governor of Washington has also directed state agencies to implement certain actions to benefit Southern Resident killer whales based on threats to the species as identified in a report by the Southern Resident Orca Task Force (Office of the Washington Governor, 2018). The major threats to Southern Resident killer whales identified in the report are a lack of prey, disturbance from noise and vessel traffic, and toxic contaminants in the waters they inhabit; Navy actions were not the sources for any of these identified threats (Office of the Washington Governor, 2018).

Seven killer whale stocks are recognized in the Eastern North Pacific: (1) the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock (Prince William Sound through the Aleutian Islands and Bering Sea); (2) the AT1 Transient stock (Alaska from Prince William Sound through the Kenai Fjords); (3) the Eastern North Pacific Alaska resident stock (southeastern Alaska to the Aleutian Islands and Bering Sea); (4) the Eastern North Pacific Northern Resident stock (Washington State through part of southeastern Alaska); (5) the West Coast Transient stock (Alaska through California); (6) the Eastern North Pacific Offshore stock (southeast Alaska through California); and (7) the Eastern North Pacific Southern Resident stock (mainly within the inland waters of Washington State and southern British Columbia, but also in coastal waters from southeast Alaska through California) (Carretta et al., 2017c; Carretta et al., 2018a; Muto et al., 2017; Muto et al., 2018b). As shown in the NMFS SARs, out of these seven stocks there are five (Alaska Resident, Northern Resident, West Coast Transient, Offshore, and Southern Resident stocks) that may be present in the Study Area. Out of those five stocks, only the Southern Resident stock is considered depleted under the MMPA (Carretta et al., 2017c; Carretta et al., 2018b; Muto et al., 2017; Muto et al., 2018b).

3.4.1.16.2 Abundance

The abundance estimates from NMFS for the five killer whale stocks expected to occur in the Study Area are as follows: Alaska Resident stock = 2,347 animals; Northern Resident stock = 261 animals; West Coast Transient stock = 243 animals; Offshore stock = 300 animals; and Southern Resident stock = 77 individuals (Carretta et al., 2017c; Carretta et al., 2018a, 2018b; Muto et al., 2017; Muto et al., 2018b). The West Coast transient population of killer whales has more than doubled in size since 1990 (Towers et al., 2018a). For the Offshore portion of the Study Area and based on summer/fall surveys undertaken by NMFS from 1996 to 2014, the abundance of killer whales in the area (the combined Oregon/Washington stratum and the Northern California stratum) is estimated at 224 animals (Barlow, 2016). This abundance estimate is for animals from the Offshore and West Coast Transient stocks present in U.S. waters (Carretta et al., 2017c; Carretta et al., 2018a, 2018b; Muto et al., 2018b). In the 2018 Pacific Stock Assessment Report regarding the Offshore stock of killer whales, NMFS concluded, "The fraction of this population that utilizes U.S. waters at any one time is unknown and the number of animals that utilize areas outside of the currently known geographic range (Aleutian Islands to southern California) is also unknown" (Carretta et al., 2018a). With regard to the number of Southern Resident killer whales, Navy is aware of the information presented in the report by the Southern Resident Orca Task Force indicating the population numbering 74 individuals as of the end of November 2018 (Office of the Washington Governor, 2018).

3.4.1.16.3 Distribution

Killer whales are found in all marine habitats from the coastal zone, including most bays and inshore channels, to the deep ocean and from equatorial regions to the polar pack ice zones of both hemispheres (Dahlheim et al., 2008; Forney & Wade, 2006; Garcia et al., 2016; Hanson et al., 2017; Wiles, 2016). Some killer whales such as the Southern Residents have seasonal shifts in distribution from the inland waters of the Salish Sea and Puget Sound to locations that can be up to hundreds of miles both north or south of the Study Area (Cogan, 2015; Dahlheim et al., 2008; Ford et al., 2014; Hanson et al., 2015; Hanson et al., 2018; Houghton et al., 2015a; National Marine Fisheries Service, 2016c; National Oceanic and Atmospheric Administration, 2011; National Oceanic and Atmospheric Administration Fisheries, 2014; Olson et al., 2018; Rice et al., 2017). The K1 and L1 pods have been sighted as far south as Monterey Bay and central California in recent years (Carretta et al., 2018b).

Distributions of killer whales are somewhat associated with the killer whale ecotypes, and all three ecotypes (offshore, transients, and residents) are known to occur in the Study Area (Carretta et al., 2017c; Carretta et al., 2018a; Cogan, 2015; Debich et al., 2014; Ford et al., 2013; Ford et al., 2014; Hanson et al., 2017; Hanson et al., 2018; Kerosky et al., 2013; Muto et al., 2017; National Marine Fisheries Service, 2016c; National Marine Fisheries Service: Northwest Region, 2006; Oleson et al., 2009; Oleson & Hildebrand, 2012; Rice et al., 2017; Širović et al., 2012a; Trickey et al., 2015; Wiles, 2016).

Offshore. In the Offshore portion of the Study Area, there are variable seasonal distributions for all three killer whale ecotypes and associated stocks, which overlap in many cases. Details regarding these distributions, the seasonal variation, and overlap within sub-areas are presented in the NWTT Marine Species Density Database Technical Report (U.S. Department of the Navy, 2019). In general for the offshore area, the stocks present may include the Offshore, West Coast Transient, Northern Resident, and Southern Resident stocks depending on the season and the distance from shore (Debich et al., 2014; Fisheries and Oceans Canada, 2015a; Ford et al., 2013; Ford et al., 2014; Hanson et al., 2017; Hanson et al., 2018; Kerosky et al., 2013; National Marine Fisheries Service, 2016c; National Marine Fisheries Service: Northwest Region, 2006; Oleson et al., 2009; Oleson & Hildebrand, 2012; Rice et al., 2017; Širović et al., 2012a; Trickey et al., 2015; Wiles, 2016).

To better predict the pattern of distribution of the endangered Southern Resident killer whales off the Washington, Oregon, and Northern California coasts, researchers integrated visual sightings, location data obtained between 2012 and 2016 from satellite-tagged Southern Resident killer whales, and acoustic detections from underwater hydrophones obtained from 6 to 13 recorders deployed from 2011 to 2015 off the Washington, Oregon, and California coast (Hanson et al., 2018; U.S. Department of the

Navy, 2018a). Along the Pacific coast, the distribution of satellite-tag locations confirms that Southern Resident killer whales generally inhabit nearshore waters and over multiple years have spent the highest amount of time near the mouth of the Columbia River and Westport, Washington (Hanson et al., 2017; Hanson et al., 2018; U.S. Department of the Navy, 2018a). Southern Resident killer whales were also acoustically detected by the monitoring hydrophones as far as 62 km off Cape Flattery, at the northern extreme of the NWTT Study Area off Washington (Hanson et al., 2018; U.S. Department of the Navy, 2018a), which is also the area where there appears to be the semi-permanent and highly productive eddy associated with the outflow from the Strait of Juan de Fuca (Dalla-Rosa et al., 2012; MacFadyen et al., 2008).

Inland Waters. The stocks present in the Inland Waters portion of the Study Area may include the West Coast Transient, Northern Resident, and Southern Resident stocks depending on the season and the sub-area within the inland waters (Cogan, 2015; Ford et al., 2013; Ford et al., 2014; Hanson et al., 2017; National Marine Fisheries Service, 2016c; National Marine Fisheries Service: Northwest Region, 2006; Olson et al., 2018; Smultea et al., 2017; Wiles, 2016). Details regarding these distributions, the seasonal variation, and overlap within sub-areas of the inland waters were provided in the 2015 NWTT Final EIS/OEIS and are incorporated as appropriate into the NWTT Marine Species Density Database Technical Report (U.S. Department of the Navy, 2019). A summary and supplemental update of the discussion from the 2015 NWTT Final EIS/OEIS is provided in the paragraphs below using updated references not available at the time.

Transient killer whales in the Pacific Northwest spend most of their time along the outer coast of British Columbia and Washington, but they visit inland waters in search of harbor seals, sea lions, and other prey (Cogan, 2015; Ford & Ellis, 1999; Ford et al., 2013; Rice et al., 2017; Wiles, 2016). Transients may occur in inland waters in any month (Cogan, 2015; Ford et al., 2013; Kriete, 2007; Rice et al., 2017). The number of West Coast Transient killer whale occurrences in inland waters increased between 1987 and 2010, possibly because the abundance of some prey species (e.g., seals, sea lions, and porpoises) had increased (Houghton et al., 2015a; Shields et al., 2018a). Over the last 14 years, transient killer whale numbers in the Salish Sea have continued to increase, with 2017 having the record as the most sightings in a single year (Shields et al., 2018a).

Individuals of the Northern Resident stock are occasionally present in the Strait of San Juan de Fuca Inland Waters portion of the Study Area (Cogan, 2015; Wiles, 2016; Wright et al., 2017b).

The Southern Resident stock inhabits both inland Washington and southern British Columbia waters and offshore waters along the coast of North America (Carretta et al., 2017d; Carretta et al., 2018a; National Marine Fisheries Service, 2016c). Photo-identification of individual whales through the years, as well as more recent satellite tagging and passive acoustic monitoring, has resulted in a substantial understanding of this stock's structure, behaviors, and movements in inland waters (Wiles, 2016; Wright et al., 2017b). In spring and summer months, the Southern Resident stock is most frequently seen in the San Juan Islands region with intermittent sightings in Puget Sound (Olson & Osborne, 2017; Olson et al., 2018; Shields et al., 2018b), which is consistent with the "summer core area" identified during the establishment of the critical habitat for the species. In the fall and early winter months, the Southern Residents are seen more frequently in Puget Sound, where returning chum, steelhead, and Chinook salmon are concentrated; Chinook are targeted preferentially when available (Ford et al., 2009; Ford et al., 2016; Hanson et al., 2018). By winter, they spend progressively less time in the inland marine waters and more time off the coast of Washington, Oregon, and California (Black, 2011; Cogan, 2015; Hanson et al., 2017; National Marine Fisheries Service, 2016c; Olson & Osborne, 2017). As noted previously, the use of the Inland Waters portion of the NWTT Study Area by Southern Resident killer whales has declined in recent years as they shift their range in response to reduced prey availability in Puget Sound (Olson & Osborne, 2017; Olson et al., 2018; Shields et al., 2018b).

While both Southern Resident killer whales and transient killer whales are frequently sighted in the main basin of Puget Sound, their presence near Navy installations varies from not present at all to infrequent sightings, depending on the season (Olson & Osborne, 2017; Olson et al., 2018). As was detailed in the 2015 NWTT Final EIS/OEIS, Section 3.4.2.15.3 (Distribution), Southern Resident killer whales have not been reported in Hood Canal or Dabob Bay since 1995; transient killer whales were observed in Hood Canal in 2003 and 2005 (National Marine Fisheries Service: Northwest Region, 2006), but there were no reports of subsequent visits to those waters until May 2018 (The Seattle Times, 2018). Near Naval Base Kitsap Bremerton and Keyport, the Southern Resident killer whale is also rare, with the last confirmed sighting in Dyes Inlet in 1997 (Navy has assumed transients will occasionally be present in these areas). Both Southern Resident killer whales and transients have been observed in Saratoga Passage and Possession Sound near Naval Air Station Whidbey Island and Naval Station Everett, respectively. Transients and Southern Resident killer whales have also been observed in southern Puget Sound in the Carr Inlet area.

Western Behm Canal, Alaska. In Southeast Alaska including the Behm Canal, the Alaska Resident, Offshore, and Transient stock ecotypes are present based on the assigned stocks in the Alaska SAR (Dahlheim et al., 2009; Muto et al., 2017; Muto et al., 2018b). Killer whales from the Transient stock are considered rare in the Behm Canal region of the Study Area (Dahlheim et al., 2009). Northern Resident killer whales have been documented in southeast Alaska, although in the summer they are found primarily in central and northern British Columbia (Muto et al., 2017; Muto et al., 2018b). Therefore, individuals belonging to the Alaska Resident stock are the killer whales most likely to occur in the SEAFAC region of the Study Area, and are more likely from spring through fall (Dahlheim et al., 2009). Southern Resident killer whales (L pod, 30 individuals) were photographically identified in Chatham Strait, Southeast Alaska (northwest of Behm Canal), in June 2007. Southern Residents were previously thought to range as far north as the Queen Charlotte Islands, BC; however, this sighting extends their known range about 200 miles to the north (Carretta et al., 2016c; Carretta et al., 2018a).

3.4.1.17 Northern Right Whale Dolphin (*Lissodelphis borealis*)

3.4.1.17.1 Status and Management

Northern right whale dolphins are not considered a threatened or endangered species under the ESA and are not considered depleted under the MMPA. Northern right whale dolphins are present in the Offshore portion of the Study Area, and those animals have been assigned to the California, Oregon, Washington stock (Carretta et al., 2017c; Carretta et al., 2018a).

3.4.1.17.2 Abundance

The most recent NMFS survey in 2014 found northern right whale dolphin abundance higher than in the previous three surveys between 2001 and 2008 (Barlow, 2016). For the Offshore portion of the Study Area and based on surveys from 1996 to 2014, the abundance for northern right whale dolphins in the area (the combined Oregon/Washington stratum and the Northern California stratum) is estimated at 17,228 animals (Barlow, 2016).

3.4.1.17.3 Distribution

The northern right whale dolphin occurs in cool-temperate to subarctic waters of the North Pacific Ocean, from the west coast of North America to Japan and Russia (Jefferson et al., 2015). The species does not migrate, although shifts in abundance and distribution may vary seasonally or between years (Barlow, 2016; Becker et al., 2014; Dohl et al., 1983; Douglas et al., 2014; Forney & Barlow, 1998; Jefferson et al., 2015). Based on habitat models developed with line-transect survey data collected off the U.S. West Coast during summer and fall from 1991 to 2009, Becker et al. (2016) found that encounters of northern right whale dolphin increased in shelf and slope waters, and encounters decreased substantially in waters warmer than approximately 64°F (18°C).

In the NMFS 2014 survey of the U.S. West Coast, all of the sightings of northern right whale dolphins were in the Oregon/Washington stratum, which is indicative of a distributional shift to the north in comparison to the species' previous distributions during three surveys undertaken between 2001 and 2008 (Barlow, 2016). Although the NMFS surveys provide limited coverage for nearshore waters, aerial surveys conducted in the approximate nearshore half of the Study Area in 2011 and 2012 (Adams et al., 2014) were consistent with the findings from 2014 NMFS survey.

Offshore. Aerial surveys conducted in waters off southern Washington, Oregon, and Northern California covering the approximate nearshore half of the Study Area in the spring, summer, and fall of 2011 and 2012 found that northern right whale dolphins were approximately the second-most frequently detected marine mammal in the area (Adams et al., 2014). For purposes of the analysis in this Supplemental, Northern right whale dolphins are considered to have a regular presence in the Offshore portion of the Study Area.

Inland Waters. Northern right whale dolphins are considered extralimital in the Inland Waters portion of the Study Area based on past sightings and stranding records (National Marine Fisheries Service, 2017a; U.S. Department of the Navy, 2017e).

Western Behm Canal, Alaska. Northern right whale dolphins are not expected to occur within the Behm Canal portion of the Study Area based on surveys conducted in Southeast Alaska from 1991 to 2007 (Dahlheim et al., 2009).

3.4.1.18 Pacific White-Sided Dolphin (*Lagenorhynchus obliquidens*)

3.4.1.18.1 Status and Management

Pacific white-sided dolphins are not considered a threatened or endangered species under the ESA, and neither stock in the Study Area is considered depleted under the MMPA. Pacific white-sided dolphin in the Behm Canal portion of the Study Area are from the North Pacific stock (Muto et al., 2017; Muto et al., 2018b) and those in the Offshore and Inland Waters portion are from the California, Oregon, Washington stock (Carretta et al., 2017c; Carretta et al., 2018a).

3.4.1.18.2 Abundance

Although the species was sighted in relatively high numbers in Southeast Alaska (Dahlheim et al., 2009), there is no estimate of a specific abundance for Pacific white-sided dolphins in the Behm Canal or the broader Southeast Alaska region. The stock assigned to Pacific white-sided dolphin is for all animals in the North Pacific north of 45° North from Southeast Alaska to the Aleutian Islands (Muto et al., 2017; Muto et al., 2018b). Based on marine mammal sighting data collected in the Gulf of Alaska from 1987 to 1990, the population for this stock is 26,880 individuals (Muto et al., 2017; Muto et al., 2018b).

In the 2014 NMFS survey that included the NWTT Offshore area, Pacific white-sided dolphin abundance was fairly typical of their abundance in the previous three surveys between 2001 and 2008 (Barlow, 2016). For the Offshore portion of the Study Area based on surveys from 1991 to 2014, the abundance of Pacific white-sided dolphins in the area (the combined Oregon/Washington stratum and the Northern California stratum) is estimated at 18,680 animals (Barlow, 2016).

3.4.1.18.3 Distribution

Pacific white-sided dolphins are found in cold temperate waters across the northern rim of the Pacific Ocean as far north as the southern Bering Sea and as far south as the Gulf of California off Mexico (Dahlheim et al., 2009; Ferguson, 2005; Hamilton et al., 2009; Jefferson et al., 2015; Leatherwood et al., 1984; Reeves et al., 2002b). The species is also known to inhabit inshore regions of southeast Alaska, British Columbia, and Washington (Brownell et al., 1999; Dahlheim et al., 2009; Forney & Barlow, 1998; U.S. Department of the Navy, 2017e; Williams & Thomas, 2007).

Like other species, Forney and Barlow (1998) found Pacific white-sided dolphins may occasionally shift their distribution in response to changes in oceanographic conditions. Based on passive acoustic monitoring recordings, Pacific white-sided dolphins are the most commonly detected odontocete off Washington, present for 9–10 months each year (Klinck et al., 2015; Oleson & Hildebrand, 2012; Širović et al., 2012a). Aerial surveys conducted in waters off Washington, Oregon, and Northern California in the spring, summer, and fall of 2011 and 2012 found Pacific white-sided dolphins present in all three survey seasons. They were the second-most frequently sighted species, and the sightings included two encounters with large pods estimated to number 955 individuals (Adams et al., 2014). Based on habitat models derived from line-transect survey data collected between 1991 and 2009 off the U.S. West Coast, Pacific white-sided dolphins are distributed throughout the Offshore portion of the Study Area during the summer and fall (Barlow et al., 2009; Becker et al., 2010; Becker et al., 2016; Forney et al., 2012). In the NMFS 2014 survey of the U.S. West Coast, sightings of Pacific white-sided dolphins were very low in southern and central California, indicative of a distributional shift to the north in comparison to their previous distribution found during the three surveys undertaken between 2001 and 2008 (Barlow, 2016).

Offshore. For the Offshore portion of the Study Area, the Navy assumes Pacific white-sided dolphins may be present year round, with increased abundance in the summer and fall seasons.

Inland Waters. With the exception of reported opportunistic sightings of the species the Strait of Juan de Fuca and the waters around the San Juan Islands, there have been very few sightings in the Inland Waters area in the last decade, and none were detected during aerial surveys of Puget Sound between 2013 and 2016 (Smultea et al., 2017; U.S. Department of the Navy, 2017e). Pacific white-sided dolphin occurrence in the Inland Waters is considered rare with the exception of southern Puget Sound, where occurrence is considered extralimital.

Western Behm Canal, Alaska. Based on survey data from Southeast Alaska (Dahlheim et al., 2009), Pacific white-sided dolphins may occur within the Behm Canal portion of the Study Area.

3.4.1.19 Risso's Dolphin (*Grampus griseus*)

3.4.1.19.1 Status and Management

Risso's dolphins are not considered a threatened or endangered species under the ESA and are not considered depleted under the MMPA. Risso's dolphins in the Offshore and Inland Waters portions of the Study Area are from the California, Oregon, Washington stock (Carretta et al., 2017c).

3.4.1.19.2 Abundance

For the Offshore portion of the Study Area and based on surveys from 1996 to 2014, the abundance of Risso's dolphins in the area (the combined Oregon/Washington stratum and the Northern California stratum) is estimated at 4,906 animals (Barlow, 2016).

3.4.1.19.3 Distribution

Risso's dolphins are not present in Alaska waters. In the Pacific off the U.S. West Coast, Risso's dolphins are found along the continental slope, over the outer continental shelf (Baumgartner, 1997; Cañadas et al., 2002; Cetacean and Turtle Assessment Program, 1982; Davis et al., 1998; Green et al., 1992; Kruse et al., 1999; Mignucci-Giannoni, 1998), and over submarine canyons (Mussi et al., 2004). Surveys off southern Washington, Oregon, and Northern California in the spring, summer, and fall of 2011 and 2012 found Risso's dolphins mostly at the outer-shelf and slope domains between the 200 m and 2,000 m depth stratum (Adams et al., 2014), which was consistent with the distribution of vocalizing Risso's dolphins detected during acoustic monitoring during the same approximate timeframe (Klinck et al., 2015). Based on habitat models derived from line-transect survey data collected between 1991 and 2009 off the U.S. West Coast, relatively high densities of Risso's dolphin are predicted in the Offshore portion of the Study Area during the summer and fall (Barlow et al., 2009; Becker et al., 2010; Becker et al., 2016; Forney et al., 2012).

Offshore. In surveys of waters within the Offshore portion of the Study Area between 2011 and 2014, Risso's dolphins were found to be fewer in number than Dall's porpoises, but tended to occur in large pods with a mean group size of approximately 17 (Barlow, 2016), and maximum group sizes occasionally exceeding 100 individuals (Adams et al., 2014). Risso's dolphins are expected to be present in the area year round.

Inland Waters. This species is not expected to regularly occur within the Inland Waters portion of the Study Area. There has been only one stranding of the species in the inland waters since 2000 (March 2015 at Samish Bay) and this involved a single individual (National Marine Fisheries Service, 2017a). There were reported sightings of a pair of Risso's dolphins in Puget Sound from the winter of 2011 (Cascadia Research Collective, 2011a) off and on through 2013 (U.S. Department of the Navy, 2017e). Aerial surveys in Puget Sound reported two sightings of a pair of Risso's dolphins in 2013 but none were seen during surveys in 2014, 2015, and 2016 (Smultea et al., 2017) and there were no reports of sightings subsequent to 2013 (U.S. Department of the Navy, 2017e). As a result of these findings, Risso's dolphins are considered rare in the Inland Waters portion of the Study Area.

Western Behm Canal, Alaska. Risso's dolphins are not expected to occur within the Behm Canal portion of the Study Area given there is no indication that they inhabit the area (Dahlheim et al., 2009; Muto et al., 2017; Muto et al., 2018b) and are considered extralimital in this region.

3.4.1.20 Short-Beaked Common Dolphin (*Delphinus delphis*)

3.4.1.20.1 Status and Management

Short-beaked common dolphins are not considered a threatened or endangered species under the ESA and are not considered depleted under the MMPA. Short-beaked common dolphins in the Offshore and Inland Waters portions of the Study Area are from the California, Oregon, Washington stock (Carretta et al., 2017c).

3.4.1.20.2 Abundance

For the Offshore portion of the Study Area and based on surveys from 1996 to 2014, the abundance for short-beaked common dolphins in the area (the combined Oregon/Washington stratum and the Northern California stratum) is estimated at 137,381 animals (Barlow, 2016). Over the period of the surveys, there has been a nearly monotonic increase in abundance of short-beaked common dolphins along the U.S. West Coast (Barlow, 2016).

3.4.1.20.3 Distribution

Short-beaked common dolphins are not present in Alaska waters. Short-beaked common dolphins are mostly a warm temperate to tropical species having densities that are greatest when waters are warmest (Barlow et al., 2009; Becker et al., 2010; Becker et al., 2014; Becker et al., 2016; Forney & Barlow, 1998; Forney et al., 2012). Shifts in distribution are pronounced with seasonal and year-to-year changes in oceanographic conditions; movements may be north-south or inshore-offshore (Barlow et al., 2009; Becker et al., 2014; Becker et al., 2016; Forney & Barlow, 1998; Forney et al., 2012; Henderson et al., 2014a). Short-beaked common dolphin have been encountered in the Offshore portion of the Study Area occasionally as far north as approximately the Washington/Canada border (Adams et al., 2014; Barlow, 2016; Forney, 2007; Hamilton et al., 2009). However, based on habitat models derived from line-transect survey data collected between 1991 and 2009 off the U.S. West Coast, very low densities of short-beaked common dolphins are predicted in the Offshore portion of the Study Area during the summer and fall (Barlow et al., 2009; Becker et al., 2010; Becker et al., 2016; Forney et al., 2012).

Offshore. In aerial surveys conducted in waters off southern Washington, Oregon, and Northern California covering the approximate nearshore half of the Study Area in the spring, summer, and fall of 2011 and 2012, there was only one sighting of short-beaked common dolphins in nearshore waters off Northern California (Adams et al., 2014). During the NMFS 2014 survey, there were no short-beaked common dolphins sighted north of central Oregon (approximately 44° North), and all of those sightings were in the deep ocean beyond the continental shelf (Barlow, 2016). For purposes of the analysis in this Supplemental, short-beaked common dolphins are considered to have a regular presence in the Offshore portion of the Study Area.

Inland Waters. This species is not expected to regularly occur within the Inland Waters portion of the Study Area. A sighting of a pair of short-beaked common dolphins in Puget Sound in 2003 (U.S. Department of the Navy, 2017e) is the only record of this species in the Inland Waters portion of the Study Area. Given the normal distribution of the species and the sightings record, short-beaked common dolphins are considered rare in the Inland Waters of the Study Area.

Western Behm Canal, Alaska. Short-beaked common dolphins are not expected to occur within the Behm Canal portion of the Study Area given there is no indication that they inhabit the area (Dahlheim et al., 2009; Muto et al., 2017) and are considered extralimital in this region.

3.4.1.21 Short-Finned Pilot Whale (*Globicephala macrorhynchus*)

3.4.1.21.1 Status and Management

Short-finned pilot whales are not considered a threatened or endangered species under the ESA and are not considered depleted under the MMPA. Short-finned pilot whales in the Offshore and Inland Waters portions of the Study Area are from the California, Oregon, Washington stock (Carretta et al., 2018b).

3.4.1.21.2 Abundance

For the Offshore portion of the Study Area and based on surveys from 1996 to 2014, the abundance for short-finned pilot whales in the area (the combined Oregon/Washington stratum and the Northern California stratum) is estimated at 224 animals (Barlow, 2016).

3.4.1.21.3 Distribution

The short-finned pilot whale is widely distributed throughout most tropical and warm temperate waters of the world coinciding with the abundance of squid, their preferred prey (Bernard & Reilly, 1999; Hui, 1985; Payne & Heinemann, 1993). Pilot whales are typically distributed along the continental shelf break and movements over the continental shelf are common based on observations made off the northeastern United States (Payne & Heinemann, 1993). Short-finned pilot whales are not expected to be present in Alaskan waters based on their preference for warm water areas.

Offshore. During systematic ship surveys conducted between 1996 and 2014, short-finned pilot whales were detected in the Offshore portion of the Study Area once off southern Washington (Hamilton et al., 2009) and once off Northern California during the 2014 survey (Barlow, 2016). In aerial surveys conducted in waters off Washington, Oregon, and Northern California covering the approximate nearshore half of the Study Area in the spring, summer, and fall of 2011 and 2012, short-finned pilot whales were encountered once in a pod of eight individuals off Northern California (Adams et al., 2014). Between 2000 and 2016, there are records of one stranded individual in 2002 on the Oregon's Pacific coast, and one off Washington in 2007 (National Marine Fisheries Service, 2017a). For purposes of the analysis in this Supplemental, short-finned pilot whales are considered to have a regular presence in the Offshore portion of the Study Area.

Inland Waters. This species is not expected to regularly occur within the Inland Waters portion of the Study Area. There have been occasional sightings with unconfirmed and low confidence within Puget Sound attributed to possible short-finned pilot whales (U.S. Department of the Navy, 2017e). Given the normal distribution of the species and the record of sightings, short-finned pilot whales are considered rare in the Inland Waters of the Study Area.

Western Behm Canal, Alaska. Short-finned pilot whales are not expected to occur within the Behm Canal portion of the Study Area given there is no indication that they inhabit the area (Dahlheim et al., 2009; Muto et al., 2017) and are considered extralimital in that region.

3.4.1.22 Striped Dolphin (*Stenella coeruleoalba*)

3.4.1.22.1 Status and Management

Striped dolphins are not considered a threatened or endangered species under the ESA and are not considered depleted under the MMPA. Striped dolphins in the Offshore portion of the Study Area are from the California, Oregon, Washington stock (Carretta et al., 2017c; Carretta et al., 2018b).

3.4.1.22.2 Abundance

For the Offshore portion of the Study Area and based on surveys from 1996 to 2014, the abundance of striped dolphins in the area (the combined Oregon/Washington stratum and the Northern California stratum) is estimated at 8,335 animals (Barlow, 2016).

3.4.1.22.3 Distribution

Although primarily a warm-water species, the range of the striped dolphin extends higher into temperate regions than those of any other species in the genus *Stenella*. Striped dolphins are generally restricted to oceanic regions and are seen close to shore only where deep water approaches the coast. Along the west coast of North America, southern Washington State is the known northern limit of the species (Barlow, 2016; Hamilton et al., 2009; Reeves et al., 2002b). Striped dolphins are not present as far north as Alaska waters. Based on habitat models derived from line-transect survey data collected between 1991 and 2009 off the U.S. West Coast, extremely low densities of striped dolphins are predicted well offshore in the Study Area during the summer and fall (Barlow et al., 2009; Becker et al., 2010; Becker et al., 2016; Forney et al., 2012).

Offshore. NMFS summer surveys between 1996 and 2014 only detected striped dolphins off the coast of southern Washington State and waters to the south, generally in the deep ocean beyond approximately 100 NM from shore (Barlow, 2016; Hamilton et al., 2009). Striped dolphins were not identified in aerial surveys conducted in waters inside the 2,000 m isobath off southern Washington, Oregon, and Northern California in the spring, summer, and fall of 2011 and 2012 (Adams et al., 2014), which is expected given their general offshore distribution.

Inland Waters. This species is not expected to occur within the Inland Waters portion of the Study Area. Given the normal distribution of the species, striped dolphins are considered extralimital in the Inland Waters portion of the Study Area.

Western Behm Canal, Alaska. Striped dolphins are not expected to occur within the Behm Canal portion of the Study Area given there is no indication that they inhabit the area (Dahlheim et al., 2009; Muto et al., 2017) and are considered extralimital in this region.

3.4.1.23 Dwarf Sperm Whale (*Kogia sima*)

3.4.1.23.1 Status and Management

Dwarf sperm whales are not considered a threatened or endangered species under the ESA and are not considered depleted under the MMPA. Dwarf sperm whales in the Offshore portion of the Study Area are from the California, Oregon, Washington stock (Carretta et al., 2017c). Along the U.S. West Coast and because of the difficulty distinguishing between dwarf and pygmy sperm whales at sea, identifications during surveys have generally been to *Kogia* spp. as the lowest taxonomic level of identification possible (Barlow, 2016; Carretta et al., 2017c; Hamilton et al., 2009). As a result, metrics for the population in the stock assessments for U.S. West Coast have been to *Kogia* spp. (Carretta et al., 2017c).

3.4.1.23.2 Abundance

For the Offshore portion of the Study Area and based on surveys from 1996 to 2014, the abundance for *Kogia* spp. in the area (the combined Oregon/Washington stratum and the Northern California stratum) is estimated at 766 animals (Barlow, 2016).

3.4.1.23.3 Distribution

There has only been one sighting identified as *Kogia* spp. north of California on any of the survey efforts between 1991 and 2014 (Barlow, 2016; Hamilton et al., 2009). Along the U.S. West Coast, no reported sightings of this species have been confirmed as dwarf sperm whales, and it is likely that most Kogia species off California are pygmy sperm whale (*Kogia breviceps*) (Carretta et al., 2017c). There is record of a single dwarf sperm whale stranding at Vancouver Island British Columbia (Willis & Baird, 1998b) and one stranded unidentified *Kogia* spp. in Washington in 2007 (National Marine Fisheries Service, 2017a).

Offshore. Dwarf sperm whales are expected to be rare in the Offshore portion of the Study Area.

Inland Waters. Dwarf sperm whales are not expected to occur within the Inland Waters portion of the Study Area.

Western Behm Canal, Alaska. Dwarf sperm whales are not expected to occur within the Behm Canal portion of the Study Area.

3.4.1.24 Pygmy Sperm Whale (*Kogia breviceps*)

3.4.1.24.1 Status and Management

Pygmy sperm whales are not considered a threatened or endangered species under the ESA and are not considered depleted under the MMPA. Pygmy sperm whales in the Offshore portion of the Study Area are from the California, Oregon, Washington stock (Carretta et al., 2017c). Along the U.S. West Coast and because of the difficulty distinguishing between pygmy and dwarf sperm whales at sea, identifications during surveys have generally been to *Kogia* spp. as the lowest taxonomic level of identification possible (Barlow, 2016; Carretta et al., 2017c; Hamilton et al., 2009). As a result, metrics for the population in the SAR for U.S. West Coast are for *Kogia* spp. (Carretta et al., 2017c).

3.4.1.24.2 Abundance

For the Offshore portion of the Study Area and based on surveys from 1996 to 2014, the abundance for *Kogia* spp. in the area (the combined Oregon/Washington stratum and the Northern California stratum) is estimated at 766 animals (Barlow, 2016).

3.4.1.24.3 Distribution

There has only been one sighting identified as *Kogia* spp. north of California on any of the survey efforts between 1991 and 2014 (Barlow, 2016; Hamilton et al., 2009). It has been suggested that most of the sightings identified as *Kogia* spp. were probably pygmy sperm whales (Carretta et al., 2017c). The presence of pygmy sperm whales in the Study Area is also suggested by the occurrence of three strandings confirmed as pygmy sperm whale (one individual in Oregon in 2006 and 2016; one in Washington in 2005) and one stranded unidentified *Kogia* spp. Washington in 2007 (National Marine Fisheries Service, 2017a).

Offshore. Pygmy sperm whales are expected to be present year round in the Offshore portion of the Study Area.

Inland Waters. Pygmy sperm whales are not expected to occur within the Inland Waters portion of the Study Area.

Western Behm Canal, Alaska. Pygmy sperm whales are not expected to occur within the Behm Canal portion of the Study Area.

3.4.1.25 Dall's Porpoise (*Phocoenoides dalli*)

3.4.1.25.1 Status and Management

Dall's porpoise are not considered a threatened or endangered species under the ESA and neither stock in the Study Area is considered depleted under the MMPA. Dall's porpoise in the Behm Canal portion of the Study Area are from the Alaska stock (Muto et al., 2017; Muto et al., 2018b), and those in the Offshore and Inland Waters portion are from the California, Oregon, Washington stock (Carretta et al., 2017c).

3.4.1.25.2 Abundance

There are no reliable abundance data for the Alaska stock of Dall's porpoise given the most recent data are over 26 years old (Muto et al., 2017; Muto et al., 2018b). The current estimate of abundance provided in the Alaska SAR is 83,400 animals (Muto et al., 2017; Muto et al., 2018b). For the Offshore and Inland Waters portion of the Study Area and based on surveys from 1991 to 2014, the abundance for Dall's porpoise in the area (the combined Oregon/Washington stratum and the Northern California stratum) is estimated at 33,073 animals (Barlow, 2016). The most recent NMFS survey in 2014 found Dall's porpoise abundance fairly typical of their abundance in the previous three surveys between 2001 and 2008 (Barlow, 2016).

3.4.1.25.3 Distribution

Dall's porpoise is one of the most abundant small cetaceans in the North Pacific Ocean along the outer continental shelf, slope, and oceanic waters where water temperatures are less than 17°C (Barlow, 2016; Becker et al., 2017; Carretta et al., 2017c; Ford et al., 2010; Houck & Jefferson, 1999; Jefferson et al., 2015; Reeves et al., 2002b; Suzuki et al., 2016). In the eastern north Pacific, the species ranges from Southern California to the Bering Sea. Dall's porpoise distribution off the U.S. West Coast is highly variable between years, most likely due to changes in oceanographic condition, with Dall's porpoise shifting their distribution in response to those changes on both interannual and seasonal time scales (Barlow, 2016; Becker et al., 2010; Becker et al., 2012b; Becker et al., 2017; Carretta et al., 2017c; Forney & Barlow, 1998; Forney et al., 2012; Forney et al., 2015). In the NMFS 2014 survey of the U.S. West Coast, sightings of Dall's porpoise were very low in southern and central California, indicative of a distributional shift to the north in comparison to their previous distribution found during the three surveys undertaken between 2001 and 2008 (Barlow, 2016).

Offshore. Dall's porpoise have been one of the most frequently sighted marine mammal during surveys in waters off Washington, Oregon, and Northern California (Adams et al., 2014; Barlow, 2016; Hamilton et al., 2009; Oleson et al., 2009). In the spring, summer, and fall of 2011 and 2012, Dall's porpoise were most often encountered between the 200 and 2,000 m depth isobaths (Adams et al., 2014). For purposes of the analysis in this Supplemental, Dall's porpoise are considered to have a regular presence in the Offshore portion of the Study Area.

Inland Waters. Dall's porpoise used to be present in the inland waters year round with seasonably variable but relatively high estimated abundance (Calambokidis & Baird, 1994). In recent years, Dall's porpoise have been declining in number in the Salish Sea and Puget Sound, and speculation has been that this decline is a result of competition with harbor porpoise, which have dramatically increased in numbers over approximately the last 15 years (Evenson et al., 2016; Jefferson et al., 2016; Smultea et al., 2017). Consistent with this decline, in six aerial surveys of Puget Sound between 2013 and 2016, only a single Dall's porpoise was observed in Hood Canal in April 2015, and a group of eight was observed in Admiralty Inlet in January 2016 (Smultea et al., 2017). Although they have been seen in decreasing numbers in recent years, for purposes of the analysis in this Supplemental, Dall's porpoise are considered to have a regular presence in the Inland Waters portion of the Study Area.

Western Behm Canal, Alaska. Dall's porpoise was the most frequently observed species during surveys conducted in the inland waters of southeast Alaska between 1991 and 2007 (Dahlheim et al., 2009). Although surveys have not been conducted in the winter months in southeast Alaska, it is possible that Dall's porpoises may be present in the winter season; for purposes of this analysis, the Navy assumes the species is present year round.

3.4.1.26 Harbor Porpoise (*Phocoena phocoena*)

3.4.1.26.1 Status and Management

Harbor porpoise are not considered a threatened or endangered species under the ESA. Harbor porpoise in the Behm Canal portion of the Study Area belong to the Southeast Alaska stock, which spans an area of approximately 500 NM in length from Dixon Entrance in the south to Cape Suckling in the north (Muto et al., 2017; Muto et al., 2018b). Studies of harbor porpoise distribution elsewhere have indicated that this stock structure is likely more fine-scaled than is reflected in the current Alaska SAR but no data are available to more precisely define the stock structure for harbor porpoise in Alaska (Muto et al., 2017; Muto et al., 2018b). In the Offshore portion of the Study Area, there are two stocks consisting of the Northern Oregon/Washington Coast stock and the Northern California/Southern Oregon stock (Carretta et al., 2017c). In the Inland Waters portion of the Study Area harbor porpoise belong to the Washington Inland Waters stock (Carretta et al., 2017c). None of the stocks of harbor porpoise in the Study Area are considered depleted under the MMPA.

3.4.1.26.2 Abundance

In surveys conducted over approximately 20 years in Southeast Alaska, the overall abundance of harbor porpoise in the Ketchikan region (including Behm Canal) significantly declined from the early 1990s to the mid-2000s, followed by a significant increase in the early 2010s when abundance rose to levels similar to those observed 20 years earlier (Dahlheim et al., 2015). It is not clear whether the observed decline and subsequent increase in abundance noted in the Ketchikan region was a true change in the stock abundance or if the decline and subsequent increase reflected the redistribution of local harbor porpoise to and from other areas in response to local fluctuations in prey availability, habitat suitability, or other unidentified factors (Dahlheim et al., 2015; Muto et al., 2017; Muto et al., 2018b). The Alaska SAR divides the estimates of abundance for the Southeast Alaska stock of harbor porpoise into a northern and a southern region including Frederick Sound, Sumner Strait, Wrangell and Zarembo Islands, and Clarence Strait as far south as Ketchikan, with an abundance of 577 animals in that southern region (Muto et al., 2017; Muto et al., 2018b).

In the Offshore portion of the Study Area, the abundance of the Northern Oregon/Washington Coast stock is 21,487 and the Northern California/Southern Oregon stock is 35,769 (Carretta et al., 2017c). In the Inland Waters portion of the Study Area the abundance of the Washington Inland Waters stock is 11,233 (Carretta et al., 2017c). Evenson et al. (2016) determined that the annual growth rate for harbor porpoise between 1995 and 2014 was 8.1 percent for the Strait of Juan de Fuca region and the annual growth rate between 2000 and 2014 was 36.9 percent for Puget Sound. Aerial surveys between 2013 and 2015 have demonstrated that since the 1970s, harbor porpoises have recovered and reoccupied waters of Puget Sound (Jefferson et al., 2016).

3.4.1.26.3 Distribution

In the eastern North Pacific from Alaska south to Point Conception, California, harbor porpoise are found in nearshore coastal and inland waters, generally within a mile or two of shore (Barlow, 1988; Carretta et al., 2015; Carretta et al., 2017c; Dahlheim et al., 2015; Dohl et al., 1983; Hamilton et al., 2009; Muto et al., 2017; Muto et al., 2018b). As noted previously, there is evidence for the redistribution of local harbor porpoise to and from other areas in response to what are likely local fluctuations in prey availability, habitat suitability, or other unidentified factors (Dahlheim et al., 2015; Evenson et al., 2016; Jefferson et al., 2016; Muto et al., 2017; Muto et al., 2018b; Smultea et al., 2015; Smultea et al., 2017; Wisniewska et al., 2018).

Offshore. In aerial surveys conducted in waters off Washington, Oregon, and Northern California covering the approximate nearshore half of the Study Area in the spring, summer, and fall of 2011 and 2012, harbor porpoise were the most frequently sighted marine mammal (Adams et al., 2014). Harbor porpoise are expected to be present in the Offshore portion of the Study Area year round.

Inland Waters. Based on surveys in the Salish Sea and Puget Sound (Elliser et al., 2017; Evenson et al., 2016; Jefferson et al., 2016; Smultea et al., 2017), harbor porpoise are expected to be present in the Inland Waters portion of the Study Area year round. Calves are more likely to be seen in fall, which surveys off Fidalgo Island from January 2014 to February 2017 indicated was also when the highest number of sightings per unit of survey effort were present (Elliser et al., 2017).

Western Behm Canal, Alaska. Although surveys have not occurred in Southeast Alaska in the winter (Dahlheim et al., 2009; Dahlheim et al., 2015), for purposes of this analysis the Navy assumes harbor porpoise will be present in the Behm Canal portion of the Study Area year round.

3.4.1.27 Sperm Whale (*Physeter macrocephalus*)

3.4.1.27.1 Status and Management

Sperm whales are listed as endangered under the ESA, but there is no designated critical habitat for this species. Sperm whales in Alaska are from the North Pacific stock (Muto et al., 2017; Muto et al., 2018b) but are not expected to be present in the Behm Canal portion of the Study Area. Sperm Whales in the Offshore portion of the Study Area are from the California, Oregon, Washington stock (Carretta et al., 2017c; Carretta et al., 2018b). Both of these stocks of sperm whales are considered depleted under the MMPA.

3.4.1.27.2 Abundance

For the Offshore portion of the Study Area and based on surveys from 1996 to 2014, the abundance for sperm whales in the area (the combined Oregon/Washington stratum and the Northern California stratum) is estimated at 1,001 animals (Barlow, 2016).

3.4.1.27.3 Distribution

Sperm whales are typically found in temperate and tropical waters of the Pacific (Rice, 1989). The secondary range includes the areas of higher latitudes in the northern Pacific including Alaska (Jefferson et al., 2015; Whitehead & Weilgart, 2000; Whitehead et al., 2008; Whitehead et al., 2009). This species appears to have a preference for deep waters (Baird, 2013; Becker et al., 2010; Becker et al., 2012a; Forney et al., 2012; Jefferson et al., 2015). Typically, sperm whale concentrations correlate with areas of high productivity. These areas are generally near drop offs and areas with strong currents and steep topography (Gannier & Praca, 2007; Jefferson et al., 2015); the semi-permanent the Strait of Juan de Fuca eddy is one such area (see MacFadyen et al. (2008)). Sperm whales are somewhat migratory as demonstrated by discovery tag data and subsequent satellite tag locational data; three sperm whales satellite-tagged off southeastern Alaska were documented moving far south to waters off Mexico and the Mexico/Guatemala border (Straley et al., 2014).

Offshore. No sperm whales were detected during systematic surveys of waters between the British Columbia border with Alaska and Washington (Williams & Thomas, 2007). In aerial surveys conducted in waters off Washington, Oregon, and Northern California covering the approximate nearshore half of the Study Area in the spring, summer, and fall of 2011 and 2012, sperm whales were encountered only twice, in deep water off the coast from Grays Harbor (Adams et al., 2014). During the NMFS 2014 summer shipboard survey in the Study Area, there were a total of five sperm whale sightings (Barlow, 2016). The variable presence of sperm whales in the area is reflected in the acoustic monitoring record of sperm whale click detections. In 2008, sperm whales were present in the acoustic record between April through November and in the following year from February through May (Oleson & Hildebrand, 2012). In similar acoustic monitoring efforts between 2010 to 2013, sperm whales were found to be present from November through June (Debich et al., 2014; Kerosky et al., 2013; Klinck et al., 2015; Širović et al., 2012a). For purposes of the analysis in this Supplemental, sperm whales are considered to have a regular presence in the Offshore portion of the Study Area.

Inland Waters. This species is not expected to occur within the Inland Waters portion of the Study Area. Given the normal distribution of sperm whales in deep water ocean areas, they are considered extralimital in the Inland Waters of the Study Area.

Western Behm Canal, Alaska. Sperm whales are not expected to occur within the Behm Canal portion of the Study Area given there is no indication that they inhabit the area (Dahlheim et al., 2009; Muto et al., 2017; Muto et al., 2018b) and are considered extralimital in this region.

3.4.1.28 Baird's Beaked Whale (*Berardius bairdii*)

3.4.1.28.1 Status and Management

Baird's beaked whale is not listed under the ESA. Baird's beaked whale is managed by NMFS within Pacific U.S. EEZ waters as two stocks: (1) an Alaska stock; and (2) a California, Oregon, and Washington stock, and these stocks are not considered depleted under the MMPA (Carretta et al., 2017c; Carretta et al., 2018b; Muto et al., 2017; Muto et al., 2018b).

3.4.1.28.2 Abundance

There is currently no reliable abundance estimate for the Alaska stock of Baird's beaked whale (Muto et al., 2017; Muto et al., 2018b), which the Navy has assumed will not be present in Behm Canal. For the Offshore portion of the Study Area and based on surveys from 1991 to 2014, the abundance for Baird's beaked whales in the area (the combined Oregon/Washington stratum and the Northern California stratum) is estimated at 4,326 animals (Barlow, 2016).

3.4.1.28.3 Distribution

This species is generally found through the colder waters of the North Pacific north of 28°N ranging from waters off Baja California, Mexico, to the Aleutian Islands of Alaska (Jefferson et al., 2015; Kasuya & Miyashita, 1997; MacLeod et al., 2006; Reeves et al., 2002b). Within their range, Baird's beaked whale occurs mainly in deep waters over the continental slope, near oceanic seamounts, and areas with submarine escarpments, although they may be seen close to shore where deep water approaches the coast (Jefferson et al., 2015; Kasuya, 2009). Off Washington and British Columbia, Baird's beaked whales have been sighted in offshore waters with bottom depths of 700 m to 1,675 m (Willis & Baird, 1998a). Based on habitat models derived from line-transect survey data collected between 1991 and 2008 off the U.S. West Coast, encounters with Baird's beaked whales increase near the 2,000 m isobath and further offshore in waters off Washington and Oregon (Barlow, 2016; Becker et al., 2012b). Satellite location data from an individual Baird's beaked whale recently tagged off of Southern California indicated that, over a period of 6.5 days, the individual traveled north along the continental shelf-edge more than 740 km from the initial tagging location while making dives as deep as 1,968 m and lasting as long as 78 minutes (Schorr et. al., Unpublished). This seemingly routine long-distance movement is consistent with research findings from Cuvier's beaked whales documented in previous research (Schorr et al., 2008; Schorr et al., 2014).

Offshore. NMFS surveys have consistently revealed that abundance estimates were highest off Oregon and Washington as compared to areas off California (Barlow, 2003, 2010, 2016).

Acoustic analyses of data collected from Navy-funded monitoring devices in Washington offshore waters have routinely detected Baird's beaked whale vocalizations (Debich et al., 2014; Kerosky et al., 2013; Širović et al., 2012a; Trickey et al., 2015). There has, however, been variability for the timing of these detections; they occurred between January and November 2011, with a peak in detections in February and July (Širović et al., 2012b), from October through December 2012, with a peak in detections in May 2013 (Debich et al., 2014; Kerosky et al., 2013), and from August 2013 through January 2014, with an additional single encounter in March 2014 (Trickey et al., 2015). During aerial surveys conducted in waters off Washington, Oregon, and Northern California covering the approximate nearshore half of the Study Area in the spring, summer, and fall of 2011 and 2012, there was a sighting of a Baird's beaked whale group consisting of 10 individuals (Adams et al., 2014), and five group sightings during the 2014 NMFS survey with the same approximate average group size (Barlow, 2016). For purposes of the analysis in this Supplemental, Baird's beaked whales are considered to have a regular presence in the Offshore portion of the Study Area.

Inland Waters. Given their offshore distribution, Baird's beaked whales are not expected to occur within the Inland Waters portion of the Study Area.

Western Behm Canal, Alaska. In the North Pacific Ocean and along the U.S. West Coast, Baird's beaked whales are seen primarily along the continental slope in deep waters (Barlow, 2016; Rone et al., 2017). Baird's beaked whales have been sighted in the Gulf of Alaska (Rone et al., 2017) and off the Pacific coast of Southeast Alaska (Hamilton et al., 2009), but were not observed during the 1991–2007 surveys of the inland waters of southeast Alaska (Dahlheim et al., 2009). There is no indication that beaked whales inhabit the Behm Canal portion of the Study Area (Dahlheim et al., 2009; Muto et al., 2017; Muto et al., 2018b), and they are considered extralimital in this location.

3.4.1.29 Cuvier's Beaked Whale (*Ziphius cavirostris*)

3.4.1.29.1 Status and Management

Cuvier's beaked whales are not considered a threatened or endangered species under the ESA, and neither of these stocks in the Study Area is considered depleted under the MMPA. Cuvier's beaked whale is managed by NMFS within Pacific U.S. EEZ waters as two stocks: (1) the Alaska stock (Muto et al., 2017; Muto et al., 2018b); and (2) the California, Oregon, Washington stock (Carretta et al., 2017c; Carretta et al., 2018b).

3.4.1.29.2 Abundance

There is currently no reliable abundance estimate for the Alaska stock of Cuvier's beaked whale (Muto et al., 2017; Muto et al., 2018b), which Navy assumes will not be present in Behm Canal.

For the Offshore portion of the Study Area and based on surveys from 1991 to 2014, the abundance for Cuvier's beaked whales in the area (the combined Oregon/Washington stratum and the Northern California stratum) is estimated at 1,442 animals (Barlow, 2016).

3.4.1.29.3 Distribution

Cuvier's beaked whales have an extensive range that includes all oceans, from the tropics to the polar waters of both hemispheres (Baird et al., 2010; Heyning & Mead, 2009; Jefferson et al., 2015; MacLeod et al., 2006; Schorr et al., 2014). Worldwide, beaked whales normally inhabit both slope and deep oceanic waters with depths greater than 200 m and frequently where depths are greater than 1,000 m (Baird et al., 2010; Jefferson et al., 2015; MacLeod et al., 2006; MacLeod et al., 2003; MacLeod & D'Amico, 2006; Schorr et al., 2014). Research findings for satellite location tagged Cuvier's beaked whales in the Southern California Range Complex (Falcone et al., 2009; Falcone & Schorr, 2011, 2012, 2013, 2014), which is the same stock of animals present in the NTWW Study Area, have documented movements by individuals in excess of hundreds of kilometers. Schorr et al. (2014) reported that five out of eight tagged whales journeyed approximately 250 km from their tag deployment location, and one of these individuals made an excursion of over 450 km to the south of its initial location and then back.

Offshore. Cuvier's beaked whales have been routinely sighted during NMFS surveys in the waters of the Study Area (Barlow, 2016; Hamilton et al., 2009). Offshore of Washington, Cuvier's beaked whales have been acoustically detected in the winter and spring (between mid-November and April (Debich et al., 2015; Kerosky et al., 2013; Trickey et al., 2015)), although they were also detected sporadically in the spring through fall (February–September) in 2011 and 2012 (Kerosky et al., 2013; Širović et al., 2012a). The Navy assumes this is indicative of variable year-round presence in the Offshore portion of the Study Area, consistent with data gathered from other locations (DiMarzio et al., 2018; Moretti, 2017; Schorr et al., 2018).

Inland Waters. Based on the available information (National Marine Fisheries Service, 2017a; U.S. Department of the Navy, 2017e), beaked whales are not expected to occur within the Inland Waters portion of the Study Area.

Western Behm Canal, Alaska. There is no indication that beaked whales inhabit the Behm Canal portion of the Study Area (Dahlheim et al., 2009; Muto et al., 2017; Muto et al., 2018b), and they are considered extralimital in this location.

3.4.1.30 Mesoplodont Beaked Whales (*Mesoplodon spp*.)

3.4.1.30.1 Status and Management

None of the Mesoplodont beaked whales are considered a threatened or endangered species under the ESA, and none of the stocks are considered depleted under the MMPA. Due to the difficulty in distinguishing the different *Mesoplodon* species from one another at sea during surveys, NMFS has defined a single management unit ("Mesoplodont beaked whales") for all *Mesoplodon* stocks that occur along the U.S. West Coast (Carretta et al., 2018b). The stock assigned to that management unit is considered the California, Oregon, Washington stock (Carretta et al., 2018b). The six species in this Mesoplodont beaked whales management unit are Blainville's beaked whale (*M. densirostris*), Hubbs' beaked whale (*M. carlhubbs*i), Perrin's beaked whale (*M. perrini*), pygmy beaked whale (*M. peruvianus*), gingko-toothed beaked whale (*M. gingkodens*), and Stejneger's beaked whale (*M. stejnegeri*). Stejneger's beaked whale is the only species of *Mesoplodon* known to occur in Alaska waters (Muto et al., 2017; Muto et al., 2018b). In addition to the California, Oregon, and Washington stock of Mesoplodont beaked whales, the population of Stejneger's beaked whales in Alaska is recognized as the Alaska stock, separately from Stejneger's and other Mesoplodont beaked whales found off California, Oregon, and Washington (Carretta et al., 2017c; Carretta et al., 2018b; Muto et al., 2017; Muto et al., 2018b).

3.4.1.30.2 Abundance

There is currently no reliable abundance estimate for the Alaska stock of Stejneger's beaked whale. With the approximate distribution believed to be well offshore of the Pacific coast of Southeast Alaska (Muto et al., 2017; Muto et al., 2018b), the Navy presumes there will be no Stejneger's or other Mesoplodont beaked whales present in Behm Canal.

For the Offshore portion of the Study Area and based on surveys from 1991 to 2014, the abundance for Mesoplodont beaked whales in the area (the combined Oregon/Washington stratum and the Northern California stratum) is estimated at 1,036 animals (Barlow, 2016).

3.4.1.30.3 Distribution

Worldwide, beaked whales normally inhabit both slope and deep oceanic waters with depths greater than 200 m and frequently where depths are greater than 1,000 m (Baird et al., 2010; Jefferson et al., 2015; MacLeod et al., 2006; MacLeod et al., 2003; MacLeod & D'Amico, 2006; Schorr et al., 2014). As available, relevant species-specific distribution information is summarized below for the six Mesoplodont beaked whales that are included in the NMFS management unit.

Blainville's beaked whale is one of the most widely distributed species within the *Mesoplodon* genus found mostly offshore in deeper waters along the California coast, Hawaii, Fiji, Japan, and Taiwan, as well as throughout the eastern tropical Pacific (Baumann-Pickering et al., 2014; Jefferson et al., 2015; Leslie et al., 2005; MacLeod, 2000; MacLeod & Zuur, 2005; Mahaffy et al., 2015). There was one confirmed sighting of Blainville's beaked whale approximately 150 NM off the coast of Southern Oregon during a NMFS survey (Hamilton et al., 2009). An acoustic monitoring device offshore off Washington detected Blainville's beaked whale pulses once, in March 2011 (Širović et al., 2012b), but none have been detected in similar acoustic monitoring efforts since (Debich et al., 2014; Kerosky et al., 2013; Trickey et al., 2015).

Hubbs' beaked whale distribution is generally associated with the deep subarctic current system along the Pacific coast of North America (Mead et al., 1982; Mead, 1989; Yamada et al., 2012). MacLeod and D'Amico (2006) speculated that the distribution of Hubbs' beaked whale might be continuous across the North Pacific between about 30°N and 45°N, but this remains to be confirmed. There was one sighting of Hubb's beaked whale off the coast of Washington (beyond approximately 300 NM) during a NMFS survey (Hamilton et al., 2009) and there are records of the species having stranded at least seven times in British Columbia (Willis & Baird, 1998a) and once at La Push, Washington (National Marine Fisheries Service, 2017a). The characteristics of its vocalizations are not presently know so the species has not been identified in acoustic monitoring records (Baumann-Pickering et al., 2014).

Perrin's beaked whale distribution generally includes deep waters off the Pacific coast of North America where depths exceed 1,000 m (MacLeod & D'Amico, 2006). Perrin's beaked whale is known only from five stranded specimens along the California coastline south of Monterey from 1975 to 1997, and given the scarcity of data regarding the species, the full extent of Perrin's beaked whale distribution is unknown (Dalebout et al., 2002; MacLeod et al., 2006). The properties of echolocation signals produced by this species are unknown and those thought to possibly be produced by Perrin's beaked whales have not been detected in the Study Area (Baumann-Pickering et al., 2012).

Pygmy beaked whale distribution is based on stranding data from the Pacific coast of Mexico, Peru, and Chile (MacLeod & D'Amico, 2006; Pitman & Lynn, 2001; Sanino et al., 2007) and sightings during NMFS surveys indicate the species appears to be endemic to the eastern tropical Pacific between about 30°N to 30°S (Hamilton et al., 2009; MacLeod & D'Amico, 2006). The properties of echolocation signals produced by this species are unknown, and those thought to possibly be produced by Pygmy beaked whales have not been detected in the Study Area (Baumann-Pickering et al., 2012).

Ginkgo-toothed beaked whale distribution likely includes deep waters off the Pacific coast of North America. The handful of known records of the ginkgo-toothed beaked whale is from strandings, one of which occurred in California (Jefferson et al., 2015; MacLeod & D'Amico, 2006). The properties of echolocation signals produced by this species are unknown, and those thought to possibly be produced by ginkgo-toothed beaked whales have not been detected in the Study Area (Baumann-Pickering et al., 2012).

Stejneger's beaked whale appears to prefer cold temperate and subpolar waters on the steep slope of the continental shelf in water depths ranging from 730 to 1,560 m (Loughlin & Perez, 1985; MacLeod et al., 2006; Mead, 1989). The farthest south this species has been observed in the eastern Pacific is Cardiff, California (33°N); and this was previously considered an extralimital occurrence (Loughlin & Perez, 1985; MacLeod et al., 2006; Mead, 1989), but acoustic monitoring has since and on rare occasions detected vocalizations in Southern California waters, confirming the species' range that far south (Baumann-Pickering et al., 2012). Stejneger's beaked whales have only been visually detected twice during NMFS surveys, once in the Aleutian Islands and once in the Gulf of Alaska (Hamilton et al., 2009). Stejneger's beaked whales were the most consistently detected beaked whale off Washington between September and June in multiple years of acoustic monitoring effort (Baumann-Pickering et al., 2012; Debich et al., 2014; Kerosky et al., 2013; Širović et al., 2012a; Trickey et al., 2015).

Offshore. There were a total of 16 sightings of species identified to the genus *Mesoplodon* based on surveys from 1991 to 2014 for the combined Oregon/Washington stratum and the Northern California stratum (Barlow, 2016), which approximates the Offshore portion of the Study Area. Given these sightings and the consistent acoustic monitoring detections from species in the management unit, Mesoplodont beaked whales are expected to have a regular presence in the Offshore portion of the Study Area.

Inland Waters. Based on the available information (National Marine Fisheries Service, 2017a; U.S. Department of the Navy, 2017e), beaked whales are not expected to occur within the Inland Waters portion of the Study Area.

Western Behm Canal, Alaska. There is no indication that beaked whales inhabit the Behm Canal portion of the Study Area (Dahlheim et al., 2009; Muto et al., 2017; Muto et al., 2018b), and they are considered extralimital in this location.

Pinnipeds

3.4.1.31 California Sea Lion (*Zalophus californianus*)

3.4.1.31.1 Status and Management

The California sea lion is protected under the MMPA and is not listed under the ESA. NMFS has defined one stock for the California sea lion (U.S. stock), with five genetically distinct geographic populations identified: (1) Pacific Temperate, (2) Pacific Subtropical, (3) Southern Gulf of California, (4) Central Gulf of California, and (5) Northern Gulf of California (Carretta et al., 2018a). The Pacific Temperate population is the only population expected in the Study Area and constitutes the U.S. stock. However, movement of sea lions between U.S. waters as far north as the Gulf of Alaska, through Canada, and south as far as Mexican waters off the Baja Peninsula has been documented (Carretta et al., 2018a; DeLong et al., 2017). In addition to rookeries in U.S. waters the Pacific Temperate population includes sea lions from rookeries on the Coronado Islands just south of the U.S.–Mexico border. However, pup production at the Coronado Islands is minimal compared with U.S. rookeries and does not represent a significant contribution to the overall size of the Pacific Temperate population (Carretta et al., 2018a).

3.4.1.31.2 Abundance

The current population estimate of California sea lions in the U.S. stock is 257,606 (Carretta et al., 2018a). The total population in U.S. waters cannot be counted because all age and sex classes are not ashore at the same time during field surveys. In lieu of counting all sea lions, pups are counted during the breeding season (because this is the only age class that is ashore in its entirety), and the number of births is estimated from the pup count. The size of the U.S. population is then estimated from the number of births and the proportion of pups observed at the surveyed rookeries (Carretta et al., 2017c; Carretta et al., 2018a; Laake et al., 2018).

Abundance in the NWTT Study area was estimated from aerial surveys of California sea lions offshore and at haulout locations in central and Northern California conducted in May–June, September, and December of 1998 and July 1999 (Lowry & Forney, 2005; Wright et al., 2010). Only data from the Northern California strata were used to estimate abundance in the Study Area. Males are much more likely to migrate into the Oregon and Washington portion of the Study Area than females, but some females are likely to be present in Northern California waters during the non-breeding season, so extrapolating data from Lowry and Forney (2005) is reasonable and is possibly an overestimation of abundance in the Study Area. Abundance in the Study Area is expected to be higher in spring and fall when males are migrating to and from rookeries in Southern California (DeLong et al., 2017; Lowry & Forney, 2005; Wright et al., 2010). The abundances used to estimate sea lion densities in the Study Area ranged from near 0 in summer to over 10,000 in spring. Fall and winter abundances were approximately 7,300 and 8,500, respectively.

3.4.1.31.3 Distribution

California sea lions from the Pacific Temperate population migrate seasonally into the Study Area, and have also been sighted north of the Study Area in Canadian waters (Carretta et al., 2017c; Carretta et al., 2018a). In summer, California sea lions breed on islands extending from the Gulf of California, Mexico to the Channel Islands and depending on oceanographic conditions and prey availability, may travel over 300 km from island rookeries in search of prey (Carretta et al., 2017d; Melin et al., 2008). Their primary rookeries are located in the Channel Islands, specifically San Miguel, San Nicolas, Santa Barbara, and San Clemente islands. Their distribution shifts to the north in fall and to the southeast during winter and spring, probably in response to changes in prey availability (Edgell & Demarchi, 2012). In the non-breeding season, adult and subadult males migrate northward along the coast to central and Northern California, Oregon, Washington, and Vancouver Island, and return south the following spring (DeLong et al., 2017). Individuals are occasionally sighted hundreds of miles offshore (Jeffries et al., 2000; Lowry & Forney, 2005); however, most tend to forage at a maximum of approximately 20–80 NM from shore (DeLong et al., 2017; Lowry & Forney, 2005). Most adult females with pups and juveniles of both sexes remain in waters near their breeding rookeries off the coast of California and Mexico. They also enter bays, harbors, and river mouths and often haul out on human-made structures such as piers, jetties, offshore buoys, and oil platforms. Refer to the Navy's Marine Species Density Database Technical Report for more information on how abundance and distribution information was used to estimate species density (U.S. Department of the Navy, 2017f).

Offshore. California sea lions are the most frequently sighted otariid in Washington waters and use numerous haulout sites along the Pacific coast (DeLong et al., 2017; Jeffries et al., 2000; Lowry & Forney, 2005). In the Study Area, adult females and juvenile animals are rarely present, while males may be present for up to approximately 10 months of each year, returning to rookery islands in Southern California during the pupping and breeding season (May–July) (DeLong & Jeffries, 2017; DeLong et al., 2017; Laake et al., 2018). Sea lions are present along the coast of Oregon from October to April (Lowry et al., 2014). Main haulout sites include the Columbia River (South Jetty), Cascade Head, Cape Arago, and Orford and Rogue Reefs (DeLong & Jeffries, 2017). Sea lions also use the northern coast of California mainly during May and June, and September and October (Lowry & Forney, 2005; Oleson et al., 2009). Main haulout sites include St. George Reef, Castle Rock, and Farallon and Año Nuevo Islands.

California sea lions feed on a wide variety of prey, including many species of fish and squid that are typically found over the continental shelf; the availability of prey drives the distribution of California sea lions. The U.S. Geological Survey conducted seabird and marine mammal surveys off the coasts of Washington, Oregon, and Northern California in winter, summer, and fall from 2011 to 2012 (Adams et al., 2014). California sea lions were the most frequently sighted pinniped species (125 sightings and 213 individuals) and were present year round with slightly more sightings recorded during fall. The number of sightings and relative abundance decreased with distance from shore. California sea lions were most frequently observed over the inner-continental shelf, with 60 percent of sightings and 74 percent of individuals observed at depths less than 100 m (Adams et al., 2014).

Approximately 90 percent of California sea lions are expected to occur within 40 km of shore and all are expected to occur within 70 km of shore (Lowry & Forney, 2005; Oleson et al., 2009; Wright et al., 2010). Males are present in the Offshore Area from November to mid-June when they typically leave the Study Area en route to rookeries in the Channel Islands (DeLong & Jeffries, 2017; Gearin et al., 2017; Wright et al., 2010). Transit time between breeding rookeries and the Study Area is approximately 25 days (Gearin et al., 2017; Wright et al., 2010). Gearin (2017) shows sea lions remain within the 1,000 m isobath during north and south migrations. However, during anomalous conditions (e.g., during an El Nino period) California sea lions may travel farther offshore, presumably seeking prey (Elorriaga-Verplancken et al., 2016); Weise et al., (2006) reported seeing male California sea lions 450 km from shore, and Melin et al. (2008) reported lactating females traveling more than 300 km from shore on foraging trips.

Inland Waters. Location data from satellite tags on 30 male California sea lions over a two-year period indicated most were transient visitors to the Navy Facilities in Puget Sound (DeLong et al., 2017). As noted above, California sea lions migrate from Puget Sound to rookeries in Southern California in spring and return in fall (DeLong et al., 2017; Gearin et al., 2017; Jeffries, 2014; Jeffries et al., 2000). Adult female and juvenile sea lions are rare in Washington inland waters (DeLong et al., 2017). Transit through Strait of Juan de Fuca is described as rapid (Gearin et al., 2017). The southbound migration between Puget Sound and Southern California rookeries takes approximately 25 days (Gearin et al., 2017); therefore, occurrence of any one individual in the Strait of Juan de Fuca is likely limited to several days in spring and several days in fall. However, not all sea lions would be expected to be in the Strait at the same time.

Seasonal abundance in Puget Sound was estimated to be 788 California sea lions based on counts made at Navy facilities at Bremerton, Bangor, Everett, and Manchester (DeLong et al., 2017). The abundance of California sea lions in the Strait of Juan de Fuca was estimated by assuming all sea lions moved through the Strait of Juan de Fuca in spring (March through May) and fall (September through November) (DeLong & Jeffries, 2017; 2014). Some California sea lions are present year round in Puget Sound (DeLong & Jeffries, 2017; DeLong et al., 2017; Jeffries, 2014). Other established haulout sites are located at Shilshole Bay near Seattle, Commencement Bay and Budd Inlet in southern Puget Sound, and numerous navigation buoys south of Whidbey Island to Olympia (DeLong et al., 2017; Jeffries, 2014; Jeffries et al., 2000). A major winter haulout site is Race Rocks located in Canadian waters of the Strait of Juan de Fuca adjacent to the Study Area (Edgell & Demarchi, 2012) indicating the population is larger and has broader distributions that just within the NWTT Study Area, even when considering only the Inland Waters portion of the NWTT Area.

Western Behm Canal, Alaska. A total of 52 (25 male, 5 female, and 22 undetermined) California sea lions have been reported in Alaskan waters between 1974 and 2004, with an increasing presence in later years (Maniscalco et al., 2004). California sea lions in Alaska most often were seen alone and only occasionally in small groups of two or more, although hundreds have been found to haul out together along the Washington coast and in southern British Columbia. The relatively few California sea lions found in Alaska usually have been associated with Steller sea lions at their haulouts and rookeries. California sea lions are not expected to occur in Behm Canal near SEAFAC.

3.4.1.32 Steller Sea Lion (*Eumetopias jubatus*)

3.4.1.32.1 Status and Management

The Western U.S. stock is listed as depleted under the MMPA and endangered under the ESA (Muto et al., 2018a; Muto et al., 2018b). However, Steller sea lions from the Western U.S. stock are not expected to be present in the Study Area, with the exception being the potential negligible presence of a few juvenile males wandering outside the core range area of the stock (DeLong, 2018; Fritz et al., 2016; Jemison et al., 2013; Raum-Suryan et al., 2004). In 1993 (58 FR 45269), areas of critical habitat for the Western DPS were designated by NMFS to include a 20 NM buffer around all major haulouts and rookeries, as well as associated terrestrial, air, and aquatic zones, and three large offshore foraging areas that are all in Alaska waters. None of these designated areas are close (>150 km) to Western Behm Canal, and so analysis of the species critical habitat will not be discussed further in this Supplemental.

The Eastern U.S. stock of Steller sea lions is currently listed as depleted under the MMPA and in recognition of their recovery, Steller sea lions in the Eastern U.S. stock were removed from the List of Endangered and Threatened Wildlife in October 2013 (Muto et al., 2018a; Muto et al., 2018b; National Marine Fisheries Service, 2016d).

NMFS has designated two Steller sea lion stocks in the North Pacific corresponding to two DPSs with the same names (Muto et al., 2017; Muto et al., 2018b). The Eastern U.S. stock (or DPS) is defined as the population occurring east of 144°W longitude and the Western U.S. stock (or DPS) consists of sea lions occurring west of 144°W longitude. Although the distribution of individuals from the two stocks overlaps outside of the breeding season (DeLong, 2018; Fritz et al., 2016; Jemison et al., 2013; Raum-Suryan et al., 2004), only sea lions from the Eastern U.S. stock, defined as those living in southeast Alaska, British Columbia, California, and Oregon, are expected in the Study Area (DeLong, 2018; Fritz et al., 2016; Jemison et al., 2013; Raum-Suryan et al., 2004)

3.4.1.32.2 Abundance

The Eastern U.S. stock of Steller sea lions has established rookeries and breeding sites along the coasts of California, Oregon, British Columbia, and southeast Alaska. A new rookery has recently been discovered along the coast of Washington at the Carroll Island and Sea Lion Rock complex, where more than 100 pups were born in 2015 (Muto et al., 2017; Muto et al., 2018b; Wiles, 2015). The total abundance of the Eastern U.S. stock was estimated to be 41,638 sea lions (30,917 non-pups and 10,721 pups) in 2015. This total includes Steller sea lions from rookeries and haulouts in California, Oregon, Washington (non-pups only), and southeast Alaska. Approximately 30,000 Steller sea lions occur along the coast of British Columbia but are not included in the abundance of sea lions occurring in U.S. waters. The NMFS 2016 SAR does not factor in pups born at sites along the Washington coast (Muto et al., 2017; Muto et al., 2018b). Considering that pups have been observed at multiple breeding sites since 2013, specifically at the Carroll Island and Sea Lion Rock complex and the Tatoosh Island area (Wiles, 2015), the abundance of 1,407 non-pups reported in the Pacific SAR for Washington likely underestimates the population. Wiles (2015) estimates that up to 2,500 Steller sea lions are present along the Washington coast, which increases the abundance estimate for the Eastern U.S. stock to 42,730 sea lions (Table 3.4-3). Applying the trend, or growth rate, associated with each population results in a projected 2017 abundance of 45,063 Steller sea lions on U.S. waters.

Table 3.4-3: Abundance and Trend of Eastern U.S. Stock of Steller Sea Lions in U.S. Waters in 2015

Region	Trend (%)	2015 Abundance (non-pups + pups)	2017 Projected Abundance
California	1.95	4,056	4,216
Oregon	2.39	7,480	7,947
Washington	8.77	2,500	2,958
Southeast Alaska	2.33	28,594	29,942
Total Eastern U.S. Stock		**42,730**	**45,063**

Sources: (Muto et al., 2017; Wiles, 2015)

3.4.1.32.3 Distribution

Steller sea lions range along the North Pacific Rim from northern Japan to California, with centers of abundance and distribution in the Gulf of Alaska and Aleutian Islands. The species is not known to migrate, but individuals disperse widely outside of the breeding season (May–July) likely in search of different types of prey (Fritz et al., 2016; Jemison et al., 2013; Muto et al., 2017; Muto et al., 2018b; National Marine Fisheries Service, 2013b; Raum-Suryan et al., 2004; Sigler et al., 2017). Males arrive at breeding sites in May with females following shortly afterwards. Pups are born from late May to early July and begin transiting with their mothers to other haulouts at two to three months of age. Adults depart rookeries in August. Females with pups remain within 500 km of their rookery during the non-breeding season, but juveniles of both sexes and adult males disperse more widely but remain primarily over the continental shelf (Wiles, 2015).

Despite the wide-ranging movements of juveniles and adult males in particular, until recently (the past 15–30 years) there has been little evidence that breeding adults emigrated from one stock to the other (except at adjacent rookeries at the DPS boundary) (Fritz et al., 2016; Hoffman et al., 2009; Jemison et al., 2013; Muto et al., 2017; Muto et al., 2018b; Raum-Suryan et al., 2004; Trujillo et al., 2004). An analysis of over 4,000 Steller sea lions branded as pups between 2000 and 2010 from both the western and eastern DPSs revealed that juvenile males regularly crossed the DPS boundary and that there is "strong evidence" that some breeding females from the western DPS have permanently emigrated to and are reproducing in the eastern DPS (Fritz et al., 2016; Jemison et al., 2013; Raum-Suryan et al., 2004). These females are likely reproducing at rookeries at White Sisters and Grave Rocks, which are both located over 250 km north of the Behm Canal area. Females from the eastern DPS had a very low probability of migrating into the western DPS, and the majority of the overlap that does occur is present in the northern portion of Southeast Alaska (Fritz et al., 2016; Jemison et al., 2013; National Marine Fisheries Service, 2013b). Poor or declining environmental conditions in the west and favorable environmental conditions in the east are thought to have facilitated the migration of male and female Steller sea lions across the DPS boundary and resulted in higher survivability and reproductive success in the east (Jemison et al., 2013).

The locations and distribution of the Eastern population's breeding sites along the U.S. Pacific coast have shifted northward, with fewer breeding sites in Southern California and more sites established in Washington and Southeast Alaska (Pitcher et al., 2007; Wiles, 2015). Refer to the Navy's Marine Species Density Database Technical Report for more information on how abundance and distribution information was used to estimate species density (U.S. Department of the Navy, 2017f).

Offshore. Steller sea lions in the Offshore portion of the Study Area are from the Eastern stock, with the possible presence of occasional juvenile males from the Western stock. NMFS has determined that Western stock Steller sea lions are "extremely unlikely" to be present south of Sumner Strait near Wrangell Alaska (National Marine Fisheries Service, 2013b). For Washington's Pacific coast, there are unpublished reports of a branded Western DPS juvenile male Steller sea lion present in June 2005 on Tatoosh Island (at the entrance to Juan de Fuca) and another branded Western DPS juvenile male at the same general location and at Carrol Island (off southern Washington) in July and August 2013 (DeLong, 2018). Given this is an opportunistic sample, the presence of two Western DPS over the last 12 years suggests additional Western DPS animals may occasionally be present. However, juvenile male Steller sea lions wandering outside the core range of the population is not uncommon (Fritz et al., 2016; Jemison et al., 2013; Raum-Suryan et al., 2004). Given the NMFS characterization that the species' presence is extremely unlikely, the Navy's assumption is that the Western DPS animals should be absent or, at most, extremely few in number in the Study Area. Navy considers the presence of Western DPS Steller sea lions to be discountable. Furthermore, it is unlikely that they may be present contemporaneously in time and space with Navy training and testing activities. Based on the current information and assumptions, the proposed action will not affect the ESA-listed Western DPS Steller sea lions.

Steller sea lion of the Eastern stock and DPS use haulout and breeding sites primarily along the Pacific coast from the Columbia River to Cape Flattery, as well as along the coast of Vancouver Island, British Columbia (Madson et al., 2017; Wiles, 2015; Wright et al., 2017a). The distance that female sea lions travel from rookeries and haulout sites during foraging trips depends on whether or not they have dependent young (e.g., nursing pups) (Merrick & Loughlin, 1997). Females in the Aleutian Islands with dependent young traveled an average distance of 17 km on foraging trips, whereas females without dependent young traveled an average of 133 km to seek out a wider variety of prey species (Merrick & Loughlin, 1997; Trites & Porter, 2002).

Outside of breeding season, Steller sea lions may be present throughout the Offshore Area. Their distribution is likely driven by the distribution of prey, which may be concentrated in areas where oceanic fronts and eddies persist (Lander et al., 2010; Sigler et al., 2017).

Based on 11 sightings along the Washington coast, Steller sea lions were observed at an average distance of 13 km from shore and 35 km from the shelf break (defined as the 200 m isobath) (Oleson et al., 2009). The mean water depth in the area of occurrence was 42 m, and surveys were conducted out to approximately 60 km from shore. Wiles (2015) estimated that Steller sea lions off the Washington coast primarily occurred within 60 km of land, favoring habitat over the continental shelf. However, a few individuals may travel several hundred kilometers offshore (Merrick & Loughlin, 1997; Wiles, 2015). The U.S. Geological Survey conducted seabird and marine mammal surveys off the coasts of Washington, Oregon, and Northern California in winter, summer, and fall from 2011 to 2012 (Adams et al., 2014). Steller sea lions were sighted infrequently, with a total of 4 sightings and 10 individuals, all observed over the continental shelf in depths less than 200 m. Three of the four sightings (and all but one individual) occurred in fall; the other occurred in winter (Adams et al., 2014). The locations and seasonality observed in the documented sightings were integrated into the distributions (U.S. Department of the Navy, 2019) used in the analysis of potential impacts from the Navy's Proposed Actions.

Inland Waters. Eastern stock Steller sea lions occur mainly along the Washington coast from the Columbia River to Cape Flattery (Jeffries et al., 2000; Madson et al., 2017; Wiles, 2015; Wright et al., 2017a). Smaller numbers use the Strait of Juan de Fuca, San Juan Islands, and Puget Sound south to the mouth of the Nisqually River in Thurston and Pierce counties (Wiles, 2015). A total of 22 haulouts used by Eastern Stock Steller sea lions (and other pinnipeds) are located in Washington inland waters, and an additional 6 sites are located on the Canadian side of the Strait of Juan de Fuca and southern Strait of Georgia (Jeffries, 2014; Wiles, 2015).

While Steller sea lions are occasionally observed in the Strait of Juan de Fuca, they are seasonally present in Puget Sound. An estimate of several dozen to a few hundred Steller sea lions (mostly males) are present in Puget Sound at any given time with peak abundance in fall and winter (Smultea et al., 2017). No sea lions were sighted from May through July during aerial surveys of Puget Sound from 2014 through 2016 (Smultea et al., 2017). However, aerial surveys conducted in 2013 and 2014 recorded peak abundance of over 600 Steller sea lions on Tatoosh Island at the mouth of the Strait of Juan de Fuca in late July (Jeffries, 2014). Jeffries (2014) identified five winter haulout sites in Puget Sound used by Steller sea lions, ranging from immediately south of Port Townsend (near Admiralty Inlet) and southern Puget Sound near Olympia. At these Puget Sound haulouts, the highest total count was 50 Steller sea lions recorded in the month of November (Jeffries, 2014). Although Steller sea lions may occur through Puget Sound, they have generally been observed in greater numbers in Admiralty Inlet (Smultea et al., 2017).

Steller sea lions have been seasonally documented at Naval Base Kitsap Bangor in Hood Canal since 2008 during daily haulout surveys (Jeffries, 2014; Jeffries et al., 2000; U.S. Department of the Navy, 2016). Aerial surveys conducted by the Washington Department of Fish and Wildlife in 2013 and 2014 recorded Steller sea lions hauled out on pontoons used as security barriers at Naval Base Kitsap Bremerton and Naval Station Everett (Jeffries, 2014). There is also a large sea lion haulout (used by California and Steller sea lions) near Manchester, approximately 8 miles from Naval Base Kitsap Bremerton. There are no known occurrences of Steller sea lions at Keyport or Crescent Harbor (Jeffries, 2014). Steller sea lions are seasonally present in large numbers in southern Puget Sound near Carr Inlet and off the mouth of the Nisqually River (Wiles, 2015).

Adjacent to the Study Area, Race Rocks is a well-established winter haulout site in the Canadian side of the Strait of Juan de Fuca used by hundreds of Steller sea lions as they enter inland waters to feed on herring (Edgell & Demarchi, 2012). Peak abundance at Race Rocks based on sightings from 1997 to 2009 occurred in October. During the summer breeding season, very few, if any, Steller sea lions would be expected in the Inland Waters portion of the Study Area (Jeffries, 2014; Smultea et al., 2017).

Western Behm Canal, Alaska. Steller sea lions from the Eastern U.S. stock are prevalent in southeast Alaska where over 65 percent of the population in U.S. waters resides (Table 3.4-3). The majority of rookeries and haulout sites in southeast Alaska are located north of the Behm Canal area (Jemison et al., 2013), and there are no haulout sites in Behm Canal. The closest haulouts are West Rock, located southwest of the southern end of Behm Canal, and Nose Point, located west of the northern end of Behm Canal (DeLong & Jeffries, 2017). The West Rock haulout is used by Steller sea lions year round, and the most recent counts of non-pups were 302 and 769 in late June of 2013 and 2015, respectively. The only winter count was 334 non-pups in December 1994. The haulout at Nose Point is used only in winter (DeLong & Jeffries, 2017). As noted above, Steller sea lions from the Western U.S. stock are not expected to be present in the Behm Canal portion of the Study Area, with the possible exception of a few wandering juvenile males (DeLong, 2018; Fritz et al., 2016; Jemison et al., 2013; National Marine Fisheries Service, 2013b). Western stock Steller sea lions are "extremely unlikely" to be present south of Sumner Strait (National Marine Fisheries Service, 2013b), which is approximately 70 NM north of waters in the vicinity of Behm Canal. For Southeast Alaska, the majority of the documented overlap of the two DPS in the east are in "northern Southeast Alaska," with only one to two additional animals documented at haulout locations along Alaska's Pacific Coast and as far south as Forrester Island (Jemison et al., 2013); this island in the Pacific is approximately 100 NM by sea from the entrance to Western Behm Canal so Steller sea lions are not expected to be in Western Behm Canal.

3.4.1.33 Guadalupe Fur Seal (*Arctocephalus townsendi*)

3.4.1.33.1 Status and Management

The Guadalupe fur seal is listed as depleted under the MMPA and threatened under the ESA, but there is no designated critical habitat for this species. The primary breeding rookery of Guadalupe fur seals is at Isla de Guadalupe, Mexico, and a second breeding population has been established at Islas San Benito, Baja California, Mexico (Esperon-Rodriguez & Gallo-Reynoso, 2012; Juárez-Ruiz et al., 2018; Maravilla-Chavez & Lowry, 1999). Guadalupe fur seals are considered by NMFS to be a single stock (Carretta et al., 2017c).

3.4.1.33.2 Abundance

The abundance estimate for the entire stock of Guadalupe fur seals is over 33,000 animals. The abundance is based on surveys of fur seals on Isla de Guadalupe, Mexico from 2008 to 2010, population estimates of fur seals breeding at a smaller rookery on Islas San Benito, Baja California, Mexico, and an average annual growth rate of 7.64 percent applied from 2010 to 2017 (Carretta et al., 2017a; Norris, 2017a).

3.4.1.33.3 Distribution

Until recently the distribution of Guadalupe fur seals in the NWTT Study Area had been documented primarily through stranding records and archeological evidence (Aurioles-Gamboa & Camacho-Rios, 2007; Aurioles-Gamboa et al., 2010; Etnier, 2002; Lambourn et al., 2012; National Marine Fisheries Service, 2017a; Norris, 2017b; Rick et al., 2009). Norris (2017a) describes preliminary results of an on-going study tracking satellite-tagged fur seals as they migrate from rookeries on Isla de Guadalupe, Mexico and from rehabilitated fur seals released off of Point Reyes, California. Data from animals leaving Guadalupe Island indicate that Guadalupe fur seals primarily use habitats offshore of the continental shelf between 50-300 km from the U.S. West Coast, with approximately one quarter of the population foraging farther out and up to 700 km offshore (Norris, 2017a). While a small percentage of adult and juvenile fur seals may migrate north of Point Cabrillo, California, and into the NWTT Study Area, the majority of these individuals are likely weaned pups and yearlings less than two years old. Several rehabilitated fur seals between 10 and 15 months old were fitted with satellite tracking tags and released off Point Reyes, California from 2015 through 2017 (Norris, 2017a). Several of these animals remained close to shore as they migrated north and spent most of their time over the continental shelf. In contrast, "wild" Guadalupe fur seal pups and yearlings that migrated from Isla de Guadalupe, Mexico after the breeding season remained seaward of the continental shelf in deep pelagic waters. Even though the rehabilitated fur seals tended to remain closer to shore, they are not considered representative of the population as a whole, which is expected to remain in pelagic waters beyond the continental shelf. Healthy Guadalupe fur seals are not expected to haul out in the Study Area (Norris, 2017a). Sightings of live animals off Washington and Oregon are more limited, although there is photo documentation of apparently healthy Guadalupe fur seals in offshore waters of Washington and British Columbia during summer and early autumn (Lambourn et al., 2012).

Refer to the Navy's Marine Species Density Database Technical Report for more information on how abundance and distribution information was used to estimate species density (U.S. Department of the Navy, 2017f).

Offshore. During the summer breeding season adult and juvenile Guadalupe fur seals are mainly distributed offshore of Baja California, Mexico around rookeries on Isla de Guadalupe and Islas San Benito, Baja California, Mexico (Esperon-Rodriguez & Gallo-Reynoso, 2012; Juárez-Ruiz et al., 2018; Maravilla-Chavez & Lowry, 1999). During other times of the year, adult and juvenile fur seals, particularly males, are more widely distributed; however, very few are expected to migrate into the Study Area (Norris, 2017a). A large percentage of weaned pups and yearlings (fur seals less than two years old) are likely to migrate into the Offshore Area and remain there year round, with greater abundance expected from May to at least November (in summer and fall). Several rehabilitated fur seals between 10 and 15 months old were fitted with satellite tracking tags and released off Point Reyes, California from 2015 through 2017 (Norris, 2017a). Several of these animals remained close to shore as they migrated north and spent most of their time over the continental shelf. In contrast, "wild" Guadalupe fur seal pups and yearlings that migrated from Isla de Guadalupe, Mexico after the breeding season remained seaward of the continental shelf in deep pelagic waters. Even though the rehabilitated fur seals tended to remain closer to shore, they are not considered representative of the population as a whole, which is expected to remain in pelagic waters beyond the continental shelf. Healthy Guadalupe fur seals that are not at a rookery are not expected to haul out in the Study Area (Norris, 2017a). Adult Guadalupe fur seals are known to forage primarily off the continental shelf (beyond the 200 m isobath) in pelagic waters. Their preferred prey is squid and other cephalopods, with pelagic and benthic species of fish constituting a smaller fraction of their diet (Gallo-Reynoso & Esperón-Rodríguez, 2013; Juárez-Ruiz et al., 2018). Foraging in coastal waters is not uncommon; however, the pursuit of prey can take them out to at least 300 km from shore, and it would not be uncommon to encounter fur seals foraging 700 km from shore (Norris, 2017a). The Navy has assumed that Guadalupe fur seals will be present at sea in the Offshore portion of the NWTT Study Area.

Inland Waters. Guadalupe fur seals are pelagic outside of the breeding season and are not expected to occur within the Inland Waters portion of the Study Area at any time.

Western Behm Canal, Alaska. Guadalupe fur seals are not expected to occur within the Western Behm Canal portion of the Study Area (Norris, 2017a).

3.4.1.34 Northern Fur Seal (*Callorhinus ursinus*)

3.4.1.34.1 Status and Management

NMFS has identified two stocks of northern fur seals in U.S. waters in the North Pacific: the Eastern Pacific stock and the California stock (Carretta et al., 2017c; Muto et al., 2017; Muto et al., 2018b). The

Eastern Pacific stock of northern fur seals is listed as depleted under the MMPA and is not listed under the ESA. The California stock of northern fur seals is not considered to be depleted under the MMPA and is not listed under the ESA. The stocks are differentiated based on high natal site fidelity and substantial differences in population dynamics. The Eastern Pacific stock breeds primarily on the Pribilof Islands (located in the Bering Sea), and the California stock breeds on San Miguel Island off Southern California and the Farallon Islands off central California (Carretta et al., 2017c; Muto et al., 2017; Muto et al., 2018b). The distribution of the stocks overlaps during the non-breeding season and individuals from both stocks may be present in the Study Area.

3.4.1.34.2 Abundance

The abundance of the Eastern Pacific stock is currently estimated to be 620,660 animals (Muto et al., 2017; Muto et al., 2018b), and the California stock is estimated to have an abundance of 14,050 fur seals (Carretta et al., 2017c). Adult male northern fur seals comprise approximately 7 percent of the population (43,871 fur seals) and are not expected to be in the Study Area at any time given their North Pacific mid-ocean foraging when not otherwise in the Pribilof Islands (Olesiuk, 2012). The abundance estimates are based on survey data from 2014. To arrive at a projected abundance for 2017, an annual growth rate of 8.6 percent from the SAR (Muto et al., 2018b) was applied over three years. The resulting projected abundance is 764,489 and includes all females and juvenile males in both stocks as a baseline for estimating occurrence in the Study Area. Abundance is highest in winter and spring (non-breeding season) but fur seals less than three years old may remain in the Study Area year round (DeLong & Jeffries, 2017; Olesiuk, 2012).

3.4.1.34.3 Distribution

The northern fur seal is endemic to the North Pacific Ocean and occurs from Southern California to the Bering Sea, the Okhotsk Sea, and Honshu Island, Japan. Northern fur seals are on shore at breeding sites and haulouts outside of Study Area from mid-May through mid-November (summer and fall) and at sea the remaining half of the year (winter and spring) (Carretta et al., 2017c; Melin et al., 2012; Muto et al., 2017; Muto et al., 2018b). Males move ashore at breeding sites in the Pribilof Islands from May to mid-August (depending on age) and remain on shore until October (National Marine Fisheries Service, 2007a). After the breeding season, adult males move into the Gulf of Alaska north of the Study Area (Olesiuk, 2012; Sterling et al., 2014). Females arrive at breeding sites in June, pup in July, and leave in October or November. Pups are born from June through August and leave breeding sites in November, after the adults. Seasonal migrations begin in November with fur seals transiting through Aleutian Islands. Unpublished satellite tag location data indicates that while a majority of northern fur seal population remains at sea foraging in the north Pacific, a small portion of the females and juvenile males move south off the coasts of Southeast Alaska, British Columbia, Washington, Oregon, and California to forage and occasionally haul out on those coastlines. The smaller breeding population from San Miguel Island and the Farallon Islands migrates north into the Study Area after the breeding season, arriving in the region in November and December. The return migration begins in March (Carretta et al., 2017c; Muto et al., 2017; Muto et al., 2018b). Refer to the Navy's Marine Species Density Database Technical Report for more information on how abundance and distribution information was used to estimate species density (U.S. Department of the Navy, 2017f).

Offshore. Northern fur seals are mainly pelagic in the Study Area occurring in oceanic waters far from shore. Their offshore distribution has been correlated with oceanographic features (e.g., eddies and fronts) where prey may be concentrated (Ream et al., 2005; Sterling et al., 2014). Sightings are more common off the northern Washington and Vancouver Island coasts in winter and off central and southern Oregon in spring. Based on visual detections off Washington, Oleson (2009) described northern fur seals as occurring an average of 55 km from shore, 11 km from the 200 m isobath (a proxy for the shelf break), and in waters with a mean depth of 754 m. Kenyon and Wilke (1953) summarized information from a number of disparate sources, including sealing records and U.S. Coast Guard observations, on the migration of northern fur seals in the North Pacific. Migrating fur seals were generally found from 10 to 50 miles from shore in depths of thousands of feet (Kenyon & Wilke, 1953).

Kajimura (1984) analyzed the stomach contents of fur seals captured in the eastern North Pacific from 1958 to 1974 to better understand their foraging behavior and distribution. While the fur seals were widely distributed at sea and fed opportunistically, they were most frequently sighted between 70 and 130 km from shore, over outer continental shelf and slope. Olesiuk (2012) characterized northern fur seals as ubiquitous in the North Pacific between 60° N and 40° N latitude with their distribution at sea driven by prey concentrations associated with oceanographic features such as the boundary of the sub-arctic – sub-tropical transition zone near 42° N latitude (Polovina et al., 2001).

The U.S. Geological Survey conducted seabird and marine mammal surveys off the coasts of Washington, Oregon, and Northern California in winter, summer, and fall from 2011 to 2012 (Adams et al., 2014). Northern fur seals were sighted 35 times (47 individuals) primarily in winter and fall, with very few sightings in summer. The number of sightings and relative abundance increased with depth and distance from shore. Northern fur seals were most frequently observed beyond the-continental shelf (200 m isobath) with over 83 percent of sightings and individuals observed at depths between 200 and 2,000 m (Adams et al., 2014).

Pelland et al. (2015) examined the migratory behavior of 40 satellite-tagged female northern fur seals following their departure from breeding grounds on Bogoslof and St. Paul islands in the Aleutian Islands, Alaska. This study concentrated on foraging in the waters off Washington, but the tagged fur seals foraged along the Pacific Coast from British Columbia to central California and as far out to as approximately 620 km from the shelf break (defined in the study as the 200 m isobath). The tracking data spanned seven migratory seasons from 2002 to 2010 and were compared with oceanographic data gathered from autonomous gliders deployed over the same time period and in proximity to seals' satellite tracks. A seal's extended presence in a relatively limited spatial area was presumed to represent foraging behavior and frequently coincided in space and time with oceanographic features such as eddies, fronts, chlorophyll concentrations, and river plumes within 200 km of the continental shelf break. The median (50 percent of time spent) of the cross-shore distribution had a maximum of 260 km in January and minimum of 71 km in May, presumably shifting in response to dynamic mesoscale circulation and surface wind changes. One of the 40 tagged seals spent several weeks in the spring and early summer of 2007 following the Columbia River plume as it shifted with downwelling and upwelling favorable winds, primarily seaward of the shelf break, consistent with findings from the other tagged northern fur seals in the study (Pelland et al., 2015).

Inland Waters. The northern fur seal is a highly oceanic species. Some individuals, mostly juveniles, make their way into the Strait of Juan de Fuca and Puget Sound each year (Everitt et al., 1980), albeit not in large numbers or with any regularity. Aboriginal sealers have also reported their presence within the entrance of the Strait of Juan de Fuca (Kenyon & Wilke, 1953). Northern fur seals rarely haul out on land during migrations and would not be expected at haulouts along the coast or inland (Bonnell & Dailey, 1993). As a result of the available information, the Inland Waters of the Puget Sound are an area of rare occurrence for this species.

Western Behm Canal, Alaska. Satellite tracking data of female northern fur seals tagged at locations in the Bering Sea documented all bypassing the inland waters are of Southeast Alaska as they crossed the North Pacific to the continental margin of northwestern North America (Melin et al., 2012; Ream et al., 2005; Sterling et al., 2014). The tracks are consistent with the historic distribution recorded by sealing operations, which occurred only along the Pacific Coast and did not include the inland waters of Southeast Alaska (Olesiuk, 2012). Adult male fur seals remain in colder waters and are distributed in an expansive region of the North Pacific, Aleutian Islands, Gulf of Alaska, and the Bering Sea in a foraging strategy different than that of females and younger males (National Marine Fisheries Service, 2007a; Sterling et al., 2014). Northern fur seals from San Miguel Island appear to migrate only as far north as the Washington border and not to southeast Alaska. Kenyon and Wilke (1953) reported observations of a few thousand adult female northern fur seals regularly entering inlets of southeastern Alaska to forage during the winter-spring herring runs. The herring fishery is currently closed in Behm Canal, so no fishing vessels are on site to record the presence or absence of northern fur seals; however, the fur seals are likely there from February through April (i.e., spring) but not at other times of the year (DeLong & Jeffries, 2017).

3.4.1.35 Harbor Seal (*Phoca vitulina*)

3.4.1.35.1 Status and Management

There are no harbor seals listed under the ESA in the Study Area and no designated critical habitat. For management purposes under the MMPA, differences in mean pupping date, movement patterns, pollutant loads, and fishery interactions have led NMFS to recognize 17 stocks within U.S. waters from California to Alaska (Carretta et al., 2017c; Muto et al., 2017; Muto et al., 2018b). As shown in Table 3.4-1, out of these 17 stocks there are 6 present in the Study Area. The Clarence Strait stock is the only stock within the Western Behm Canal portion of the Study Area (Muto et al., 2018b). Within U.S. West Coast waters (excluding Alaska), five stocks of harbor seals are recognized: (1) Oregon/Washington Coast, (2) California, (3) Washington Northern Inland Waters (including Puget Sound north of the Tacoma Narrows Bridge, the San Juan Islands, and the Strait of Juan de Fuca); (4) Southern Puget Sound (south of the Tacoma Narrows Bridge), and (5) Hood Canal (Carretta et al., 2017c).

3.4.1.35.2 Abundance

Harbor seals are the most abundant pinniped in the Pacific Northwest. They occur in coastal waters over the continental shelf, in bays and estuaries, and in the inland waters of Washington (Huber et al., 2001). Abundances for the six stocks occurring in the Study Area are presented below.

Clarence Strait Stock: The abundance of the Clarence Strait population of harbor seals was estimated to be 31,634 (Muto et al., 2018b). The current estimate of the Clarence Strait population trend is +921 seals per year as provided by NMFS (Muto et al., 2018b).

California Stock: Based on the most recent harbor seal counts (20,109 animals in May–July 2012) and a correction factor of 1.54 to account for the number of animals in the water during the time of the survey, the harbor seal population in California is estimated to be 30,968 seals (coefficient of variation = 0.157) (Carretta et al., 2017c). Trend analysis in Carretta (2017a) and preliminary analysis of recent abundance data by the Washington Department of Fish and Wildlife DeLong (2017) indicate that the California stock of harbor seals is at carrying capacity, and the current abundance estimate is appropriate for 2017.

Oregon/Washington Stock: Aerial surveys were conducted offshore in Oregon and Washington during the 1999 pupping season. Radio-tagging studies in 1991 and 1992 were considered and a correction factor was applied to account for animals in the water during the time of the survey. Based on that analysis, the most recent population estimate for the Oregon/Washington stock is 24,732. NMFS SARs do not estimate abundance based on data more than eight years old; however, trend analysis in (Carretta et al., 2017c) and preliminary analysis of recent abundance data by the Washington Department of Fish and Wildlife DeLong (2017) indicate that the Oregon/Washington stock of harbor seals is at carrying capacity, and the current abundance estimate is appropriate for 2017.

Washington Northern Inland Waters Stock: The Navy sponsored aerial surveys of marine mammals, particularly harbor seals and harbor porpoises, from the summer of 2013 through the winter of 2016 in Puget Sound to update seasonal, in-water abundance and density estimates in proximity to Navy facilities in the inland waters portion of the Study Area (Smultea et al., 2017). An in-water abundance estimate of 3,116 harbor seals in the Washington Northern Inland Waters stock was calculated based on pooling seasonal data for the Admiralty Inlet, East Whidbey, and South Whidbey strata. Note that this in-water abundance is not equivalent to the total number of harbors seals in the stock, because it does not account for hauled-out seals. Calculating the total stock abundance based on in-water surveys and separate counts of hauled-out seals is not straightforward and presents several challenges. For example, aerial surveys are conducted at randomly chosen times, but counts of hauled-out seals are typically conducted at high tide (Jefferson et al., 2017). Simply summing the two totals would invariably result in an overestimate of abundance. This abundance estimate presented above is appropriate for 2017.

Southern Puget Sound Stock: The aerial surveys conducted by Smultea et al. (2017) from 2013 through 2016 also included Puget Sound. An in-water abundance estimate of 4,042 harbor seals in the Southern Puget Sound stock was calculated based on pooling seasonal data for the Bainbridge, Seattle, Southern Puget Sound, and Vashon strata. Note that this is an in-water abundance estimate and does not represent the abundance of the entire stock. This abundance estimate is appropriate for 2017.

Hood Canal Stock: Jefferson et al. (2017) analyzed aerial survey data for Hood Canal collected during the same surveys reported on by Smultea et al. (2017). To calculate seasonal in-water abundance and density estimates for harbor seals in Hood Canal, Jefferson et al. (2017) divided the canal into six sub-regions and calculated separate estimates for each sub-region in each season (winter, spring, summer, and fall). As noted above, calculating a total abundance for harbor seals in Hood Canal based solely on aerial surveys is problematic; however, Jefferson et al. (2017) estimate that there are approximately 2,000 harbor seals in the Hood Canal stock.

Refer to the Navy's Marine Species Density Database Technical Report for more information on how abundance and distribution information was used to estimate species density (U.S. Department of the Navy, 2017f).

3.4.1.35.3 Distribution

Harbor seals are a coastal species, rarely found more than 25–30 km from shore, and frequently occupy bays, estuaries, and inlets (Bailey et al., 2014; Baird, 2001; Oleson et al., 2009). Ideal harbor seal habitat includes access to numerous haulout sites, shelter during the breeding periods, and sufficient food (London et al., 2012; Peterson et al., 2012; Simpkins et al., 2003; Womble et al., 2015). Haulout areas can include intertidal and subtidal rock outcrops, sandbars, sandy beaches, peat banks in salt marshes, and human-made structures such as log booms, docks, and recreational floats (Jefferson et al., 2017; Jeffries, 2014; Jeffries et al., 2000; London et al., 2012; Smultea et al., 2017). Harbor seals in the Study Area may be hauled out approximately 65 percent of time; although, duration can vary by season, sex, and lifestage (Huber et al., 2001). Harbor seals do not make extensive pelagic migrations, showing strong fidelity to breeding and haulout locations year round (Carretta et al., 2017c), some long distance movement of tagged animals in Alaska (108 miles) and along the U.S. West Coast (up to 342 mi.) have been recorded (Brown & Mate, 1983; Womble & Gende, 2013).

Offshore. Harbor seals occur in the Offshore Area year round (Carretta et al., 2017c; Jeffries et al., 2003). They spend most of their time within 25–30 km from shore and haul out frequently along the coastline (Bailey et al., 2014; Oleson et al., 2009). Visual and acoustic surveys conducted off the Washington coast noted that a few harbor seals were sighted out to 64 km from shore, with farthest sighting at 70 km from shore and near the 1,000 m isobath, particularly in spring, indicating that they do range into deeper waters (Oleson et al., 2009). The U.S. Geological Survey conducted seabird and marine mammal surveys off the coasts of Washington, Oregon, and Northern California in winter, summer, and fall from 2011 to 2012 (Adams et al., 2014). Harbor seals were the second most frequently sighted pinniped (out of 5 species), with a total of 40 sightings and 56 individuals observed. Harbor seals occurred in all three seasons but were most frequently sighted in winter when 50 percent of sightings and 63 percent of individuals occurred. Consistent with other coastal surveys, 93 percent of sightings and all but three individuals occurred in water depths less than 100 m, and the remaining harbor seal observations were in depths between 100 and 200 m (i.e., over the continental shelf) (Adams et al., 2014).

Inland Waters. The harbor seal is the most common, widely distributed pinniped found in Washington inland waters, and is frequently observed by recreational boaters, ferry passengers and other users of the marine environment (Jeffries, 2014). Gaydos et al. (2013) have suggested that San Juan County, Washington, might have one of the most dense harbor seal populations in the world. Harbor seals are the most abundant marine mammal in Puget Sound and Hood Canal in particular, where they occur throughout the canal year round (Jefferson et al., 2017). London et al. (2012) identified five locations in Hood Canal as “major harbor seal haul-out sites” and noted these were locations having documented human (non-Navy) disturbance. London et al. (2012) report that disturbance occurs on a regular basis and described that disturbance for four of the five sites as follows: Quilcene Bay—operational salmon net-pen floats and oyster rafts; Dosewallips—state park and marina with motorized boats, kayakers, and canoers; Hamma Hamma—working oyster farm; and Skokomish—a kayak rental facility and a tribal and commercial fisheries site. Harbor seals also haul out year round at Navy facilities, including at Naval Base Kitsap Bangor located along Hood Canal, Naval Station Everett, the Manchester Fuel Depot, and Naval Base Kitsap Bremerton in Puget Sound (Jeffries, 2014; Jeffries et al., 2000).

In southern Puget Sound, harbor seals haul out on a variety of substrate materials including intertidal beaches, reefs, sandbars, log booms and floats. There are five main harbor seal haulout areas including mouth of the Nisqually River, Cutts Island, Gertrude Island, Eagle Island, and Woodard Bay (Lambourn et al., 2010). Based on periodic aerial and boat surveys, each of these sites regularly supports a population of over 100 seals (Lambourn et al., 2010). Pupping seasons vary by geographic region, with pups born in coastal estuaries (Columbia River, Willapa Bay, and Gray Harbor) from mid-April through June; Olympic Peninsula coast from May through July; San Juan Islands and eastern bays of Puget Sound from June through August; southern Puget Sound from mid-July through September; and Hood Canal from August through January (Jeffries et al., 2000). Historically, harbor seals were thought to remain within approximately 30 km of established haulout sites; however, Peterson et al. (2012) reported on 8 out of 14 satellite-tagged males captured east of the San Juan Islands moving more than 100 km from their haulout. The results of the study also support the hypothesis that males are moving between the

Oregon/Washington coastal stock and the Washington Northern Inland Waters stock and potentially mating in both locations.

Western Behm Canal, Alaska. Harbor seals from the Clarence Strait stock occur year round in southeast Alaska (Muto et al., 2017; Muto et al., 2018b). As in other regions, harbor seals haul out along the coastline and on human-made structures, and they also will use glacial ice as haulouts in southeast Alaska. During the summer molting season they spend only about 19 percent their time in the water (Simpkins et al., 2003). The rest of the year they are in the water about 43 percent of the time (Huber et al., 2001). Withrow et al. (1999) counted harbor seals at numerous sites along the eastern coast of Prince Edward Island adjacent to Clearance Strait and at haulouts in eastern Behm Canal during August of 1999. The counts were averaged over each survey data and summed to equal over 5,400 harbor seals. No sites in western Behm Canal were surveyed, however, harbor seals are expected to be present in western of Behm Canal.

3.4.1.36 Northern Elephant Seal (*Mirounga angustirostris*)

3.4.1.36.1 Status and Management

The northern elephant seal is protected under the MMPA and is not listed under the ESA. There are rookeries on islands off Mexico and rookeries in central California and the Channel Islands, but because there is no international agreement between Mexico and the U.S. for the joint management of this species, NMFS only recognizes and counts elephant seals present in U.S. waters at the California rookeries; NMFS has defined one stock for the northern elephant seals present in U.S. Waters, designated the California Breeding stock (Carretta et al., 2017c). The abundance numbers provided for elephant seals are based only on those elephant seals counted at U.S. rookeries although elephant seals from Mexico and U.S. waters overlap across their range when not at their rookeries (Robinson et al., 2012), which includes the NWTT Study Area.

3.4.1.36.2 Abundance

Lowry et al. (2014) reported that 40,684 pups were born on U.S. rookeries in 2010. Based on the pup count, the population estimate in the California Breeding stock is approximately 179,000 elephant seals. Assuming an annual growth rate of 3.8 percent as provided by NMFS, the projected 2017 abundance is 232,399 elephant seals potentially transiting the North Pacific ocean including the Offshore Area (Carretta et al., 2017c; Lowry et al., 2014).

Based on data from Jeffries (2014) and (DeLong & Jeffries, 2017), an abundance of 13 juvenile elephant seals was used for the analysis in this supplemental in the Inland Waters portion of the Study Area.

Only approximately 10 percent of male elephant seals are expected to enter Behm Canal and only in fall and spring (DeLong & Jeffries, 2017; Le Boeuf et al., 2000). An estimate of the male population based on the 2010 pup count and a multiplication factor of 3.88 is 78,926 (Lowry et al., 2014). Based on the assumption that 10 percent of males use inland waters in Alaska, a baseline abundance of 7,893 male elephant seals was used for the analysis in this supplemental for the Western Behm Canal portion of the Study Area.

3.4.1.36.3 Distribution

Northern elephant seals breed on islands offshore and mainland rookeries in California and Baja California, Mexico from December to March (Lowry et al., 2014). It has been suggested that since the 1990s, elephant seals in Mexico are not returning as far south as they had in the past due to warming sea and air temperatures (Garcia-Aguilar et al., 2018), which would shift their general distribution into more northern waters. Following the breeding season, they migrate north with male elephant seals migrating to the Gulf of Alaska and western Aleutian Islands while feeding along the continental shelf and females moving farther offshore into pelagic waters in the Gulf of Alaska and central North Pacific (Abrahms et al., 2017; Carretta et al., 2017c; Le Boeuf et al., 2000). Between March and August, adults return to land, primarily in the Aleutian Islands to molt. Females arrive in March and April while males arrive later in July and August (Robinson et al., 2012; Stewart & DeLong, 1995). After molting both adult males and females return to sea to feed in spring and summer before making the return migration to breeding colonies in California and Mexico. There are rookeries as far north as northern California at the Farallon Islands, Point Reyes, and Castle Rock off Crescent City (Hodder et al., 1998; Lowry et al., 2014). Le Boeuf (2000) reports that 20 males fitted with satellite-tags at California breeding rookeries migrated to feeding areas off the coast of eastern Alaska and noted that all feeding areas were located near the continental shelf break. One male was tracked to the "inland passage" of southern Alaska. Robinson (2012) used satellite tracking data from 297 adult female elephant seals to show that post breeding and post molting foraging areas were primarily offshore in the North Pacific at the convergence of the sub-arctic and sub-tropical gyres. Peterson et al. (2015) also showed that satellite-tagged female seals migrated northwest into offshore waters of the North Pacific.

Refer to the Navy's Marine Species Density Database Technical Report for more information on how abundance and distribution information was used to estimate species density (U.S. Department of the Navy, 2017f).

Offshore. Adult male elephant seals migrate north, primarily to Alaska, following the winter breeding season. Out of 26 males tracked from rookeries off Mexico, 20 migrated to the Alaska coast, 4 terminated their migration off Canada, 2 remained off of Oregon, and 1 migrated to the Washington coast (Le Boeuf et al., 2000). Migrating elephant seals did not linger during migrations and moved steadily and directly to their destinations during north and south bound migrations. After reaching their destination, they foraged in the area for one to three months. Male elephant seals are most likely to transit through the Offshore Area over approximately 30 days in March/April (northbound), June/July (southbound), August/September (northbound), and November/December (southbound) during migrations associated with breeding and molting periods (DeLong & Jeffries, 2017; Le Boeuf et al., 2000; Stewart & DeLong, 1995). Female elephant seals primarily migrated and foraged farther offshore than males, which are primarily benthic feeders, but satellite-tagged females and males followed similar migration routes (Le Boeuf et al., 2000; Robinson et al., 2012; Simmons et al., 2007).

Elephant seals were sighted during aerial surveys off the Washington coast from 2004 through 2008 (Oleson et al., 2009). Sightings occurred an average of 59 km off the coast, with most seals sighted approximately 70 km from shore and near the 1,000 m isobath. The elephant seals were an average of 13 km west of the shelf break (200 m isobath), indicating that they were foraging and migrating off the continental shelf. While migrating adult elephant seals tend to stay offshore, juveniles and sub-adults have been seen closer to shore along the coasts of Oregon, Washington, and British Columbia (Condit & Le Boeuf, 1984; Stewart & Huber, 1993). The U.S. Geological Survey conducted seabird and marine mammal surveys off the coasts of Washington, Oregon, and Northern California in winter, summer, and fall from 2011 to 2012 (Adams et al., 2014). Observers sighted northern elephant seals 31 times (33 individuals), and sightings were distributed fairly evenly across strata ranging from depths of 0 to 2,000 m. Sightings were also uniformly distributed over all three seasons (Adams et al., 2014).

Inland Waters. Jeffries (2014) observed one to three juvenile elephant seals during surveys from April to November 2013 at haulout sites in the eastern end of the Strait of Juan de Fuca. The elephant seals were hauled out with harbor seals, and the sightings were distributed evenly over the survey period. A few individuals have been seen hauled out on beaches at Destruction Island, Protection Island, and Smith and Minor islands as well as Dungeness Spit (Jeffries et al., 2000). Individuals have also been seen hauled out on Race Rocks on the Canadian side of the Strait of Juan de Fuca. Solitary individuals may occasionally be seen farther inland than the Strait of Juan de Fuca, but substantial numbers of northern elephant seals are not expected to occur in Hood Canal or Puget Sound (DeLong & Jeffries, 2017). No regular haulout sites occur in Puget Sound, however, individual elephant seals occasionally haul out for two to four weeks to molt, usually during spring and summer, and typically on sandy beaches (Calambokidis & Baird, 1994). These animals are typically yearlings or sub-adults, and their haulout locations are unpredictable. The National Stranding Network database reported one male subadult elephant seal hauled out to molt at Manchester Fuel Depot in February 2004. Rat Island across the bay from the Port Townsend ferry terminal is occasionally used by juvenile elephant seals. Most reported haulout sites are in the Strait of Juan de Fuca, and the occurrence of elephant seals in the Puget Sound region would occur infrequently and most likely during the molting season.

Migration routes of satellite-tagged adult elephant seals all remained offshore (Abrahms et al., 2017; Le Boeuf et al., 2000; Robinson et al., 2012; Simmons et al., 2007), so considering that and the other information presented above, the Navy has assumed those few individuals observed hauled out in Inland Waters are juveniles and constitute an extremely small fraction of the northern elephant seal population.

Western Behm Canal, Alaska. A small number of male northern elephant seals may be present in Behm Canal for brief periods in fall (September to November) and spring (April to June). The deep water (approximately 600 m) in the canal is consistent with foraging habitat preferred by male elephant seals (DeLong & Jeffries, 2017). The elephant seals would not be expected to haul out while in Behm Canal. Le Boeuf et al. (2000) noted that 2 out of 20 (10 percent) tagged males used inland waters in southeast Alaska and Puget Sound. This ratio was used to estimate the abundance of male elephant seals potentially entering Behm Canal to forage, which as noted above is approximately 8,000 and is the number of animals assumed present in the analysis undertaken for this Supplemental.

Mustelidae

3.4.1.37 Northern Sea Otter (*Enhydra lutris kenyoni*)

3.4.1.37.1 Status and Management

Sea otters that occur along the coast of Washington are the result of reintroduction efforts of the northern sea otter (from Amchitka Island, Alaska) in 1969 and 1970 (Lance et al., 2004; Sato, 2018) are not listed as threatened or endangered under the ESA (Carretta et al., 2017c). The Washington stock is not classified as strategic because the population is growing and is not listed as depleted under the MMPA. The State of Washington developed a recovery plan to address the northern sea otter population in its waters (Lance et al., 2004; Sato, 2018). The U.S. Fish and Wildlife Service recognizes five northern sea otter stocks in U.S. waters under MMPA guidelines. There is a single stock in Washington waters (the northern sea otter [*Enhydra lutris kenyoni*]); and a single stock in California (the southern sea otter [*Enhydra lutris nereis*]). Only the Washington stock of sea otter occurs in the Study Area (Carretta et al., 2017c). There are three sea otter stocks in Alaska that are designated Southeast, Southcentral, and Southwest stocks. The boundaries of the Southcentral and the Southwest stocks are far from the Study Area and the Southeast Alaska stock is not likely to be present in the western Behm

Canal portion of the Study Area since they routinely only inhabit the Pacific Coast in southeast Alaska (Muto et al., 2018a; Muto et al., 2018b).

3.4.1.37.2 Abundance

The Washington population of sea otters has continued to increase since the initial reintroduction of 59 individuals in 1969. Population growth has averaged 9.5 percent per year since 1989, and the numbers of sea otters have increased with a three-year (2015 through 2017) running average estimated to total 1,753 individuals (Sato, 2018).

3.4.1.37.3 Distribution

Sea otters occupy nearly all coastal marine habitats, from bays and estuaries to rocky shores exposed to oceanic swells (Calambokidis et al., 1987; Fisheries and Oceans Canada, 2015b; Jeffries et al., 2016a; Riedman & Estes, 1990; U.S. Geological Survey, 2014; Yeates et al., 2007). Although sea otters prefer rocky shoreline and relatively shallow water (up to 40 m deep) with kelp beds, this is not an essential habitat requirement, and some individuals use soft-sediment areas where kelp is absent (Laidre et al., 2009; Muto et al., 2017; Riedman & Estes, 1990; Sato, 2018). In the Pacific Northwest, sea otters generally occupy coastal areas exposed to the open Pacific Ocean along shorelines characterized by jagged coastlines with clusters of small islets and reefs and shallow variable depths (Fisheries and Oceans Canada, 2015b; Nichol et al., 2015). Sea otters seldom range more than 2 km from shore, because they are benthic foragers and limited by their ability to dive to the seafloor; although some individuals, particularly juvenile males, travel farther offshore (Calambokidis et al., 1987; Laidre et al., 2009; Muto et al., 2017; Riedman & Estes, 1990). In Alaska, home territories are relatively small, ranging from 4 to 11 square kilometers for males and from a few to 24 square kilometers for adult females (Muto et al., 2017). In Washington, observations have indicated female sea otters were most frequently found resting and foraging in shallow waters between 0 and 10 m in depth, whereas males rested and foraged farther offshore where water depths were between 10 and 30 m (Laidre et al., 2009). Sea otters move seasonally to areas where there is food or where sheltered water offers protection from storms and rough seas (Laidre et al., 2009; Lance et al., 2004; Riedman & Estes, 1990; Sato, 2018). Results from 75 sea otters radiotagged off Washington indicated adult males had the largest home ranges along the coastline (50 ± 9 km), adult females had significantly smaller home ranges (38 ± 10 km), and subadult females used the least area of coastline (24 ± 9 km) for a home range. In Washington waters, otters range along a roughly 130-km stretch of the coast from Point Grenville in the south to Pillar Point on the Strait of Juan de Fuca year round (Jeffries et al., 2016a; Laidre et al., 2009; Lance et al., 2004; Sato, 2018). In recent years, the majority of the sea otter population in Washington (approximately 75 percent) has been present south of LaPush (Jeffries et al., 2016a; Sato, 2018).

Offshore. Aerial and ground sea otter surveys conducted along the Washington coast in June/July since 1989 have included the area extending from the mouth of the Columbia River into the Strait of Juan de Fuca to approximately Port Angeles (Jeffries & Jameson, 2014; Jeffries et al., 2016a, 2016b; Sato, 2018), so the distribution of sea otters has been well established. Given that sea otters seldom range farther than 2 km from shore, prefer to forage in water less than 40 m in depth, and are not known to migrate, they are unlikely to co-occur in the offshore portion of the Study Area contemporaneously with Navy training and testing activities.

Inland Waters. There are confirmed sightings and movements of tagged sea otters in the eastern Strait of Juan de Fuca, around the San Juan Islands, and within the Puget Sound near Olympia (Calambokidis et al., 1987; Jeffries & Jameson, 2014; Lance et al., 2004; Sato, 2018). Sea otter surveys have not covered the Inland Waters east of Tongue Point; however, there have been confirmed sightings of scattered individuals in the San Juan Islands and Puget Sound. One sea otter was sighted about 9 km inland up McAllister Creek in south Puget Sound (Jeffries & Allen, 2001). More recently, a lone sea otter was reported in 2015 in south Puget Sound. No sea otter were sighted in the Strait of Juan de Fuca during the 2015 and 2016 survey, but a small group was sighted in the 2013 survey between Cape Flattery and Pillar Point (Jeffries & Jameson, 2014; Jeffries et al., 2016a, 2016b). Most of these sightings have been of one or two animals, with no sightings of multiple animals reported (Jeffries & Jameson, 2014; Sato, 2018). For purposes of the analysis in this Supplemental, sea otters in the Inland Waters area are unlikely to co-occur with Navy training and testing activities.

Western Behm Canal, Alaska. Based on surveys conducted in 2003, there are common sightings in southeast Alaska along the western portions of Prince of Wales Islands and throughout the Chatham and Summer Strait. The closest sea otter populations, as determined by these surveys, are along the Pacific coast approximately 32–43 NM west of the Behm Canal SEAFAC area (Esslinger & Bodkin, 2009). As sea otters seldom range more than 2 km from shore and are not known to migrate, and given they are only presently known to occupy distinct spots along the Pacific Coast, they are unlikely to occur in the Behm Canal SEAFAC area where their presence would be considered extralimital.

3.4.2 Environmental Consequences

Under the Proposed Action for this Supplemental, there have been some modifications to the quantity and type of acoustic stressors under the two action alternatives. Because of new activities being proposed, two new stressors would be introduced that are analyzed for their potential effects on marine species: high-energy lasers (as an Energy stressor), as detailed in Section 3.0.3.3.2.2 (High-Energy Lasers), and biodegradable polymer (as an Entanglement stressor), as detailed in Section 3.0.3.5.3 (Biodegradable Polymer).

In the 2015 NWTT Final EIS/OEIS (U.S. Department of the Navy, 2015a), the Navy considered all potential stressors associated with ongoing training and testing in the Study Area and then analyzed their potential impacts on marine mammals in that area. In addition, NMFS also reviewed the Navy's analysis and detailed their findings with regard to requirements under the MMPA (National Oceanic and Atmospheric Administration, 2015b) and pursuant to the ESA for the Navy's Proposed Action in the Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2014).

In general, there have been no substantial changes to the overall conclusions reached regarding ESA-listed species or populations of marine mammals in the Study Area. Use of acoustic stressors (sonar and other transducers) and use of explosives have occurred since the 2015 completion of the NWTT Final EIS/OEIS Record of Decision, MMPA Authorization, and ESA Biological Opinion.

In this Supplemental, the Navy has reviewed the analysis of impacts from these ongoing activities and additionally analyzed the 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. The Navy has compiled, thoroughly reviewed, and incorporated, the best available emergent marine mammal science since 2015 that is relevant to the analysis of environmental impacts from the proposed activities as presented in 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 2015 NWTT Final EIS/OEIS analysis. Where there has been substantive change in the action, science, or regulations, the information provided in this analysis will supplement the 2015 NWTT Final EIS/OEIS to support environmental compliance with applicable environmental statutes for marine mammals (the MMPA and ESA) for the foreseeable future beginning in 2020.

The 2015 NWTT Final EIS/OEIS considered training and testing activities proposed to occur in the Study Area that may have the potential to result in the MMPA defined take of marine mammals or to affect ESA-listed marine mammal species. The stressors applicable to marine mammals in the Study Area for this Supplemental include the two new stressors and the same stressors considered in the 2015 NWTT Final EIS/OEIS:

- **Acoustic** (sonar and other transducers, vessel noise, aircraft noise, weapons noise)
- **Explosives** (in-air explosions, in-water explosions)
- **Energy** (in-water electromagnetic devices, high-energy lasers, radar)
- **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** (impacts on habitat, impacts on prey availability)

This section of this Supplemental evaluates how and to what degree potential impacts on marine mammals from stressors described in Section 3.0 (Introduction) may have changed since the analysis presented in the 2015 NWTT Final EIS/OEIS was completed. Tables 2.5-1, 2.5-2, and 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 described in the 2015 NWTT Final EIS/OEIS so that the proposed levels of training and testing under this Supplemental can be easily compared. The analysis in this Supplemental includes consideration of the Navy's standard operating procedures and mitigation that the Navy will implement to avoid or reduce potential impacts on marine mammals from acoustic, explosive, and physical disturbance and strike stressors. Mitigation for marine mammals will be coordinated with NMFS through the MMPA and ESA consultation processes, and is detailed in Chapter 5 (Mitigation) and Appendix K (Geographic Mitigation Assessment) of this Supplemental.

In 2015, the Navy and NMFS determined that within the Study Area only acoustic stressors and explosive stressors could potentially result in harassment and/or the incidental taking of marine mammals from Navy training and testing activities (National Oceanic and Atmospheric Administration, 2015b) and that none of the other stressors would result in significant adverse impacts or jeopardize the continued existence of any ESA-listed marine mammals (National Marine Fisheries Service, 2014).

As detailed in Chapter 2 (Description of Proposed Action and Alternatives) of this Supplemental, there are no changes to proposed training and testing activities that would necessitate re-analysis of any of the activities associated with those stressors for which NMFS has previously determined did not rise to the level of a take under the MMPA. As presented in Section 3.0 (Introduction), since completion of the NWTT Final EIS/OEIS in 2015 there have been refinements made in the modeling of potential impacts from sonar and other transducers and in-water explosives. These changes have been incorporated into the re-analysis of acoustic and explosive stressors presented in this Supplemental. In addition to the new effects criteria, weighting functions, and thresholds for multiple species, new information for marine mammals includes the integration of new marine mammal density data based on new predictive habitat modeling (Becker et al., 2017; Hazen et al., 2016; Mannocci et al., 2017; U.S. Department of the Navy, 2019), new survey data and analyses (Barlow, 2016; Dahlheim et al., 2015; Houghton et al., 2015a; Jefferson et al., 2016; Jefferson et al., 2017; Smultea et al., 2017), tagging data (Calambokidis et al., 2017a; DeLong et al., 2017; Hanson et al., 2017; Mate et al., 2015a; Mate et al., 2017), and acoustic monitoring data (Rice et al., 2017; Trickey et al., 2015; Wiggins et al., 2017).

There have been no changes to the NWTT Study Area, existing conditions, species life histories, or any new information available since 2015 that the Navy believes would otherwise substantively change the conclusions[4] presented in the 2015 NWTT Final EIS/OEIS. What is new since 2015 are refinements to the Navy Acoustic Effects Model. This Supplemental, therefore, focuses on a re-analysis of potential impacts on marine mammals from acoustic stressors involving use of sonar and other transducers and the use of in-water explosives. The following paragraphs provide details on refinements to the Navy's acoustic modeling since 2015. Most important is the information found in Section 3.4.3.4 (Summary of Monitoring and Observations During Navy Activities Since 2015) regarding scientific data gathered on marine mammals in locations where Navy has been training and testing, which serves as an empirical basis for the marine mammal impact assessment presented in this Supplemental.

New Effects Criteria, Weighting Functions, and Thresholds

A detailed description of the Phase III acoustic and explosive criteria and threshold development regarding marine mammals is included in the supporting technical report *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (U.S. Department of the Navy, 2017a). In summary, the update to the acoustic impact criteria has largely been predicated on a series of behavioral studies (often sponsored by the U.S. Navy), which have led to a new understanding of how some marine mammals react to sonar and other sound sources (e.g., (Baird et al., 2017; Crowell et al., 2016; Curé et al., 2016; Dunlop et al., 2016; Friedlaender et al., 2016; Graham et al., 2017; Harris et al., 2018; Henderson et al., 2015a; Kvadsheim et al., 2017; Pirotta et al., 2016; Sabet et al., 2016; Sivle et al., 2015; Southall et al., 2016; Visser et al., 2016)). As a result of that new understanding, the previous behavioral response functions for estimating alterations in behavior have been refined to accurately reflect studies undertaken both in the ocean and in well controlled studies done in laboratory settings. Additional studies have also provided information allowing for the refinement of the previous auditory weighting functions (Finneran et al., 2015; Houser et al., 2016; Houser et al., 2017; Kastelein et al., 2015b; Kastelein et al., 2015d; Kastelein et al., 2015e; Kastelein et al., 2016; Kastelein et al., 2017c; Mulsow et al., 2015) and has led to a new methodology to predict these functions for each hearing group along with the accompanying hearing loss thresholds. These criteria for estimating hearing loss in marine mammals was largely adopted by NMFS for species within their purview (81 FR 51693), and is used in the analysis for impacts on marine mammals presented in this Supplemental.

The majority of the changes in the results of the impact analyses presented in this Supplemental pursuant to requirements of the MMPA and ESA arise from changes in the model input; specifically, more accurate marine mammal density data, revised acoustic impact criteria, and revised computer

[4] Conclusions in this regard refer to the findings reached by Navy and NMFS on the two previous sets of analyses for the continuation of training and testing in Study Area and as recently re-considered by NMFS for many of the same actions elsewhere (FR 83[247]:66846-67031; December 27, 2018). Under the MMPA, the Navy and NMFS have found that there will not be negligible impacts to populations of marine mammals. Under ESA, the actions may affect certain ESA-listed marine mammal species, but are not likely to jeopardize the continued existence of those species.

modeling of predicted effects on marine mammals. Assessment of likely long-term consequences to populations of marine mammals are provided by empirical data gathered from areas where Navy routinely trains and tests. Substantial Navy-funded marine mammal survey data, monitoring data, and scientific research have been completed since 2006. These empirical data are beginning to provide insight on the qualitative analysis of the actual (as opposed to model predicted numerical) impact on marine mammals resulting from Navy training and testing activities based on observations of marine mammals generally in and around Navy Range Complexes. The following subsections of this Supplemental presents the potential environmental consequences based on an updated modeling methodology and the scientific observations and investigations made over 12 years of monitoring of Navy training and testing activities in the Pacific and elsewhere that are representative of the type of activities proposed in this Supplemental.

3.4.2.1 Acoustic Stressors

Assessing whether a sound may disturb or injure a marine mammal involves understanding the characteristics of the acoustic sources, the marine mammals that may be present in the vicinity of the sources, and the effects that sound may have on the physiology and behavior of those marine mammals. Although it is known that sound is important for marine mammal communication, navigation, and foraging (National Research Council, 2003, 2005), there are many unknowns in assessing impacts such as the potential interaction of different effects and the significance of responses by marine mammals to sound exposures (Nowacek et al., 2007; Southall et al., 2007). Many other factors besides just the received level of sound may affect an animal's reaction such as the duration of the sound-producing activity, the animal's physical condition, prior experience with the sound, activity at the time of exposure (e.g., feeding, traveling, resting), the context of the exposure (e.g., in a semi-enclosed bay vs open ocean), and proximity to the source of the sound.

The ways in which an acoustic exposure could result in immediate effects or long-term consequences for an animal are explained in Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities). The following Background section discusses what is currently known about acoustic effects to marine mammals. These effects could hypothetically extend from physical injury or trauma to a behavioral or stress response that may or may not be detectable. Injury (physical trauma) can occur to organs or tissues of an animal (Section 3.4.2.1.1.1, Injury). Hearing Loss (Section 3.4.2.1.1.2, Hearing Loss) is a noise-induced decrease in hearing sensitivity, which can be either temporary or permanent. Physiological stress (Section 3.4.2.1.1.3, Physiological Stress) is an adaptive process that helps an animal cope with changing conditions; however, too much stress can result in physiological effects. Masking (Section 3.4.2.1.1.4, Masking) can occur when the perception of a biologically important sound (i.e., signal) is interfered with by a second sound (i.e., noise). Behavioral response (Section 3.4.2.1.1.5, Behavioral Reactions) ranges from brief distractions to avoidance of a sound source to prolonged flight. Extreme behavioral or physiological responses can lead to stranding (Section 3.4.2.1.1.6, Stranding). Long-term consequences (Section 3.4.2.1.1.7, Long-Term Consequences) are those impacts, or accumulation of impacts, that can result in decreases in individual fitness or population changes. To avoid or reduce potential impacts to the maximum extent practicable, the Navy will implement marine mammal mitigation measures during applicable training and testing activities that generate acoustic stressors (see Chapter 5, Mitigation, and Appendix K, Geographic Mitigation Assessment).

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, marine mammal densities, and revisions to the Navy Acoustic Effects Model, the analysis provided in Section 3.4.2.1.2 (Impacts from Sonar and Other Transducers) of this Supplemental supplants the 2015 NWTT Final EIS/OEIS for marine mammals and changes estimated impacts for some species since the 2015 NWTT Final EIS/OEIS.

3.4.2.1.1 Background

3.4.2.1.1.1 Injury

Injury (i.e., physical trauma) refers to the effects on the tissues or organs of an animal due to some mechanical cause. Injury due to exposure to sound, such as sonar (and excluding blast waves associated with explosions), is discussed below. Exposure to moderate- to low-level sound sources, including vessel and aircraft noise, would not cause injury. Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities) provides additional information on injury (i.e., physical trauma) and the framework used to analyze this potential impact.

Several mechanisms of acoustically induced tissue damage (non-auditory) have been proposed and are discussed below.

Injury due to Sonar-Induced Acoustic Resonance

An object exposed to its resonant frequency will tend to amplify its vibration at that frequency, a phenomenon called acoustic resonance. Acoustic resonance has been proposed as a mechanism by which a sonar or sources with similar operating characteristics could damage tissues of marine mammals. In 2002, NMFS convened a panel of government and private scientists to investigate the potential for acoustic resonance to occur in marine mammals (National Oceanic and Atmospheric Administration, 2002). They modeled and evaluated the likelihood that Navy mid-frequency sonar caused resonance effects in beaked whales that eventually led to their stranding. The conclusions of the group were that resonance in air-filled structures was not likely to have caused the Bahamas stranding in 2000. The frequency at which resonance was predicted to occur in the animals' lungs was 50 Hz, well below the frequencies used by the mid-frequency sonar systems associated with the Bahamas event. Furthermore, air cavity vibrations, even at resonant frequencies, were not considered to be of sufficient amplitude to cause tissue damage, even under the unrealistic scenario in which air volumes would be undamped (unrestrained) by surrounding tissues and the amplitude of the resonant response would be greatest. These same conclusions would apply to other training and testing activities involving acoustic sources. Therefore, the Navy concludes that acoustic resonance would not occur under real training conditions and testing activities. The potential impact of acoustic resonance is not considered further in this analysis.

Nitrogen Decompression

Marine mammals mitigate nitrogen gas accumulation in their blood and other tissues, caused by gas exchange from the lungs under conditions of increased hydrostatic pressure during diving, through anatomical, behavioral, and physiological adaptations (Hooker et al., 2012).

Although not an injury caused by the interaction of sound with tissues, variations in marine mammal diving behavior or avoidance responses in response to sound exposure have been hypothesized to result in the off-gassing of nitrogen super-saturated tissues, possibly to the point of deleterious vascular and tissue bubble formation (Hooker et al., 2012; Jepson et al., 2003; Saunders et al., 2008) with resulting symptoms similar to decompression sickness (also known as "the bends"). Whether marine mammals can produce deleterious gas emboli has been under debate in the scientific community (Hooker et al., 2012; Saunders et al., 2008), although various lines of evidence have been presented in support of the phenomenon. For example:

1. Analyses of bycaught animals demonstrated that nitrogen bubble formation occurs in drowned animals when brought to the surface (Bernaldo de Quiros et al., 2013b; Moore et al., 2009). Since gas exchange with the lungs no longer occurs once drowned, tissues become supersaturated with nitrogen due to the reduction in hydrostatic pressure near the surface, thus demonstrating that the phenomenon of bubble formation is at least physically possible.
2. The presence of osteonecrosis (bone death due to reduced blood flow) in deep-diving sperm whales has been offered as evidence of impacts due to chronic nitrogen supersaturation and a lifetime of decompression insults (Moore & Early, 2004).
3. Dennison et al. (2012) investigated dolphins stranded in 2009–2010 and, using ultrasound, identified gas bubbles in kidneys of 21 of the 22 live-stranded dolphins and in the liver of two of the 22. The authors postulated that stranded animals were unable to recompress by diving, and thus retained bubbles that would have otherwise re-absorbed in animals that continued to dive. However, the researchers concluded that the minor bubble formation observed could be tolerated since the majority of stranded dolphins released did not re-strand.
4. A fat embolic syndrome (out of place fat particles, typically in the bloodstream) was identified by Fernández et al. (2005) coincident with the identification of bubble emboli in stranded beaked whales. The fat embolic syndrome was the first pathology of this type identified in marine mammals and was thought to possibly arise from the formation of bubbles in fat bodies, which subsequently resulted in the release of fat emboli into the blood stream.
5. Findings of gas and fat emboli in a few stranded Risso's dolphin, and in which sonar exposure was ruled out as a cause of stranding, suggested that other factors, in this case struggling with a prey item, might cause significant variations in dive behavior such that emboli formation could occur (Fernandez et al., 2017).

Only one study has attempted to find vascular bubbles in a freely diving marine mammal (Houser et al., 2009). In that study, no vascular bubbles were imaged by ultrasound in a bottlenose dolphin that repeatedly dove to a 100 m depth and maintained a dive profile meant to maximize nitrogen gas uptake. Thus, although lines of evidence suggest that marine mammals manage excessive nitrogen gas loads, the majority of the evidence for the formation of bubble and fat emboli come from stranded animals in which physiological compromise due to the stranding event is a potential confound.

Researchers have examined how dive behavior affects tissue supersaturation conditions that could put an animal at risk of gas bubble embolism. An early hypothesis was that if exposure to a startling sound elicits a rapid ascent to the surface, tissue gas saturation sufficient for the evolution of nitrogen bubbles might result (Fernandez et al., 2005; Jepson et al., 2003). However, modeling suggested that even unrealistically rapid rates of ascent from normal dive behaviors are unlikely to result in supersaturation to the extent that bubble formation would be expected in beaked whales (Zimmer & Tyack, 2007). Instead, emboli observed in animals exposed to mid-frequency active sonar (Fernandez et al., 2005; Jepson et al., 2003) could stem from a behavioral response that involves repeated dives, shallower than the depth of lung collapse (Aguilar de Soto et al., 2006; Hooker et al., 2012; Tyack et al., 2006; Zimmer & Tyack, 2007). Longer times spent diving at mid-depths above lung collapse would allow gas exchange from the lungs to continue under high hydrostatic pressure conditions, increasing potential for supersaturation; below the depth of lung collapse, gas exchange from the lungs to the blood would likely not occur (Fahlman et al., 2014b). (2016). To estimate risk of decompression sickness, Kvadsheim et al. (2012) modeled gas exchange in the tissues of sperm, pilot, killer, and beaked whales based on actual dive behavior during exposure to sonar in the wild. Results predicted that venous supersaturation would be within the normal range for these species, which would presumably have naturally higher levels of nitrogen gas loading. Nevertheless, deep-diving whales, such as beaked whales, have also been predicted to have higher nitrogen gas loads in body tissues for certain modeled changes in dive behavior, which might make them more susceptible to decompression sickness (Fahlman et al., 2014b; Fernandez et al., 2005; Hooker et al., 2012; Jepson et al., 2003).

Modeling has also suggested that the long, deep dives performed regularly by beaked whales over a lifetime could result in the saturation of long-halftime tissues (i.e., tissues that take longer to give off nitrogen, e.g., fat and bone lipid) to the point that they are supersaturated when the animals are at the surface (Fahlman et al., 2014b; Hooker et al., 2009; Saunders et al., 2008). Proposed adaptations for prevention of bubble formation under conditions of persistent tissue saturation have been suggested (Fahlman et al., 2006; Hooker et al., 2009), and because of the time it takes for tissue offloading, it is feasible that long-halftime tissues are not a concern for decompression insults under normal ventilation or dive (recompression) conditions. However, for beaked whale strandings associated with sonar use, one proposed hypothesis is that observed bubble formation may be caused by compromised blood flow due to stranding-related cardiovascular collapse. This would reduce the ability to remove nitrogen from tissues following rapid sonar-induced stranding and could preclude typical management of nitrogen in supersaturated, long-halftime tissues (Houser et al., 2009).

Predictive modeling conducted to date has been performed with many unknowns about the respiratory physiology of deep-diving breath-hold animals. For example, as hypothesized by Garcia Parraga et al. (2018), mechanisms may exist that allow marine mammals to create a pulmonary shunt without the need for hydrostatic pressure-induced lung collapse, i.e. by varying perfusion to the lung independent of lung collapse and degree of ventilation. If such a mechanism exists, then assumptions in prior gas models require reconsideration, the degree of nitrogen gas accumulation associated with dive profiles needs to be re-evaluated, and behavioral responses potentially leading to a destabilization of the relationship between pulmonary ventilation and perfusion should be considered. Costidis and Rommel (2016) suggested that gas exchange may continue to occur across the tissues of air-filled sinuses in deep-diving odontocetes below the depth of lung collapse, if hydrostatic pressures are high enough to drive gas exchange across into non-capillary veins. If feasible, kinetic gas models would need to consider an additional gas exchange route that might be functional at great depths within the odontocetes. Other adaptations potentially mitigating and defending against deleterious nitrogen gas emboli have been proposed (Blix et al., 2013). Researchers have also considered the accumulation of carbon dioxide produced during periods of high activity by an animal, theorizing that accumulating carbon dioxide, which cannot be removed by gas exchange below the depth of lung collapse, might also facilitate the formation of bubbles in nitrogen-saturated tissues (Bernaldo de Quiros et al., 2012; Fahlman et al., 2014b). In all of these cases, the hypotheses have received little in the way of experimentation to evaluate whether or not they are supported, thus leaving many unknowns as to the predictive accuracy of modeling efforts.

The appearance of extensive bubble and fat emboli in beaked whales was unique to a small number of strandings associated with certain high-intensity sonar events; the phenomenon has not been observed to the same degree in other stranded marine mammals, including other beaked whale strandings not associated with sonar use. It is uncertain as to whether there is some more easily-triggered mechanism for this phenomenon specific to beaked whales or whether the phenomenon occurs only following rapidly occurring stranding events (i.e., when whales are not capable of sufficiently decompressing). Nevertheless, based on the rarity of observations of bubble pathology, the potential for nitrogen decompression sickness, or "the bends," as a result of exposure to Navy sound sources is considered discountable.

Acoustically Induced Bubble Formation due to Sonars

A suggested cause of injury to marine mammals is rectified diffusion (Crum & Mao, 1996), the process of increasing the size of a microscopic gas bubble by exposing it to a sound field. The process is dependent upon a number of factors, including the sound pressure level (SPL) and duration. Under this hypothesis, microscopic bubbles assumed to exist in the tissues of marine mammals may experience one of three things: (1) bubbles grow to the extent they become emboli or cause localized tissue trauma, (2) bubbles develop to the extent that a complement immune response is triggered or the nervous tissue is subjected to enough localized pressure that pain or dysfunction occurs (a stress response without injury), or (3) the bubbles are cleared by the lung without negative consequence to the animal.

Rectified diffusion is facilitated if the environment in which the ensonified bubbles exist is supersaturated with gas. As discussed above, repetitive diving by marine mammals can cause the blood and some tissues to become supersaturated (Ridgway & Howard, 1979). The dive patterns of some marine mammals (e.g., beaked whales) are predicted to induce greater supersaturation (Houser et al., 2001). If rectified diffusion were possible in marine mammals exposed to high-level sound, conditions of tissue supersaturation could theoretically speed the rate and increase the size of bubble growth. Subsequent effects due to tissue trauma and emboli would presumably mirror those observed in humans suffering from decompression sickness.

It is unlikely that the short duration of sonar pulses would be long enough to drive bubble growth to any substantial size, if such a phenomenon occurs. However, an alternative but related hypothesis has also been suggested: stable microbubbles could be destabilized by high-level sound exposures such that bubble growth then occurs through static diffusion of gas out of supersaturated tissues. In such a scenario, the marine mammal would need to be in a gas-supersaturated state for a long enough time for bubbles to become a problematic size. The phenomena of bubble growth due to a destabilizing exposure was shown by Crum et al. (2005) by exposing highly supersaturated ex vivo bovine tissues to a 37 kHz source at 214 dB re 1 µPa. Although bubble growth occurred under the extreme conditions created for the study, these conditions would not exist in the wild because the levels of tissue supersaturation in the study (as high as 400–700 percent) are substantially higher than model predictions for marine mammals (Fahlman et al., 2009; Fahlman et al., 2014b; Houser et al., 2001; Saunders et al., 2008), and such high exposure levels would only occur in very close proximity to the most powerful sonars. For these reasons, it is improbable that this mechanism is responsible for stranding events or traumas associated with beaked whale strandings.

There has been considerable disagreement among scientists as to the likelihood of this phenomenon (Evans & Miller, 2003; Piantadosi & Thalmann, 2004). Although it has been argued that traumas from beaked whale strandings are consistent with gas emboli and bubble-induced tissue separations (Fernandez et al., 2005; Jepson et al., 2003), nitrogen bubble formation as the cause of the traumas has not been verified. The presence of bubbles postmortem, particularly after decompression, is not necessarily indicative of bubble pathology (Bernaldo de Quiros et al., 2012; Bernaldo de Quiros et al., 2013a; Bernaldo de Quiros et al., 2013b; Dennison et al., 2012; Moore et al., 2009), and other mechanisms by which bubble emboli might occur once animals are rapidly stranded (e.g., cardiovascular collapse preventing tissue off-gassing) have not been ruled out (Houser et al., 2009).

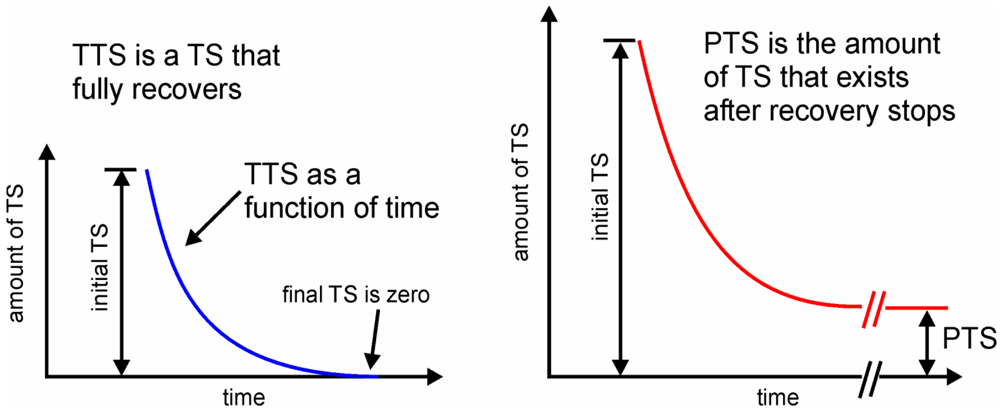
3.4.2.1.1.2 Hearing Loss

Exposure to intense sound may result in noise-induced hearing loss that persists after cessation of the noise exposure. The specific amount of hearing loss, and whether the loss is temporary or permanent, depend on factors such as the exposure frequency, received sound pressure level, temporal pattern, and duration.

Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities) provides additional information on hearing loss and the framework used to analyze this potential impact. Hearing loss has only been studied in a few species of marine mammals, although hearing studies with terrestrial mammals are also informative.

Hearing loss is typically quantified in terms of threshold shift (TS)—the amount (in dB) that hearing thresholds at one or more specified frequencies are elevated, compared to their pre-exposure values, at some specific time after the noise exposure. The amount of TS measured usually decreases with increasing recovery time—the amount of time that has elapsed since a noise exposure. If the TS eventually returns to zero (i.e., the hearing threshold returns to the pre-exposure value), the threshold shift is called a temporary threshold shift (TTS). If the TS does not completely recover (the threshold remains elevated compared to the pre-exposure value), the remaining TS is called a permanent threshold shift (PTS). Figure 3.4-2 shows two hypothetical TSs: one that completely recovers, a TTS, and one that does not completely recover, leaving some PTS. By definition, TTS is a function of the recovery time, therefore comparing the severity of noise exposures based on the amount of induced TTS can only be done if the recovery times are also taken into account. For example, a 20-dB TTS measured 24 hours post-exposure indicates a more hazardous exposure than one producing 20 dB of TTS measured only two minutes after exposure; if the TTS is 20 dB after 24 hours, the TTS measured after two minutes would have likely been much higher. Conversely, if 20 dB of TTS was measured after two minutes, the TTS measured after 24 hours would likely have been much smaller.

Studies have revealed that intense noise exposures may also cause auditory system injury that does not result in PTS (i.e., hearing thresholds return to normal after the exposure, but there is injury nonetheless). Kujawa and Liberman (2009) found that noise exposures sufficient to produce a TTS of 40 dB, measured 24 hours post-exposure using electro-physiological methods, resulted in acute loss of nerve terminals and delayed degeneration of the cochlear nerve in mice. Lin et al. (2011) found a similar result in guinea pigs, that a TTS in auditory evoked potential of up to approximately 50 dB, measured 24 hours post-exposure, resulted in neural degeneration. These studies demonstrate that PTS should not be used as the sole indicator of auditory injury, since exposures producing high levels of TTS (40 to 50 dB measured 24 hours after exposure) — but no PTS — may result in auditory injury.



Notes: TTS = Temporary Threshold Shift, TS = Threshold Shift, PTS = Permanent Threshold Shift

Figure 3.4-2: Two Hypothetical Threshold Shifts

There are no simple functional relationships between TTS and the occurrence of PTS or other auditory injury (e.g., neural degeneration). However, TTS and PTS are, by definition, mutually exclusive: an exposure that produces TTS cannot also produce PTS in the same individual; conversely, if an initial threshold shift only partially recovers, resulting in some amount of PTS, the difference between the initial TS and the PTS is not called TTS. As TTS increases, the likelihood that additional exposure SPL or duration will result in PTS or other injury also increases. Exposure thresholds for the occurrence of PTS or other auditory injury can therefore be defined based on a specific amount of TTS (i.e., although an exposure has been shown to produce only TTS, we assume that any additional exposure may result in some PTS or other injury). The specific upper limit of TTS is based on experimental data showing amounts of TTS that have not resulted in PTS or injury. In other words, we do not need to know the exact functional relationship between TTS and PTS or other injury, we only need to know the upper limit for TTS before some PTS or injury is possible.

A variety of human and terrestrial mammal data indicate that threshold shifts up to 40 to 50 dB may be induced without PTS, and that 40 dB is a reasonable upper limit for allowable threshold shift to prevent PTS (e.g., Kryter et al., 1965; Miller et al., 1963; Ward et al., 1958; Ward et al., 1959; Ward, 1960). It is reasonable to assume the same relationship would hold for marine mammals, since there are many similarities between the inner ears of marine and terrestrial mammals, and experiments with marine mammals have revealed similarities to terrestrial mammals for features such as TTS, age-related hearing loss, drug-induced hearing loss, masking, and frequency selectivity (Finneran et al., 2005a; Finneran, 2015; Ketten, 2000). Therefore, we assume that sound exposures sufficient to produce 40 dB of TTS measured approximately four minutes after exposure represent the limit of a non-injurious exposure (i.e., higher level exposures have the potential to cause auditory injury). Exposures sufficient to produce a TTS of 40 dB, measured approximately four minutes after exposure, therefore represent the threshold for auditory injury. The predicted injury could consist of either hair cell damage/loss resulting in PTS or other auditory injury, such as the delayed neural degeneration identified by Kujawa and Liberman (2009) and Lin et al. (2011) that may not result in PTS.

Numerous studies have directly examined noise-induced hearing loss in marine mammals (see Finneran, 2015). In these studies, hearing thresholds were measured in marine mammals before and after exposure to intense sounds. The difference between the pre-exposure and post-exposure thresholds was then used to determine the amount of TTS at various post-exposure times. The major findings from these studies include the following:

- The method used to test hearing may affect the resulting amount of measured TTS, with neurophysiological (i.e., auditory evoked potential) measures producing larger amounts of TTS compared to psychophysical (i.e., behavioral) measures (Finneran et al., 2007; Finneran, 2015).
- The amount of TTS varies with the hearing test frequency. As the exposure SPL increases, the frequency at which the maximum TTS occurs also increases (Kastelein et al., 2014b). For high level exposures, the maximum TTS typically occurs one-half to one octave above the exposure frequency (Finneran et al., 2007; Mooney et al., 2009a; Nachtigall et al., 2004; Popov et al., 2011; Popov et al., 2013; Schlundt et al., 2000). The overall spread of TTS from tonal exposures can therefore extend over a large frequency range (i.e., narrowband exposures can produce broadband [greater than one octave] TTS).
- The amount of TTS increases with exposure SPL and duration, and is correlated with sound exposure level (SEL), especially if the range of exposure durations is relatively small (Kastak et al., 2007; Kastelein et al., 2014b; Popov et al., 2014). As the exposure duration increases, however, the relationship between TTS and SEL begins to break down. Specifically, duration has a more significant effect on TTS than would be predicted on the basis of SEL alone (Finneran et al., 2010b; Kastak et al., 2005; Mooney et al., 2009a). This means if two exposures have the same SEL but different durations, the exposure with the longer duration (thus lower SPL) will tend to produce more TTS than the exposure with the higher SPL and shorter duration. In most acoustic impact assessments, the scenarios of interest involve shorter duration exposures than the marine mammal experimental data from which impact thresholds are derived; therefore, use of SEL tends to over-estimate the amount of TTS. Despite this, SEL continues to be used in many situations because it is relatively simple, more accurate than SPL alone, and lends itself easily to scenarios involving multiple exposures with different SPL.
- The amount of TTS depends on the exposure frequency. Sounds at low frequencies, well below the region of best sensitivity, are less hazardous than those at higher frequencies, near the region of best sensitivity (Finneran & Schlundt, 2013). The onset of TTS — defined as the exposure level necessary to produce 6 dB of TTS (i.e., clearly above the typical variation in threshold measurements) — also varies with exposure frequency. At low frequencies onset-TTS exposure levels are higher compared to those in the region of best sensitivity.
- TTS can accumulate across multiple exposures, but the resulting TTS will be less than the TTS from a single, continuous exposure with the same SEL (Finneran et al., 2010b; Kastelein et al., 2014b; Kastelein et al., 2015b; Mooney et al., 2009b). This means that TTS predictions based on the total, cumulative SEL will overestimate the amount of TTS from intermittent exposures such as sonars and impulsive sources.
- The amount of observed TTS tends to decrease with increasing time following the exposure; however, the relationship is not monotonic (i.e., increasing exposure does not always increase TTS). The time required for complete recovery of hearing depends on the magnitude of the initial shift; for relatively small shifts recovery may be complete in a few minutes, while large shifts (e.g., approximately 40 dB) may require several days for recovery. Under many circumstances TTS recovers linearly with the logarithm of time (Finneran et al., 2010a, 2010b; Finneran & Schlundt, 2013; Kastelein et al., 2012a; Kastelein et al., 2012b; Kastelein et al., 2013a; Kastelein et al., 2014b; Kastelein et al., 2014c; Kastelein et al., 2014d; Popov et al., 2011; Popov et al., 2013; Popov et al., 2014). This means that for each doubling of recovery time, the amount of TTS will decrease by the same amount (e.g., 6 dB recovery per doubling of time).

Several recent studies have shown that certain odontocete cetaceans (toothed whales) may learn to reduce their hearing sensitivity (presumably to protect their hearing) when warned of an impending intense sound exposure (Finneran, 2018; Nachtigall & Supin, 2013, 2014, 2015; Nachtigall et al., 2016a; Nachtigall et al., 2016b; Nachtigall et al., 2016c; Nachtigall et al., 2018). The effect was first demonstrated in a false killer whale (*Pseudorca crassidens*) by Nachtigall and Supin (2013). Subsequent experiments, using similar methods, demonstrated similar conditioned hearing changes in a bottlenose dolphin (Tursiops truncatus, Nachtigall & Supin, 2014; Nachtigall & Supin, 2015; Nachtigall et al., 2016c), beluga (Delphinapterus leucas, Nachtigall et al., 2016a), and harbor porpoises (Phocoena phocoena, Nachtigall et al., 2016b). Using slightly different methods, Finneran (2018) measured the time course and frequency patterns of conditioned hearing changes in two dolphins. Based on these experimental measurements with captive odontocetes, it is likely that wild odontocetes would also suppress their hearing if they could anticipate an impending, intense sound, or during a prolonged a exposure (even if not anticipated). Based on the time course and duration of the conditioned hearing reduction, odontocetes participating in some previous TTS experiments could have been protecting their hearing during exposures (Finneran, 2018). A better understanding of the mechanisms responsible for the observed hearing changes is needed for proper interpretation of some existing temporary threshold shift data, particularly for considering TTS due to short duration, unpredictable exposures. No modification of analysis of auditory impacts is currently suggested, as the Phase III auditory impact thresholds are based on best available data for both impulsive and non-impulsive exposures to marine mammals.

Due to the higher exposure levels or longer exposure durations required to induce hearing loss, only a few types of human-made sound sources have the potential to cause a threshold shift to a marine mammal in the wild. These include some sonars and other transducers and impulsive sound sources such as air guns and impact pile driving. Neither air guns nor impact pile driving will be used as part of training and testing activities being covered in this Supplement.

Threshold Shift due to Sonars and Other Transducers

TTS in mid-frequency cetaceans exposed to non-impulsive sound has been investigated in multiple studies (Finneran et al., 2005b; Finneran et al., 2010a; Finneran & Schlundt, 2013; Mooney et al., 2009a; Mooney et al., 2009b; Nachtigall et al., 2003; Nachtigall et al., 2004; Popov et al., 2013; Popov et al., 2014; Schlundt et al., 2000) from two species, bottlenose dolphins and beluga whales. Two high-frequency cetacean species have been studied for TTS due to non-impulsive sources: the harbor porpoise (Kastelein et al., 2013a; Kastelein et al., 2014b; Kastelein et al., 2014c; Kastelein et al., 2015b; Kastelein et al., 2017a) and the finless porpoise (*Neophocaena phocaenoides*) (Popov et al., 2011). TTS from non-impulsive sounds has also been investigated in three pinniped species: harbor seal (*Phoca vitulina*), California sea lion (*Zalophus californianus*), and Northern elephant seal (*Mirounga angustirostris*) (e.g., Kastak et al., 2005; Kastelein et al., 2012a). These data are reviewed in detail in Finneran (2015) as well as the *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* technical report (U.S. Department of the Navy, 2017a), and the major findings are summarized above.

Recently, Kastelein et al. (2017a) measured TTS in two harbor porpoises exposed to sequences of simulated tactical sonar sounds. Small amounts of TTS (5–6 dB) were observed after exposures with cumulative, weighted SELs of ~156–162 dB SEL, (~3–9 dB above the TTS onset threshold). The data are therefore consistent with the Phase III thresholds.

Popov et al. (2017) measured auditory evoked potentials (AEPs) at 45 kHz in a beluga before and after 10-minute exposure to half-octave noise centered at 32 kHz with SPL 170 dB re 1 µPa (weighted SEL = 198 dB re 1 µPa^{2}s). After exposure, AEP amplitude vs. stimulus SPL functions were shifted to the right, but returned to baseline values over time. Maximum threshold shift was 23–25 dB, 5 minutes post-exposure. For these exposures, Phase III criteria over-estimate the observed effects (i.e., Phase III criteria predict 40 dB of TTS for SEL of 198 dB re 1 µPa^{2}s).

Threshold Shift due to Impulsive Sound Sources

In addition to these studies, a number of impulsive noise exposure studies have been conducted without behaviorally measurable TTS of 6 dB or more. The results of these studies are either consistent with the Navy Phase III criteria and thresholds (e.g., exposure levels were below those predicted to cause TTS and TTS did not occur) or suggest that the Phase III thresholds over-estimate the potential for impact (e.g., exposure levels were above Navy Phase III TTS threshold, but TTS did not occur). The individual studies are summarized below:

Finneran et al. (2000) exposed dolphins and belugas to single impulses from an "explosion simulator" and Finneran et al. (2015) exposed three dolphins to sequences of 10 impulses from a seismic air gun (maximum cumulative SEL = 193 to 195 dB re 1 µPa^{2}s, peak SPL = 196 to 210 dB re 1 µPa) without measurable TTS. Finneran et al. (2003b) exposed two sea lions to single impulses from an arc-gap transducer with no measurable TTS (maximum unweighted SEL = 163 dB re 1 µPa^{2}s, peak SPL = 183 dB re 1 µPa).

Kastelein et al. (2015a) behaviorally measured mean TTS of 4 dB at 8 kHz and 2 dB at 4 kHz after a harbor porpoise was exposed to simulated impact pile driving sound. The cumulative SEL was approximately 180 dB re 1 µPa^{2}s (weighted SEL ~144 dB re 1 µPa^{2}s, 4 dB above the TTS onset threshold). Using similar, simulated pile driving noise, but varying total exposure duration from 15 to 360 min, Kastelein et al. (2016) found only small amounts of TTS (< 6 dB) in two harbor porpoises. The maximum weighted, cumulative SEL was 156 dB SEL (16 dB above Phase III threshold), but resulted in only ~5 dB of TTS.

Reichmuth et al. (2016) measured behavioral hearing thresholds in two spotted seals and two ringed seals before/after exposure to single air gun impulses and found no TTS. The maximum weighted SEL was ~156 dB re 1 uPa^{2}s (14 dB below TTS-onset) and the maximum p-p SPL was ~204 dB re 1 µPa (~8 dB below TTS onset).

Kastelein et al. (2017b) measured TTS in a harbor porpoise after exposure to multiple air gun impulses. Either a single or double air gun arrangement was used. Maximum exposure peak pressure was 194/199 dB re 1 µPa for single/double air guns. Maximum cumulative, weighted SEL was 127/130 dB re 1 µPa^{2}s. Maximum TTS occurred at 4 kHz and was 3 dB/4 dB for single/double air guns.

Kastelein et al. (2018a) measured TTS in two harbor seals after exposure to playbacks of impact pile-driving recordings. The maximum weighted cumulative SEL is estimated to be ~182 dB re 1 µPa^{2}s (~12 dB above Navy Phase III threshold). Maximum peak pressure is estimated to be 176 dB re 1 µPa, ~36 dB below the Navy Phase III threshold. Small amounts (4 dB maximum) of TTS were observed at 4 kHz after the maximum exposure. Use of Navy Phase III criteria and thresholds would have over-estimated measured effects.

3.4.2.1.1.3 Physiological Stress

The growing field of conservation physiology relies in part on the ability to monitor stress hormones in populations of animals, particularly those that are threatened or endangered. The ability to make predictions from stress hormones about impacts on individuals and populations exposed to various forms of stressors, natural and human-caused, relies on understanding the linkages between changes in stress hormones and resulting physiological impacts. At this time, the sound characteristics that correlate with specific stress responses in marine mammals are poorly understood, as are the ultimate consequences due to these changes. Navy-funded efforts are underway to try to improve the understanding of and the ability to predict how stressors ultimately affect marine mammal populations (e.g., King et al., 2015; New et al., 2013a; Pirotta et al., 2015a). With respect to acoustically induced stress, this includes not only determining how and to what degree various types of anthropogenic sound cause stress in marine mammals, but what factors can mitigate those responses. Factors potentially affecting an animal's response to a stressor include the mammal's life history stage, sex, age, reproductive status, overall physiological and behavioral plasticity, and whether they are naïve or experienced with the sound (e.g., prior experience with a stressor may result in a reduced response due to habituation (Finneran & Branstetter, 2013; St. Aubin & Dierauf, 2001)). Because there are many unknowns regarding the occurrence of acoustically induced stress responses in marine mammals, the Navy 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.

Marine mammals naturally experience stressors within their environment and as part of their life histories. Changing weather and ocean conditions, exposure to disease and naturally occurring toxins, lack of prey availability, and interactions with predators all contribute to the stress a marine mammal experiences (Atkinson et al., 2015). Breeding cycles, periods of fasting, social interactions with members of the same species, and molting (for pinnipeds) are also stressors, although they are natural components of an animal's life history. Anthropogenic activities have the potential to provide additional stressors beyond those that occur naturally (Fair et al., 2014; Meissner et al., 2015; Rolland et al., 2012). Anthropogenic stressors potentially include such things as fishery interactions, pollution, tourism, and ocean noise.

The stress response is a suite of physiological changes that are meant to help an organism mitigate the impact of a stressor (Moberg & Mench, 2000). However, if the magnitude and duration of the stress response is too great or too long, then it can have negative consequences to the organism (e.g., decreased immune function, decreased reproduction). The generalized stress response is classically characterized by the release of cortisol, a hormone that has many functions including elevation of blood sugar, suppression of the immune system, and alteration of the biochemical pathways that affect fat, protein, and carbohydrate metabolism. However, it is now known that the endocrine response (glandular secretions of hormones into the blood) to a stressor can extend to other hormones. For instance, thyroid hormones can also vary under the influence of certain stressors, particularly food deprivation. These types of responses typically occur on the order of minutes to days. The "fight or flight" response, an acute stress response, is characterized by the very rapid release of hormones that stimulate glucose release, increase heart rate, and increase oxygen consumption.

What is known about the function of the various stress hormones is based largely upon observations of the stress response in terrestrial mammals. The endocrine response of marine mammals to stress may not be the same as that of terrestrial mammals because of the selective pressures marine mammals faced during their evolution in an ocean environment (Atkinson et al., 2015). For example, due to the necessity of breath-holding while diving and foraging at depth, the physiological role of epinephrine and norepinephrine (the catecholamines) in marine mammals might be different than in other mammals. Catecholamines increase during breath-hold diving in seals, co-occurring with a reduction in heart rate, peripheral vasoconstriction (constriction of blood vessels), and an increased reliance on anaerobic metabolism during extended dives (Hance et al., 1982; Hochachka et al., 1995; Hurford et al., 1996); the catecholamine increase is not associated with an increased heart rate, glycemic release, and increased oxygen consumption typical of terrestrial mammals. Other hormone functions may also be different, such as aldosterone, which has been speculated to not only contribute to electrolyte balance, but possibly also the maintenance of blood pressure during periods of vasoconstriction (Houser et al., 2011). In marine mammals, aldosterone is thought to play a particular role in stress mediation because of its noted response to handling stress (St. Aubin & Dierauf, 2001; St. Aubin & Geraci, 1989).

Relatively little information exists on the linkage between anthropogenic sound exposure and stress in marine mammals, and even less information exists on the ultimate consequences of sound-induced stress responses (either acute or chronic). Most studies to date have focused on acute responses to sound either by measuring catecholamines or by measuring heart rate as an assumed proxy for an acute stress response. Belugas demonstrated no catecholamine response to the playback of oil drilling sounds (Thomas et al., 1990b) but showed a small but statistically significant increase in catecholamines following exposure to impulsive sounds produced from a seismic water gun (Romano et al., 2004). A bottlenose dolphin exposed to the same seismic water gun signals did not demonstrate a catecholamine response, but did demonstrate a statistically significant elevation in aldosterone (Romano et al., 2004), albeit the increase was within the normal daily variation observed in this species (St. Aubin et al., 1996) and was likely of little biological significance with respect to mitigating stress. Increases in heart rate were observed in bottlenose dolphins to which known calls of other dolphins were played, although no increase in heart rate was observed when background tank noise was played back (Miksis et al., 2001). Unfortunately, in this study, it cannot be determined whether the increase in heart rate was due to stress or an anticipation of being reunited with the dolphin to which the vocalization belonged. Similarly, a young beluga's heart rate was observed to increase during exposure to noise, with increases dependent upon the frequency band of noise and duration of exposure, and with a sharp decrease to normal or below normal levels upon cessation of the exposure (Lyamin et al., 2011). Spectral analysis of heart rate variability corroborated direct measures of heart rate (Bakhchina et al., 2017). This response might have been in part due to the conditions during testing, the young age of the animal, and the novelty of the exposure; a year later the exposure was repeated at a slightly higher received level and there was no heart rate response, indicating the beluga whale had potentially habituated to the noise exposure. Kvadsheim et al. (2010a) measured the heart rate of captive hooded seals during exposure to sonar signals and found an increase in the heart rate of the seals during exposure periods versus control periods when the animals were at the surface. When the animals dove, the normal dive-related bradycardia (decrease in heart rate) was not impacted by the sonar exposure. Similarly, Thompson et al. (1998) observed a rapid but short-lived decrease in heart rates in harbor and grey seals exposed to seismic air guns (cited in Gordon et al., 2003). Williams et al. (2017) recently monitored the heart rates of narwhals released from capture and found that a profound dive bradycardia persisted, even though exercise effort increased dramatically as part of their escape response following release. Thus, although some limited evidence suggests that tachycardia might occur as part of the acute stress response of animals that are at the surface, the bradycardia typical of diving in marine mammals appears to be dominant to any stress-related tachycardia and might even be enhanced in response to an acute stressor.

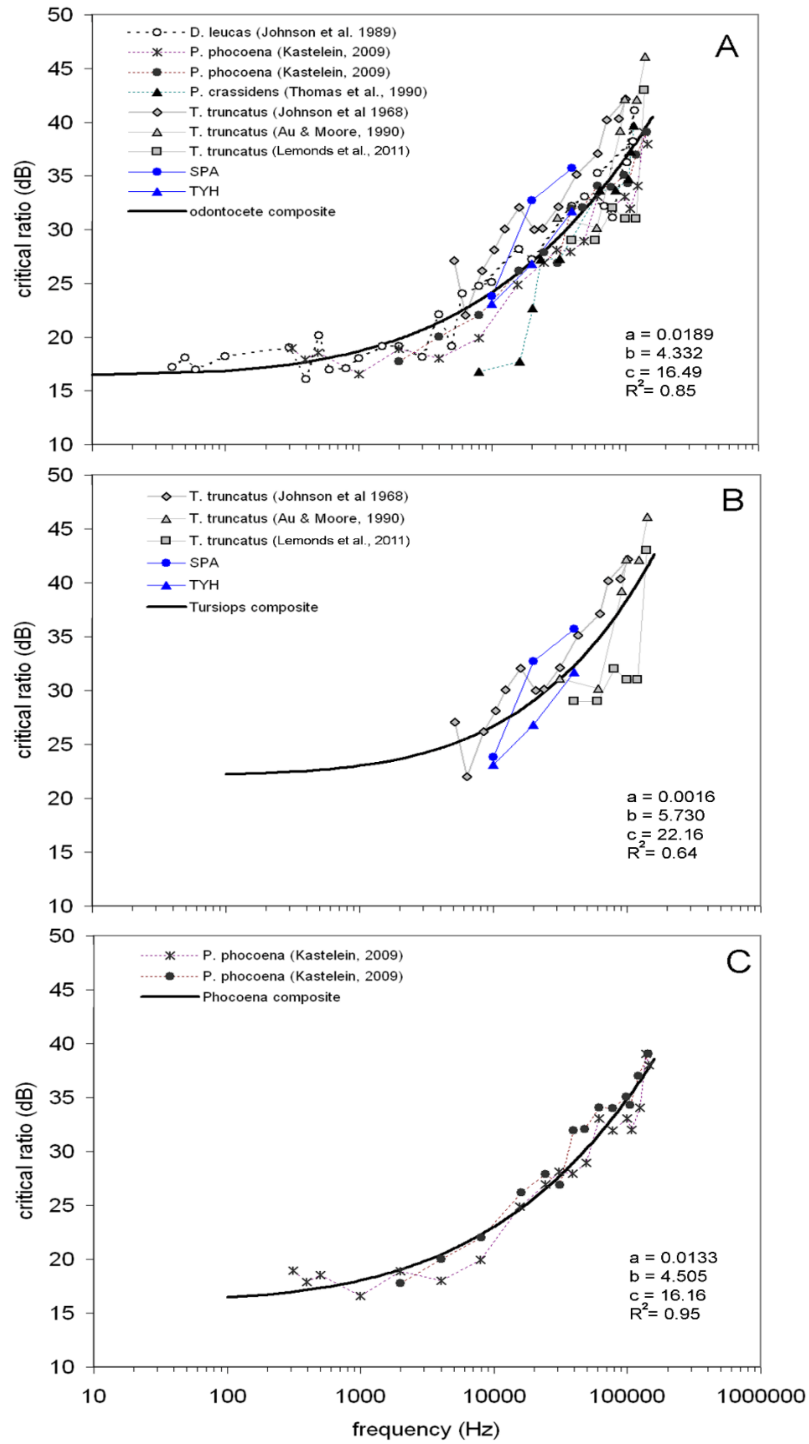
Whereas a limited amount of work has addressed the potential for acute sound exposures to produce a stress response, almost nothing is known about how chronic exposure to acoustic stressors affects stress hormones in marine mammals, particularly as it relates to survival or reproduction. In what is probably the only study of chronic noise exposure in marine mammals associating changes in a stress hormone with changes in anthropogenic noise, Rolland et al. (2012) compared the levels of cortisol metabolites in North Atlantic right whale feces collected before and after September 11, 2001. Following the events of September 11, shipping was significantly reduced in the region where fecal collections were made, and regional ocean background noise declined. Fecal cortisol metabolites significantly decreased during the period of reduced ship traffic and ocean noise (Rolland et al., 2012). Considerably more work has been conducted in an attempt to determine the potential effect of boating on smaller cetaceans, particularly killer whales (Bain, 2002; Erbe, 2002; Lusseau, 2006; Noren et al., 2009; Pirotta et al., 2015b; Read et al., 2014; Rolland et al., 2012; Williams et al., 2006; Williams et al., 2009; Williams et al., 2014b; Williams et al., 2014c). Most of these efforts focused primarily on estimates of metabolic costs associated with altered behavior or inferred consequences of boat presence and noise, but did not directly measure stress hormones. However, Ayres et al. (2012) investigated Southern Resident killer whale fecal thyroid hormone and cortisol metabolites to assess two potential threats to the species' recovery: lack of prey (salmon) and impacts from exposure to the physical presence of vessel traffic (but without measuring vessel traffic noise). Ayres et al. (2012) concluded from these stress hormone measures that the lack of prey overshadowed any population-level physiological impacts on Southern Resident killer whales due to vessel traffic. Collectively, these studies indicate the difficulty in teasing out factors that are dominant in exerting influence on the secretion of stress hormones, including the separate and additive effects of vessel presence and vessel noise. Nevertheless, although the reduced presence of the ships themselves cannot be ruled out as potentially contributing to the reduction in fecal cortisol metabolites in North Atlantic right whales, and there are potential issues in pseudoreplication and study design, the work of Rolland et al. (2012) represents the most provocative link between ocean noise and cortisol in cetaceans to date.

Navy-funded efforts are underway to try and improve our understanding and ability to predict how stressors ultimately affect marine mammal populations (e.g., King et al., 2015; New et al., 2013a; Pirotta et al., 2015a), and to determine whether a marine mammal being naïve or experienced with the sound (e.g., prior experience with a stressor) may result in a reduced response due to habituation (St. Aubin & Dierauf, 2001).

3.4.2.1.1.4 Masking

Masking occurs when one sound (i.e., noise) interferes with the detection, discrimination, or recognition of another sound (i.e., signal). The quantitative definition of masking is the amount in decibels (dB) an auditory detection, discrimination, or recognition threshold is raised in the presence of a masker (Erbe et al., 2016). As discussed in Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities), masking can effectively limit the distance over which a marine mammal can communicate, detect biologically relevant sounds, and echolocate (odontocetes). Masking only occurs in the presence of the masking noise and does not persist after the cessation of the noise. Masking can lead to vocal changes (e.g., Lombard effect, increasing amplitude, or changing frequency) and behavior changes (e.g., cessation of foraging, leaving an area) to both signalers and receivers, in an attempt to compensate for noise levels (Erbe et al., 2016).

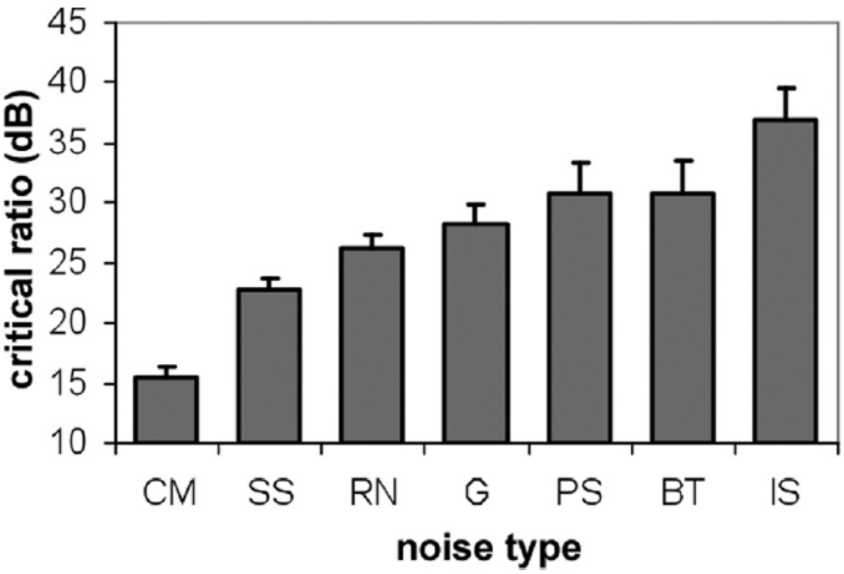
Critical ratios are the lowest signal-to-noise ratio in which detection occurs (Finneran & Branstetter, 2013; Johnson et al., 1989; Southall et al., 2000). When expressed in dB, critical ratios can easily be calculated by subtracting the noise level (in dB re 1 μPa^2/Hz) from the signal level (in dB re 1 μPa) at threshold. Critical ratios have been measured for pinnipeds (Southall et al., 2000, 2003), odontocetes (Au & Moore, 1990; Branstetter et al., 2017b; Johnson et al., 1989; Kastelein & Wensveen, 2008; Lemonds et al., 2011; Thomas et al., 1990a), and sea otters (Ghoul & Reichmuth, 2014a). Critical ratios are directly related to the bandwidth of auditory filters; as a result, critical ratios increase as a function of signal frequency (Au & Moore, 1990; Lemonds et al., 2011). Higher frequency noise is more effective at masking higher frequency signals. Composite critical ratio functions have been estimated for odontocetes (Figure 3.4-3), which allow predictions of masking if the spectral density of noise is known (Branstetter et al., 2017b). Although critical ratios are typically estimated in controlled laboratory conditions using Gaussian (white) noise, critical ratios can vary considerably (see Figure 3.4-4) depending on the noise type (Branstetter et al., 2013; Trickey et al., 2010). When broadband noise is coherently amplitude modulated, a considerable release from masking will occur known as comodulation masking release (Branstetter & Finneran, 2008; Branstetter et al., 2013). Signal type (e.g., whistles, burst-pulse, sonar clicks) and spectral characteristics (e.g., frequency modulation and/or harmonics) may further influence masked detection thresholds (Branstetter et al., 2016; Cunningham et al., 2014).



Source: Branstetter et al. (2017b)

Notes: (1) Odontocete critical ratios and composite model: CR = $a[\log_{10}(f)]^b + c$, where *a, b,* and *c* are model coefficients and *f* is the signal frequency in Hz. Equation 1 was fit to aggregate data for all odontocetes. (2) *T. truncatus.* critical ratios and composite model. (3) *P. phocoena.* critical ratios and composite model. Parameter values for composite models are displayed in the lower right of each panel.

Figure 3.4-3: Odontocete Critical Ratios



Source: Branstetter et al. (2013)

Notes: CM = comodulated, SS = snapping shrimp, RN = rain noise, G = Gaussian, PS = pile saw, BT = boat engine noise, and IS = ice squeaks

Figure 3.4-4: Critical Ratios for Different Noise Types

Clark et al. (2009) developed a model for estimating masking effects on communication signals for low-frequency cetaceans, including calculating the cumulative impact of multiple noise sources. For example, the model estimates that a right whale's optimal communication space (around 20 km) is decreased by 84 percent when two commercial ships pass through it. Similarly, Aguilar de Soto et al. (2006) found that a 15 dB increase in background noise due to vessels led to a communication range of only 18 percent of its normal value for foraging beaked whales. This method relies on empirical data on source levels of calls (which is unknown for many species) and requires many assumptions such as pre-industrial ambient noise conditions and simplifications of animal hearing and behavior, but it is an important step in determining the impact of anthropogenic noise on animal communication. Erbe (2016) developed a model with a noise source-centered view of masking to examine how a call may be masked from a receiver by a noise as a function of caller, receiver, and noise-source location, distance relative to each other, and received level of the call.

Vocal changes in response to anthropogenic noise can occur across the repertoire of sound production modes used by marine mammals, such as whistling, echolocation click production, calling, and singing. Vocalization changes include increasing the source level, modifying the frequency, increasing the call repetition rate of vocalizations, or ceasing to vocalize in the presence of increased noise (Hotchkin & Parks, 2013). In cetaceans, vocalization changes were reported from exposure to anthropogenic noise sources such as sonar, vessel noise, and seismic surveying (Gordon et al., 2003; Holt et al., 2008; Holt et al., 2011; Lesage et al., 1999; McDonald et al., 2009; Rolland et al., 2012) as well as changes in the natural acoustic environment (Dunlop et al., 2014). Vocal changes can be temporary, or can be persistent, as seen in the increase in starting frequency for the North Atlantic right whale upcall over the last 50 years (Tennessen & Parks, 2016). Model simulation suggests that the frequency shift resulted in increased detection ranges between right whales; the frequency shift, coupled with an increase in call intensity by 20 dB, led to a call detectability range of less than 3 km to over 9 km (Tennessen & Parks, 2016). In some cases, these vocal changes may have fitness consequences, such as an increase in metabolic rates and oxygen consumption, as was found for bottlenose dolphins when increasing their call amplitude (Holt et al., 2015). A switch from vocal communication to physical, surface-generated sounds such as pectoral fin slapping or breaching was observed for humpback whales in the presence of increasing natural background noise levels, indicating that adaptations to masking may also move beyond vocal modifications (Dunlop et al., 2010). These changes all represent possible tactics by the sound-producing animal to reduce the impact of masking. The receiving animal can also reduce masking by using active listening strategies such as orienting to the sound source, moving to a quieter location, or reducing self-noise from hydrodynamic flow by remaining still.

Informational Masking

Much emphasis has been placed on signal detection in noise and, as a result, most masking studies and communication space models have focused on masked detection thresholds. However, from a fitness perspective, signal detection is almost meaningless without the ability to determine the sound source location and recognize "what" is producing the sound. Marine mammals use sound to recognize conspecifics, prey, predators, or other biologically significant sources (Branstetter et al., 2016). Masked recognition thresholds (often called informational masking) for whistle-like sounds, have been measured for bottlenose dolphins (Branstetter et al., 2016) and are approximately 4 dB above detection thresholds (energetic masking) for the same signals. It should be noted that the term "threshold" typically refers to the listener's ability to detect or recognize a signal 50 percent of the time. For example, human speech communication, where only 50 percent of the words are recognized, would result in poor communication (Branstetter et al., 2016). Likewise, recognition of a conspecific call or the acoustic signature of a predator at only the 50 percent level could have severe negative impacts. If "quality communication" is arbitrarily set at 90 percent recognition (which may be more appropriately related to animal fitness), the output of communication space models (which are based on 50 percent detection) would likely result in a significant decrease in communication range (Branstetter et al., 2016).

Marine mammals use sound to recognize predators (Allen et al., 2014; Cummings & Thompson, 1971; Curé et al., 2015; Fish & Vania, 1971). Auditory recognition may be reduced in the presence of a masking noise, particularly if it occurs in the same frequency band. Therefore, the occurrence of masking may prevent marine mammals from responding to the acoustic cues produced by their predators. Whether this is a possibility depends on the duration of the masking and the likelihood of encountering a predator during the time that detection and recognition of predator cues are impeded. For example, harbor seals that reside in the coastal waters off British Columbia are frequently targeted by mammal-eating killer whales. The seals acoustically discriminate between the calls of mammal-eating and fish-eating killer whales (Deecke et al., 2002), a capability that should increase survivorship while reducing the energy required to attend to all killer whale calls. Similarly, sperm whales (Curé et al., 2016; Isojunno et al., 2016), long-finned pilot whales (Visser et al., 2016), and humpback whales (Curé et al., 2015) changed their behavior in response to killer whale vocalization playbacks; these findings indicating that some recognition of predator cues could be missed if the killer whale vocalizations were masked.

Masking by Impulsive Sound

Masking could occur in mysticetes due to the overlap between their low-frequency vocalizations and the dominant frequencies of impulsive sources, however, masking in odontocetes or pinnipeds is less likely unless the seismic survey activity is in close range when the pulses are more broadband. For example, differential vocal responses in marine mammals were documented in the presence of seismic survey noise. An overall decrease in vocalizations during active surveying was noted in large marine mammal groups (Potter et al., 2007), while blue whale feeding/social calls increased when seismic exploration was underway (Di Lorio & Clark, 2010), indicative of a possible compensatory response to the increased noise level. Bowhead whales were found to increase call rates in the presence of seismic air gun noise at lower received levels (below 100 dB re: 1 μPa^2s cumulative SEL), but once the received level rose above 127 dB re 1 μPa^2s cumulative SEL the call rate began decreasing, and stopped altogether once received levels reached 170 dB re 1 μPa^2s cumulative SEL (Blackwell et al., 2015). Nieukirk et al. (2012) recorded both seismic surveys and fin whale 20 Hz calls at various locations around the mid-Atlantic Ocean, and hypothesized that distant seismic noise could mask those calls thereby decreasing the communication range of fin whales, whose vocalizations may propagate over 400 km to reach conspecifics (Spiesberger & Fristrup, 1990). Two captive seals (one spotted and one ringed) were exposed to seismic air gun sounds recorded within 1 km and 30 km of an air gun survey conducted in shallow (<40 m) water. They were then tested on their ability to detect a 500 ms upsweep centered at 100 Hz at different points in the air gun pulse (start, middle, and end). Based on these results, a 100 Hz vocalization with a source level of 130 dB re 1 μPa would not be detected above a seismic survey 1 km away unless the animal was within 1–5 m, and would not be detected above a survey 30 km away beyond 46 m (Sills et al., 2017).

Masking by Sonar and Other Transducers

Masking by low-frequency or mid-frequency active sonar with relatively low-duty cycles is unlikely for most cetaceans and pinnipeds as sonar signals occur over a relatively short duration, and narrow bandwidth that does not overlap with vocalizations for most marine mammal species. While dolphin whistles and mid-frequency active sonar are similar in frequency, masking is unlikely due to the low-duty cycle of most sonars. Low-frequency active sonar could also overlap with mysticete vocalizations (e.g., minke and humpback whales). For example, in the presence of low-frequency active sonar, humpback whales were observed to increase the length of their songs (Fristrup et al., 2003; Miller et al., 2000), possibly due to the overlap in frequencies between the whale song and the low-frequency active sonar.

Newer high-duty cycle or continuous active sonars have more potential to mask vocalizations, particularly for delphinids and other mid-frequency cetaceans. These sonars transmit more frequently (greater than 80 percent duty cycle) than traditional sonars, but at a substantially lower source level. Similarly, high-frequency acoustic sources such as pingers that operate at higher repetition rates (e.g., 2–10 kHz with harmonics up to 19 kHz, 76 to 77 pings per minute (Culik et al., 2001)), also operate at lower source levels. While the lower source levels limit the range of impact compared to traditional systems, animals close to the sonar source are likely to experience masking on a much longer time scale than those exposed to traditional sonars. The frequency range at which high-duty cycle systems operate overlaps the vocalization frequency of many mid-frequency cetaceans. Continuous noise at the same frequency of communicative vocalizations may cause disruptions to communication, social interactions, and acoustically mediated cooperative behaviors such as foraging or reproductive activities. Similarly, because the systems are mid-frequency, there is the potential for the sonar signals to mask important environmental cues like predator vocalizations (e.g., killer whales), possibly affecting survivorship for targeted animals. While there are currently no available studies of the impacts of high-duty cycle sonars on marine mammals, masking due to these systems is likely analogous to masking produced by other continuous sources (e.g., vessel noise and low-frequency cetaceans), and will likely have similar short-term consequences, though longer in duration due to the duration of the masking noise. These may include changes to vocalization amplitude and frequency (Brumm & Slabbekoorn, 2005; Hotchkin & Parks, 2013) and behavioral impacts such as avoidance of the area and interruptions to foraging or other essential behaviors (Gordon et al., 2003). Long-term consequences could include changes to vocal behavior and vocalization structure (Foote et al., 2004; Parks et al., 2007), abandonment of habitat if masking occurs frequently enough to significantly impair communication (Brumm & Slabbekoorn, 2005), a potential decrease in survivorship if predator vocalizations are masked (Brumm & Slabbekoorn, 2005), and a potential decrease in recruitment if masking interferes with reproductive activities or mother-calf communication (Gordon et al., 2003).

Masking by Vessel Noise

Masking is more likely to occur in the presence of broadband, relatively continuous noise sources such as vessels. For example, right whales were observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks et al., 2007) as well as increasing the amplitude (intensity) of their calls (Parks, 2009; Parks et al., 2011). Right whales also had their communication space reduced by up to 84 percent in the presence of vessels (Clark et al., 2009). However, Cholewiak et al.(2018) found that right whale gunshot calls had the lowest loss of communication space in Stellwagen National Sanctuary (5 percent), while fin and humpback whales lost up to 99 percent of their communication space with increased ambient noise and shipping noise combined. Although humpback whales off Australia did not change the frequency or duration of their vocalizations in the presence of ship noise, their source levels were lower than expected based on source level changes to wind noise, potentially indicating some signal masking (Dunlop, 2016).

Multiple delphinid species have also been shown to increase the minimum or maximum frequencies of their whistles in the presence of anthropogenic noise (Papale et al., 2015). More specifically, Williams et al. (2014b) found that in median noise conditions in Haro Strait, killer whales lose 62 percent of their acoustic communication space in the frequency band of their social calls (1.5 – 3.5 kHz) out to 8 km due to vessel traffic noise, and in peak traffic hours lose up to 97 percent of that space; however, when looking at a smaller area or higher frequency bands, less communication space is lost. In fact, at the higher frequency band of their echolocation clicks (18–30 kHz), no communication space was lost out to 2 km. Holt et al. (2008; 2011) showed that Southern Resident killer whales in the waters surrounding the San Juan Islands increased their call source level as vessel noise increased. Hermannsen et al. (2014) estimated that broadband vessel noise could extend up to 160 kHz at ranges from 60 to 1,200 m, and that the higher frequency portion of that noise might mask harbor porpoise clicks. However, this may not be an issue as harbor porpoises may avoid vessels and may not be close enough to have their clicks masked (Dyndo et al., 2015; Polacheck & Thorpe, 1990; Sairanen, 2014). Furthermore, Hermannsen et al. (2014) estimated that a 6 dB elevation in noise would decrease the hearing range of a harbor porpoise by 50 percent, and a 20 dB increase in noise would decrease the hearing range by 90 percent. Gervaise et al. (2012) estimated that beluga whales in the St. Lawrence Marine Park had their communication space reduced to 30 percent during average vessel traffic. During peak traffic, communication space was further reduced to 15 percent. Lesage et al. (1999) found belugas in the St. Lawrence River estuary reduced overall call rates but increased the production of certain call types when ferry and small outboard motor boats were approaching. Furthermore, these belugas increased the vocalization frequency band when vessels were in close proximity. Liu et al. (2017) found that broadband shipping noise could cause masking of humpback dolphin whistles within 1.5–3 km, and masking of echolocation clicks within 0.5–1.5 km.

3.4.2.1.1.5 Behavioral Reactions

As discussed in Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities), any stimulus in the environment can cause a behavioral response in marine mammals. These stimuli include noise from anthropogenic sources such as vessels, sonar, or aircraft, but could also include the physical presence of a vessel or aircraft. However, stimuli such as the presence of predators, prey, or conspecifics could also influence how or if a marine mammal responds to a sound. Furthermore, the response of a marine mammal to an anthropogenic sound may depend on the frequency, duration, temporal pattern and amplitude of the sound as well as the animal's prior experience with the sound and their behavioral state (i.e., what the animal is doing and their energetic needs at the time of the exposure) (Ellison et al., 2011). The distance from the sound source and whether it is approaching or moving away can also affect the way an animal responds to a sound (Wartzok et al., 2003).

For marine mammals, a review of responses to anthropogenic sound was first conducted by Richardson et al. (1995b). Other reviews (Nowacek et al., 2007; Southall et al., 2007) addressed studies conducted since 1995 and focused on observations where the received sound level of the exposed marine mammal(s) was known or could be estimated, and also examined the role of context. Southall et al. (2007) synthesized data from many past behavioral studies and observations to determine the likelihood of behavioral reactions at specific sound levels. While in general, the louder the sound source the more intense the behavioral response, it was clear that the proximity of a sound source and the animal's experience, motivation, and conditioning were also critical factors influencing the response (Southall et al., 2007; Southall et al., 2016). Ellison et al. (2011) outlined an approach to assessing the effects of sound on marine mammals that incorporates these contextual-based factors. They recommend considering not just the received level of sound, but also in what activity the animal is engaged, the nature and novelty of the sound (i.e., is this a new sound from the animal's perspective), and the distance between the sound source and the animal. They submit that this "exposure context," as described, greatly influences the type of behavioral response exhibited by the animal (see technical report *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (U.S. Department of the Navy, 2017a)). Forney et al. (2017) also point out that an apparent lack of response (e.g., no displacement or avoidance of a sound source) may not necessarily mean there is no cost to the individual or population, as some resources or habitats may be of such high value that animals may choose to stay, even when experiencing stress or hearing loss. Forney et al. (2017) recommend considering both the costs of remaining in an area of noise exposure such as TTS, PTS, or masking, which could lead to an increased risk of predation or other threats or a decreased capability to forage, and the costs of displacement, including potential increased risk of vessel strike or bycatch, increased risks of predation or competition for resources, or decreased habitat suitable for foraging, resting, or socializing.

Behavioral reactions could result from a variety of sound sources such as sonar and other transducers (e.g., pingers), vessel noise, and aircraft noise. There is data on the reactions of some species in different behavioral states, providing evidence on the importance of context in gauging a behavioral response. However, for most species, little or no data exist on behavioral responses to any sound source, and so all species have been grouped into broad taxonomic groups from which general response information can be inferred (see technical report *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (U.S. Department of the Navy, 2017a)).

Behavioral Reactions to Sonar and Other Transducers

Sonar and other transducers can range in frequency from less than 1 kHz (e.g., low-frequency active sonar) to over 200 kHz (e.g., fish finders), with duty cycles that range from one ping per minute to an almost continuous sound. Although very high-frequency sonars are out of the hearing range of most marine mammals, some of these sources may contain artifacts at lower frequencies that could be detected (Deng et al., 2014; Hastie et al., 2014). High-duty cycle sonar systems operate at lower source levels, but with a more continuous sound output. These sources can be stationary, or on a moving platform, and there can be more than one source present at a time. Guan et al. (2017) also found that sound levels in the mid-frequency sonar bandwidth remained elevated at least 5 dB above background levels for the first 7–15 seconds (within 2 km) after the emission of a sonar ping; depending on the length of the sonar ping and the inter-ping interval, this reverberation could increase cumulative SEL estimates during periods of active sonar. This variability in parameters associated with sonar and other transducers makes the estimation of behavioral responses to these sources difficult, with observed responses ranging from no apparent change in behavior to more severe responses that could lead to some costs to the animal. As discussed in Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities) and Section 3.4.2.1.1.5 (Behavioral Reactions), responses may also occur in the presence of different contextual factors regardless of received level, including the proximity and number of vessels, the behavioral state and prior experience of an individual, and even characteristics of the signal itself or the propagation of the signal through the environment.

In order to explore this complex question, behavioral response studies have been conducted through the collaboration of various research and government organizations in Bahamian, United States (off Southern California), Mediterranean, Australian, and Norwegian waters. These studies have attempted to define and measure responses of beaked whales and other cetaceans to controlled exposures of sonar and other sounds to understand better their potential impacts. While controlling for as many variables as possible (e.g., the distance and movement of the source), these studies also introduce additional variables that do not normally occur in a real Navy training or testing activity, including the tagging of whales, following the tagged animals with multiple vessels, and continually approaching the animal to create a dose escalation. In addition, distances of the sound source from the whales during behavioral response studies were always within 1–8 km. Some of these studies have suggested that ramping up a source from a lower source level would act as a mitigation measure to protect against higher order (e.g., TTS or PTS) impacts of some active sonar sources; however, this practice may only be effective for more responsive animals, and for short durations (e.g., 5 minutes) of ramp-up (von Benda-Beckmann et al., 2014; von Benda-Beckmann et al., 2016). Therefore, while these studies have provided the most information to date on behavioral responses of marine mammals to sonar, there are still many contextual factors to be teased apart, and determining what might produce a significant behavioral response is not a trivial task. Additional information about active sonar ramp-up procedures, including why the Navy will not implement them as mitigation under the Proposed Action, is provided in Section 5.5.1 (Active Sonar).

Passive acoustic monitoring and visual observational behavioral response studies have also been conducted on Navy ranges, taking advantage of the existing seafloor hydrophones and real testing and training activity and associated sources to assess behavioral responses (Deakos & Richlen, 2015; Henderson et al., 2016; Manzano-Roth et al., 2016; Martin et al., 2015; McCarthy et al., 2011; Mobley & Deakos, 2015; Moretti et al., 2014; Tyack et al., 2011). In addition, extensive aerial, visual, and passive acoustic monitoring have been conducted before, during, and after training events to watch for behavioral responses during training and look for injured or stranded animals after training (Falcone et al., 2017; Farak et al., 2011; Henderson et al., 2016; Manzano-Roth et al., 2016; Mobley, 2011; Norris et al., 2012a; Norris et al., 2012b; Smultea & Mobley, 2009; Smultea et al., 2009; Trickey et al., 2015; U.S. Department of the Navy, 2011b, 2013a, 2014a, 2015b). During all of these monitoring efforts, very few behavioral responses were observed, and no injured or dead animal was observed that was directly related to a training event (some dead animals were observed but typically before the event or appeared to have been deceased prior to the event; e.g., Smultea et al., 2011). While passive acoustic studies are limited to observations of vocally active marine mammals, and visual studies are limited to what can be observed at the surface, these study types have the benefit of occurring in the absence of some of the added contextual variables in the controlled exposure studies. Furthermore, when visual and passive acoustic data collected during a training event are combined with ship movements and sonar use, and with tagged animal data when possible, they provide a unique and realistic scenario for analysis, as in Falcone et al. (2017), Manzano-Roth et al. (2016), or Baird et al. (2017). In addition to these types of observational behavioral response studies, Harris and Thomas (2015) highlighted additional research approaches that may provide further information on behavioral responses to sonars and other transducers beyond behavior response type studies or passive acoustic monitoring, including conducting controlled exposures on captive animals with scaled (smaller sized and deployed at closer proximity) sources, on wild animals with both scaled and real but directed sources, and predator playback studies, all of which will be discussed below.

The above behavioral response studies and observations have been conducted on a number of mysticete and odontocete species, which can be extrapolated to other similar species in these taxonomic groups. No field studies of pinniped behavioral responses to sonar have been conducted; however, there are several captive studies on some pinniped and odontocete species that can provide insight into how these animals may respond in the wild. The captive studies typically represent a more controlled approach, which allow researchers to better estimate the direct impact of the received level of sound leading to behavioral responses, and to potentially link behavioral to physiological responses. However, there are still contextual factors that must be acknowledged, including previous training to complete tasks and the presence of food rewards upon completion. There are no corresponding captive studies on mysticete whales; therefore, some of the responses to higher-level exposures must be extrapolated from odontocetes.

Mysticetes

The responses of mysticetes to sonar and other duty-cycled tonal sounds are highly dependent upon the characteristics of the signal, the behavioral state of the animal, the particular sensitivity and previous experience of an individual, and other contextual factors including distance of the source, movement of the source, and the physical presence of vessels in addition to the sonar (Goldbogen et al., 2013; Harris et al., 2015; Martin et al., 2015; Sivle et al., 2015). Behavioral response studies have been conducted over a variety of contextual and behavioral states, helping to identify which contextual factors may lead to a response beyond just the received level of the sound. Observed reactions during behavioral response studies have not been consistent across individuals based on received sound levels alone, and likely were the result of complex interactions between these contextual factors.

Surface feeding blue whales did not show a change in behavior in response to mid-frequency simulated and real sonar sources with received levels between 90 and 179 dB re 1 µPa, but deep feeding and non-feeding whales showed temporary reactions including cessation of feeding, reduced initiation of deep foraging dives, generalized avoidance responses, and changes to dive behavior (DeRuiter et al., 2017; Goldbogen et al., 2013; Sivle et al., 2015). Similarly, while the rates of foraging lunges decreased in humpback whales due to sonar exposure, there was variability in the response across individuals, with one animal ceasing to forage completely and another animal starting to forage during the exposure (Sivle et al., 2016). In addition, lunges decreased (although not significantly) during a no-sonar control vessel approach prior to the sonar exposure, and lunges decreased less during a second sonar approach than during the initial approach, possibly indicating some response to the vessel and some habituation to the sonar and vessel after repeated approaches. In the same experiment, most of the non-foraging humpback whales did not respond to any of the approaches (Sivle et al., 2016). These humpback whales also showed variable avoidance responses, with some animals avoiding the sonar vessel during the first exposure but not the second, while others avoided the sonar during the second exposure, and only one avoided both. In addition, almost half of the animals that avoided were foraging before the exposure but the others were not; the animals that avoided while not feeding responded at a slightly lower received level and greater distance than those that were feeding (Wensveen et al., 2017). These findings indicate that the behavioral state of the animal plays a role in the type and severity of a behavioral response. In fact, when the prey field was mapped and used as a covariate in similar models looking for a response in the same blue whales, the response in deep-feeding behavior by blue whales was even more apparent, reinforcing the need for contextual variables to be included when assessing behavioral responses (Friedlaender et al., 2016). However, even when responses did occur the animals quickly returned to their previous behavior after the sound exposure ended (Goldbogen et al., 2013; Sivle et al., 2015). In another study, humpback whales exposed to a 3 kHz pinger meant to act as a net alarm to prevent entanglement did not respond or change course, even when within 500 m (Harcourt et al., 2014). However, five out of six North Atlantic right whales exposed to an acoustic alarm interrupted their foraging dives; in this case, the alarm was comprised of a mixture of signals with frequencies from 500 to 4500 Hz, was long in duration (lasting several minutes), and was purposely designed to elicit a reaction from the animals as a prospective means to protect them from ship strikes (Nowacek et al., 2004). Although the animals' received SPL was similar in the latter two studies (133–150 dB re 1 $\mu Pa^2 s$), the frequency, duration, and temporal pattern of signal presentation were different.

Humpback whales in another behavioral response experiment in Australia also responded to a 2 kHz tone stimulus by changing their course during migration to move more offshore and surfaced more frequently, but otherwise did not respond (Dunlop et al., 2013). Humpback whales in the Norwegian behavioral response study may have habituated slightly between the first and second sonar exposure (Sivle et al., 2015), and actually responded more severely to killer whale vocalization playbacks than they did to the sonar playbacks. Several humpback whales have been observed during aerial or visual surveys during Navy training events involving sonar; no avoidance or other behavioral responses were ever noted, even when the whales were observed within 5 km of a vessel with active (or possibly active) sonar and maximum received levels were estimated to be between 135 and 161 dB re 1 µPa (Mobley & Milette, 2010; Mobley, 2011; Mobley & Pacini, 2012; Mobley et al., 2012; Smultea et al., 2009). In fact, one group of humpback whales approached a vessel with active sonar so closely that the sonar was shut down and the vessel slowed; the animals continued approaching and swam under the bow of the vessel (U.S. Department of the Navy, 2011a). Another group of humpback whales continued heading towards a vessel with active sonar as the vessel was moving away for almost 30 minutes, with an estimated median received level of 143 dB re 1 µPa. This group was observed producing surface active behaviors such as pec slaps, tail slaps, and breaches; however, these are very common behaviors in competitive pods during the breeding season and were not considered to have occurred in response to the sonar (Mobley et al., 2012).

The strongest baleen whale response in any behavioral response study was observed in a minke whale in the 3S2 study, which responded at 146 dB re 1 µPa by strongly avoiding the sound source (Kvadsheim et al., 2017; Sivle et al., 2015). Although the minke whale increased its swim speed, directional movement, and respiration rate, none of these were greater than rates observed in baseline behavior, and its dive behavior remained similar to baseline dives. A minke whale tagged in the Southern California behavioral response study also responded by increasing its directional movement, but maintained its speed and dive patterns, and so did not demonstrate as strong of a response (Kvadsheim et al., 2017). In addition, the 3S2 minke whale demonstrated some of the same avoidance behavior during the controlled ship approach with no sonar, indicating at least some of the response was to the vessel (Kvadsheim et al., 2017). Martin et al. (2015) found that the density of calling minke whales was reduced during periods of Navy training involving sonar relative to the periods before training, and increased again in the days after training was completed. The responses of individual whales could not be assessed, so in this case it is unknown whether the decrease in calling animals indicated that the animals left the range, or simply ceased calling. Similarly, minke whale detections made using Marine Acoustic Recording Instruments off Jacksonville, FL, were reduced or ceased altogether during periods of sonar use (Norris et al., 2012b; U.S. Department of the Navy, 2013a), especially with an increased ping rate (Charif et al., 2015). Two minke whales also stranded in shallow water after the U.S. Navy training event in the Bahamas in 2000, although these animals were successfully returned to deep water with no physical examinations; therefore, no final conclusions were drawn on whether the sonar led to their stranding (Filadelfo et al., 2009a; Filadelfo et al., 2009b; U.S. Department of Commerce & U.S. Department of the Navy, 2001).

Baleen whales have also been exposed to lower frequency sonars, with the hypothesis that these whales may react more strongly to lower frequency sounds that overlap with their vocalization range. One series of studies was undertaken in 1997–1998 pursuant to the Navy's Low-Frequency Sound Scientific Research Program. The frequency bands of the low-frequency sonars used were between 100 and 500 Hz, with received levels between 115 and 150 dB re 1 µPa, and the source was always stationary. Fin and blue whales were targeted on foraging grounds, singing humpback whales were exposed on breeding grounds, and gray whales were exposed during migratory behavior. These studies found only short-term responses to low-frequency sound by some fin and humpback whales, including changes in vocal activity and avoidance of the source vessel, while other fin, humpback, and blue whales did not respond at all. When the source was in the path of migrating gray whales they changed course up to 2 km to avoid the sound, but when the source was outside their path, little response was observed although received levels were similar (Clark & Fristrup, 2001; Croll et al., 2001; Fristrup et al., 2003; Miller et al., 2000; Nowacek et al., 2007). Low-frequency signals of the Acoustic Thermometry of Ocean Climate sound source were also not found to affect dive times of humpback whales in Hawaiian waters (Frankel & Clark, 2000).

Opportunistic passive acoustic based studies have also detected behavioral responses to sonar, although definitive conclusions are harder to draw. Blue whales exposed to mid-frequency sonar in the Southern California Bight were less likely to produce low-frequency calls usually associated with feeding behavior, beginning at received levels of 110–120 dB re 1 µPa (Melcón et al., 2012); however, without visual observations it is unknown whether there was another factor that contributed to the reduction in foraging calls, such as the presence of conspecifics. In another example, Risch et al. (2012, 2014) determined that humpback whale song produced in the Stellwagen Bank National Marine Sanctuary was reduced, and since the timing was concurrent with an Ocean Acoustic Waveguide Remote Sensing experiment occurring 200 km away, they concluded that the reduced song was a result of the Ocean Acoustic Waveguide Remote Sensing. However, Gong et al. (2014) analyzed the same data set while also looking at the presence of herring in the region, and found that the singing humpbacks were actually located on nearby Georges Bank and not on Stellwagen, and that the song rate in their data did not change in response to Ocean Acoustic Waveguide Remote Sensing, but could be explained by natural causes.

Although some strong responses have been observed in mysticetes to sonar and other transducers (e.g., the single minke whale), for the most part mysticete responses appear to be fairly moderate across all received levels. While some responses such as cessation of foraging or changes in dive behavior could carry short-term impacts, in all cases behavior returned to normal after the signal stopped. Mysticete responses also seem to be highly mediated by behavioral state, with no responses occurring in some behavioral states, and contextual factors and signal characteristics having more impact than received level alone. Many of the contextual factors resulting from the behavioral response studies (e.g., close approaches by multiple vessels or tagging) would never be introduced in real Navy testing and training scenarios. While data are lacking on behavioral responses of mysticetes to continuously active sonars, these species are known to be able to habituate to novel and continuous sounds (Nowacek et al., 2004), suggesting that they are likely to have similar responses to high-duty cycle sonars. Therefore, mysticete behavioral responses to Navy sonar will likely be a result of the animal's behavioral state and prior experience rather than external variables such as ship proximity; thus, if significant behavioral responses occur they will likely be short-term. In fact, no significant behavioral responses such as panic, stranding, or other severe reactions have been observed during monitoring of actual training exercises (Smultea et al., 2009; U.S. Department of the Navy, 2011b, 2014b; Watwood et al., 2012).

Odontocetes

Behavioral response studies have been conducted on odontocete species since 2007, with a focus on beaked whale responses to active sonar transmissions or controlled exposure playback of simulated sonar on various military ranges (Claridge et al., 2009; Defence Science and Technology Laboratory, 2007; Falcone et al., 2017; Henderson et al., 2015b; Henderson et al., 2016; Manzano-Roth et al., 2016; Manzano-Roth et al., 2013; McCarthy et al., 2011; Moretti et al., 2009; Southall et al., 2011; Southall et al., 2012a; Southall et al., 2012b; Southall et al., 2013; Southall et al., 2014; Southall et al., 2015; Tyack et al., 2011). Through analyses of these behavioral response studies, a preliminary overarching effect of greater sensitivity to most anthropogenic exposures was seen in beaked whales compared to the other odontocetes studied (Southall et al., 2009).

Observed reactions by Blainville's, Cuvier's, and Baird's beaked whales to mid-frequency sonar sounds have included cessation of clicking, termination of foraging dives, changes in direction to avoid the sound source, slower ascent rates to the surface, longer deep and shallow dive durations, and other unusual dive behavior (Boyd et al., 2008; Defence Science and Technology Laboratory, 2007; DeRuiter et al., 2013b; Miller et al., 2015; Southall et al., 2011; Stimpert et al., 2014; Tyack et al., 2011). A similar response was observed in a northern bottlenose whale, which conducted the longest and deepest dive on record for that species after the sonar exposure and continued swimming away from the source for over seven hours (Miller et al., 2015). Responses occurred at received levels between 95 and 150 dB re 1 µPa, although all of these exposures occurred within 1–8 km of the focal animal, within a few hours of tagging the animal, and with one or more boats within a few kilometers to observe responses and record acoustic data. One Cuvier's beaked whale was also incidentally exposed to real Navy sonar located over 100 km away, and the authors did not detect similar responses at comparable received levels. Received levels from the mid-frequency active sonar signals from the controlled and incidental exposures were calculated as 84–144 and 78–106 dB re 1 µPa, respectively, indicating that context of the exposures (e.g., source proximity, controlled source ramp-up) may have been a significant factor in the responses to the simulated sonars (DeRuiter et al., 2013b). Falcone et al. (2017) modeled deep and shallow dive durations, surface interval durations, and inter-deep dive intervals of Cuvier's beaked whales against predictor values that included helicopter dipping, mid-power mid-frequency active sonar and hull-mounted, high-power mid-frequency active sonar along with other, non-mid-frequency active sonar predictors. They found both shallow and deep dive durations to increase as the proximity to both mid- and high-powered sources decreased, and found surface intervals and inter-deep dive intervals to also increase in the presence of both types of sonars, although surface intervals shortened during periods of no mid-frequency active sonar. The responses to the mid-power mid-frequency active sonar at closer ranges were comparable to the responses to the higher SL ship sonar, again highlighting the importance of proximity. This study also supports context as a response factor, as helicopter dipping sonars are shorter duration and randomly located, so more difficult for beaked whales to predict or track and therefore potentially more likely to cause a response, especially when they occur at closer distances (6–25 km in this study). (Watwood et al.) found that helicopter dipping events occurred more frequently but with shorter durations than periods of hull-mounted sonar, and also found that the longer the duration of a sonar event, the greater reduction in detected Cuvier's beaked whale group dives. Therefore, when looking at the number of detected group dives there was a greater reduction during periods of hull-mounted sonar than during helicopter dipping sonar. Long-term tagging work has demonstrated that the longer duration dives considered a behavioral response by DeRuiter et al. (2013b) fell within the normal range of dive durations found for eight tagged Cuvier's beaked whales on the Southern California Offshore Range (Schorr et al., 2014). However, the longer inter-deep dive intervals found by DeRuiter et al. (2013b), which were among the longest found by Schorr et al. (2014) and (Falcone et al., 2017) and could indicate a response to sonar. In addition,Williams et al. (2017) note that in normal deep dives or during fast swim speeds, beaked whales and other marine mammals use strategies to reduce their stroke rates, including leaping or wave surfing when swimming, and interspersing glides between bouts of stroking when diving. They determined that in the post-exposure dives by the tagged Cuvier's beaked whales described in DeRuiter et al. (2013b), the whales ceased gliding and swam with almost continuous strokes. This change in swim behavior was calculated to increase metabolic costs about 30.5 percent and increase the amount of energy expending on fast swim speeds from 27 to 59 percent of their overall energy budget. This repartitioning of energy was detected in the model up to 1.7 hours after the single sonar exposure. Therefore, while the overall post-exposure dive durations were similar, the metabolic energy calculated by Williams et al. (2017) was higher.

On Navy ranges, Blainville's beaked whales located on the range appear to move off-range during sonar use and return only after the sonar transmissions have stopped, sometimes taking several days to do so (Claridge et al., 2009; Henderson et al., 2015b; Manzano-Roth et al., 2016; McCarthy et al., 2011; Moretti et al., 2009; Tyack et al., 2011). However, Blainville's beaked whales remain on the range to forage throughout the rest of the year (Henderson et al., 2016), possibly indicating that this a preferred foraging habitat regardless of the effects of the noise, or it could be that there are no long-term consequences of the sonar activity. Similarly, photo-identification studies in the Southern California Range Complex have identified approximately 100 individual Cuvier's beaked whale individuals, with 40 percent having been seen in one or more prior years, with re-sightings up to seven years apart, indicating a possibly resident population on the range (Falcone et al., 2009; Falcone & Schorr, 2014).

Beaked whales may respond similarly to shipboard echosounders, commonly used for navigation, fisheries, and scientific purposes, with frequencies ranging from 12 to 400 kHz and source levels up to 230 dB re 1 µPa but typically a very narrow beam (Cholewiak et al., 2017). During a scientific cetacean survey, an array of echosounders was used in a one-day-on, one-day-off paradigm. Beaked whale acoustic detections occurred predominantly (96 percent) when the echosounder was off, with only 4 detections occurring when it was on. Beaked whales were sighted fairly equally when the echosounder was on or off, but sightings were further from the ship when the echosounder was on (Cholewiak et al., 2017). These findings indicate that the beaked whales may be avoiding the area and may cease foraging near the echosounder.

Tyack et al. (2011) hypothesized that beaked whale responses to sonar may represent an anti-predator response. To test this idea, vocalizations of a potential predator—a killer whale—were also played back to a Blainville's beaked whale. This exposure resulted in a similar but more pronounced reaction than that elicited by sonar playback, which included longer inter-dive intervals and a sustained straight-line departure of more than 20 km from the area (Allen et al., 2014; Tyack et al., 2011). This anti-predator hypothesis was also tested by playing back killer whale vocalizations to pilot whales, sperm whales, and even other killer whales, to determine responses by both potential prey and conspecifics (Miller et al., 2011; Miller, 2012). Results varied, from no response by killer whales to an increase in group size and attraction to the source in pilot whales (Curé et al., 2012).

While there has been a focus on beaked whale responses to sonar, other species have been studied during behavioral response studies as well, including pilot whales, killer whales, and sperm whales. Responses by these species have also included horizontal avoidance, changes in behavioral state, and changes in dive behavior (Antunes et al., 2014; Miller et al., 2011; Miller, 2012; Miller et al., 2014). Additionally, separation of a killer whale calf from its group during exposure to mid-frequency sonar playback was observed (Miller et al., 2011). Received level thresholds at the onset of avoidance behavior were generally higher for pilot whales (mean 150 dB re 1 µPa) and sperm whales (mean 140 dB re 1 µPa) than killer whales (mean 129 dB re 1 µPa) (Antunes et al., 2014; Miller, 2012; Miller et al., 2014). A close examination of the tag data from the Norwegian groups showed that responses seemed to be behaviorally or signal frequency mediated. For example, killer whales only changed their dive behavior when doing deep dives at the onset of 1–2 kHz sonar (sweeping across frequencies), but did not change their dive behavior if they were deep-diving during 6–7 kHz sonar (sweeping across frequencies). Nor did they change their dive behavior if they were conducting shallow dives at the onset of either type of sonar. Similarly, pilot whales and sperm whales performed normal deep dives during 6–7 kHz sonar, while during 1–2 kHz sonar the pilot whales conducted fewer deep dives and the sperm whales performed shorter and shallower dives (Sivle et al., 2012). In addition, pilot whales were also more likely to respond to lower received levels when non-feeding than feeding during 6–7 kHz sonar exposures, but were more likely to respond at higher received levels when non-feeding during 1–2 kHz sonar exposures. Furthermore, pilot whales exposed to a 38 kHz downward-facing echosounder did not change their dive and foraging behavior during exposure periods, although the animals' heading variance increased and fewer deep dives were conducted (Quick et al., 2017). In contrast, killer whales were more likely to respond to either sonar type when non-feeding than when feeding (Harris et al., 2015). These results again demonstrate that the behavioral state of the animal mediates the likelihood of a behavioral response, as do the characteristics (e.g., frequency) of the sound source itself.

Other responses during behavioral response studies included the synchronization of pilot whale surfacings with sonar pulses during one exposure, possibly as a means of mitigating the sound (Wensveen et al., 2015), and mimicry of the sonar with whistles by pilot whales (Alves et al., 2014), false killer whales (DeRuiter et al., 2013a) and Risso's dolphins (Smultea et al., 2012). In contrast, in another study melon-headed whales had "minor transient silencing" (a brief, non-lasting period of silence) after each 6–7 kHz signal, and (in a different oceanographic region) pilot whales had no apparent response (DeRuiter et al., 2013a). The probability of detecting delphinid vocalizations (whistles, clicks, and buzzes) increased during periods of sonar relative to the period prior to sonar in a passive acoustic study using Marine Autonomous Recording Units in the Jacksonville Range Complex, while there was no impact of sonar to the probability of detecting sperm whale clicks (Charif et al., 2015; U.S. Department of the Navy, 2013b).

In addition, killer whale sighting data from the same region in Norway as the behavioral response study was used to compare the presence or absence of whales from other years against the period with sonar. The authors found a strong relationship between the presence of whales and the abundance of herring, and only a weak relationship between the whales and sonar activity (Kuningas et al., 2013). Baird et al. (2013; 2014; 2017) also tagged four shallow-diving odontocete species (rough-toothed dolphins, pilot whales, bottlenose dolphins, and false killer whales) in Hawaii off the Pacific Missile Range Facility before Navy training events. None of the tagged animals demonstrated a large-scale avoidance response to the sonar as they moved on or near the range, in some cases even traveling towards areas of higher noise levels, while estimated received SPLs varied from 130 to 168 dB re 1 µPa and distances from sonar sources ranged between 3.2 and 94.4 km. However, one pilot whale did have reduced dive rates (from 2.6 dives per hour before to 1.6 dives per hour during) and deeper dives (from a mean of 124 m to 268 m) during a period of sonar exposure. Baird et al. (2016) also tagged four short-finned pilot whales from both the resident island-associated population and from the pelagic population. The core range for the pelagic population was over 20 times larger than for the pelagic population, leading Baird et al. (2016) to hypothesize that that likelihood of exposure to mid-frequency active sonar, and therefore the potential for response, would be very different between the two populations. These diverse examples demonstrate that responses can be varied, are often context- and behavior-driven, and can be species and even exposure specific.

Other opportunistic observations of behavioral responses to sonar have occurred as well, although in those cases it is difficult to attribute observed responses directly to the sonar exposure, or to know exactly what form the response took. For example, both sperm and pilot whales potentially ceased sound production during the Heard Island feasibility test, with transmissions centered at 57 Hz and up to 220 dB re 1 µPa (Bowles et al., 1994), although it could not be determined whether the animals ceased sound production or left the area. In May 2003, killer whales in Haro Strait, Washington, exhibited what were believed by some observers to be aberrant behaviors, during which time the USS Shoup was in the vicinity and engaged in mid-frequency active sonar operations. Sound fields modeled for the USS Shoup transmissions (Fromm, 2009; National Marine Fisheries Service, 2005; U.S. Department of the Navy, 2004) estimated a mean received SPL of approximately 169 dB re 1 µPa at the location of the killer whales at the closest point of approach between the animals and the vessel (estimated SPLs ranged from 150 to 180 dB re 1 µPa). However, attributing the observed behaviors to any one cause is problematic given there were six nearby whale watch vessels surrounding the pod, and subsequent research has demonstrated that "Southern Residents modify their behavior by increasing surface activity (breaches, tail slaps, and pectoral fin slaps) and swimming in more erratic paths when vessels are close" (National Oceanic and Atmospheric Administration Fisheries, 2014). Several odontocete species, including bottlenose dolphins, Risso's dolphins, Pacific white-sided dolphins, and common dolphins have been observed near the Southern California Offshore Range during periods of mid-frequency active sonar; responses included changes in or cessation of vocalizations, changes in behavior, and leaving the area, and at the highest received levels animals were not present in the area at all (Henderson et al., 2014b). However, these observations were conducted from a vessel off-range, and so any observed responses could not be attributed to the sonar with any certainty. Research on sperm whales in the Caribbean in 1983 coincided with the U.S. intervention in Grenada, where animals were observed scattering and leaving the area in the presence of military sonar, presumably from nearby submarines (Watkins & Schevill, 1975; Watkins et al., 1985). The authors did not report received levels from these exposures and reported similar reactions from noise generated by banging on their boat hull; therefore, it was unclear if the sperm whales were reacting to the sonar signal itself or to a potentially new unknown sound in general.

During aerial and visual monitoring of Navy training events involving sonar, rough-toothed dolphins and unidentified dolphins were observed approaching the vessel with active sonar as if to bowride, while spotted dolphins were observed nearby but did not avoid or approach the vessel (Mobley, 2011; U.S. Department of the Navy, 2011a; Watwood et al., 2012). During small boat surveys near the Southern California Offshore Range in southern California, more dolphins were encountered in June compared to a similar survey conducted the previous November after 7 days of mid-frequency sonar activity; it was not investigated if this change was due to the sonar activity or was due to the poor weather conditions in November that may have prevented animals from being seen (Campbell et al., 2010). There were also fewer passive acoustic dolphin detections during and after longer sonar activities in the Mariana Islands Range Complex, with the post-activity absence lasting longer than the mean dolphin absence of two days when sonar was not present (Munger et al., 2014; Munger et al., 2015).

Acoustic harassment devices and acoustic deterrent devices, which transmit sound into the acoustic environment similar to Navy sources, have been used to deter marine mammals from fishing gear both to prevent entanglement and to reduce depredation (taking fish). These devices have been used successfully to deter harbor porpoises and beaked whales from getting entangled in fishing nets. For example, Kyhn et al. (2015) tested two types of pingers, one with a 10 kHz tone and one with a broadband 30–160 kHz sweep. Porpoise detection rates were reduced by 65 percent for the sweep and 40 percent for the tone, and while there was some gradual habituation after the first two to four exposures, longer term exposures (over 28 days) showed no evidence of additional habituation. Additionally, sperm whales in the Caribbean stopped vocalizing when presented with sounds from nearby acoustic pingers (Watkins & Schevill, 1975). However, acoustic harassment devices used to deter marine mammals from depredating long lines or aquaculture enclosures have proven less successful. For example, Tixier et al. (2014) used a 6.5 kHz pinger with a source level of 195 dB re 1 µPa on a longline to prevent depredation by killer whales, and although two groups of killer whales fled over 700 m away during the first exposure, they began depredating again after the 3rd and 7th exposures, indicating rapid habituation. In a review of marine mammal deterrents, Schakner & Blumstein (2013) point out that both the characteristics of deterrents and the motivation of the animal play a role in the effectiveness of acoustic harassment devices. Deterrents that are strongly aversive or simulate a predator or are otherwise predictive of a threat are more likely to be effective, unless the animal habituates to the signal or learns that there is no true threat associated with the signal. In some cases net pingers may create a "dinner bell effect," where marine mammals have learned to associate the signal with the availability of prey (Jefferson & Curry, 1996; Schakner & Blumstein, 2013). This may be why net pingers have been more successful at reducing entanglements for harbor porpoise and beaked whales since these species are not depredating from the nets but are getting entangled when foraging in the area and are unable to detect the net (Carretta et al., 2008; Schakner & Blumstein, 2013). Similarly, a 12 kHz acoustic harassment device intended to scare seals was ineffective at deterring seals but effectively caused avoidance in harbor porpoises out to over 500 m from the source, highlighting different species- and device-specific responses (Mikkelsen et al., 2017). Additional behavioral studies have been conducted with captive harbor porpoises using acoustic alarms, such as those used on fishing nets to help deter marine mammals from becoming caught or entangled (Kastelein et al., 2006; Kastelein et al., 2001). These studies have found that high-frequency sources with varied duration, interval, and sweep characteristics can prove to be effective deterrents for harbor porpoises (Kastelein et al., 2017c). Van

Beest et al. (2017) modeled the long-term, population-level impacts of fisheries bycatch, pinger deterrents, and time-area closures on a population of harbor porpoises. They found that when pingers were used alone (in the absence of gillnets or time-area closures), the animals were deterred from the area often enough to cause a population-level reduction of 21 percent, greater even than the modeled level of current bycatch impacts. However, when the pingers were coupled with gillnets in the model, and time-area closures were also used (allowing a net- and pinger-free area for the porpoises to move into while foraging), the population only experienced a 0.8 percent decline even with current gillnet use levels. This demonstrates that, when used correctly, pingers can successfully deter porpoises from gillnets without leading to any negative impacts.

Controlled experiments have also been conducted on captive animals to estimate received levels at which behavioral responses occur. In one study, bottlenose dolphin behavioral responses were recorded when exposed to 3 kHz sonar-like tones between 115 and 185 dB re 1 μPa (Houser et al., 2013), and in another study bottlenose dolphins and beluga whales were presented with one-second tones up to 203 dB re 1 μPa to measure TTS (Finneran et al., 2001; Finneran et al., 2003a; Finneran & Schlundt, 2004; Finneran et al., 2005b; Schlundt et al., 2000). During these studies, responses included changes in respiration rate, fluke slaps, and a refusal to participate or return to the location of the sound stimulus. This refusal included what appeared to be deliberate attempts to avoid a sound exposure or to avoid the location of the exposure site during subsequent tests (Finneran et al., 2002; Schlundt et al., 2000). In the behavioral response experiment, bottlenose dolphins demonstrated a 50 percent probability of response at 172 dB re 1 μPa over 10 trials, and in the TTS study bottlenose dolphins exposed to one-second intense tones exhibited short-term changes in behavior above received sound levels of 178 to 193 dB re 1 μPa, and beluga whales did so at received levels of 180 to 196 dB re 1 μPa and above. In some instances, animals exhibited aggressive behavior toward the test apparatus (Ridgway et al., 1997; Schlundt et al., 2000). While animals were commonly reinforced with food during these studies, the controlled environment and ability to measure received levels provide insight on received levels at which animals will behaviorally responds to noise sources.

Behavioral responses to a variety of sound sources have been studied in captive harbor porpoises, including acoustic alarms (Kastelein et al., 2006; Kastelein et al., 2001), emissions for underwater data transmission (Kastelein et al., 2005), and tones, including 1−2 kHz and 6−7 kHz sweeps with and without harmonics (Kastelein et al., 2014d), 25 kHz with and without sidebands (Kastelein et al., 2015e; Kastelein et al., 2015f), and mid-frequency sonar tones at 3.5–4.1 kHz at 2.7 percent and 96 percent duty cycles (e.g., one tone per minute versus a continuous tone for almost a minute) (Kastelein et al., 2018b). Responses include increased respiration rates, more jumping, or swimming further from the source, but responses were different depending on the source. For example, harbor porpoises responded to the 1−2 kHz upsweep at 123 dB re 1 μPa, but not to the downsweep or the 6−7 kHz tonal at the same level (Kastelein et al., 2014d). When measuring the same sweeps for a startle response, the 50 percent response threshold was 133 and 101 dB re 1 μPa for 1−2 kHz and 6−7 kHz sweeps, respectively, when no harmonics were present, and decreased to 90 dB re 1 μPa for 1−2 kHz sweeps with harmonics present (Kastelein et al., 2014d). Harbor porpoises did not respond to the low-duty cycle mid-frequency tones at any received level, but one did respond to the high-duty cycle signal with more jumping and increased respiration rates (Kastelein et al., 2018b). Harbor porpoises responded to seal scarers with broadband signals up to 44 kHz with a slight respiration response at 117 dB re 1 μPa and an avoidance response at 139 dB re 1 μPa, but another scarer with a fundamental (strongest) frequency of 18 kHz did not have an avoidance response until 151 dB re 1 μPa (Kastelein et al., 2014a). Exposure of the same acoustic pinger to a striped dolphin under the same conditions did not elicit a response (Kastelein et al., 2006), again highlighting the importance in understanding species differences in the tolerance of underwater noise, although sample sizes in these studies was small so these could reflect individual differences as well.

Behavioral responses by odontocetes to sonar and other transducers appear to range from no response at all to responses that could potentially lead to long-term consequences for individual animals (e.g., mother-calf separation). This is likely in part due to the fact that this taxonomic group is so broad and includes some of the most sensitive species (e.g., beaked whales and harbor porpoise) as well as some of the least sensitive species (e.g., bottlenose dolphins). This is also the only group for which both field behavioral response studies and captive controlled exposure experiments have been conducted, leading to the assessment of both contextually driven responses as well as dose-based responses. This wide range in both exposure situations and individual- and species-sensitivities makes reaching general conclusions difficult. However, it does appear as though exposures in close proximity, with multiple vessels that approach the animal lead to higher-level responses in most odontocete species regardless of received level or behavioral state. In contrast, in more “real-world” exposure situations, with distant sources moving in variable directions, behavioral responses appear to be driven by behavioral state, individual experience or species-level sensitivities. These responses may also occur more in-line with received level such that the likelihood of a response would increase with increased received levels. However, these “real-world” responses are more likely to be short-term, lasting the duration of the exposure or even shorter as the animal assesses the sound and (based on prior experience or contextual cues) determines a threat is unlikely. Therefore, while odontocete behavioral responses to Navy sonar will vary across species, populations, and individuals, they are not likely to lead to long-term consequences or population-level effects.

Pinnipeds

Different responses displayed by captive and wild phocid seals to sound judged to be “unpleasant” or threatening have been reported, including habituation by captive seals (they did not avoid the sound), and avoidance behavior by wild seals (Götz & Janik, 2010). Captive seals received food (reinforcement) during sound playback, while wild seals were exposed opportunistically. These results indicate that motivational state (e.g., reinforcement via food acquisition) can be a factor in whether or not an animal tolerates or habituates to novel or unpleasant sounds. Another study found that captive hooded seals reacted to 1–7 kHz sonar signals, in part with displacement (i.e., avoidance) to the areas of least SPL, at levels between 160 and 170 dB re 1 µPa (Kvadsheim et al., 2010b); however, the animals adapted to the sound and did not show the same avoidance behavior upon subsequent exposures. Captive harbor seals responded differently to three signals at 25 kHz with different waveform characteristics and duty cycles. The seals responded to the frequency modulated signal at received levels over 137 dB re 1 µPa by hauling out more, swimming faster, and raising their heads or jumping out of the water, but did not respond to the continuous wave or combination signals at any received level (up to 156 dB re 1 µPa) (Kastelein et al., 2015d). Captive California sea lions were exposed to mid-frequency sonar at various received levels (125–185 dB re 1 µPa) during a repetitive task (Houser et al., 2013). Behavioral responses included a refusal to participate, hauling out, an increase in respiration rate, and an increase in the time spent submerged. Young animals (less than two years old) were more likely to respond than older animals. Dose-response curves were developed both including and excluding those young animals. The majority of responses below 155 dB re 1 µPa were changes in respiration, whereas over 170 dB re 1 µPa more severe responses began to occur (such as hauling out or refusing to participate); many of the most severe responses came from the younger animals.

Low-frequency signals of the Acoustic Thermometry of Ocean Climate sound source centered at 75 Hz, with received levels between 118 and 137 dB re 1 µPa, were not found to overtly affect elephant seal dives (Costa et al., 2003). However, they did produce subtle effects that varied in direction and degree among the individual seals, again illustrating the equivocal nature of behavioral effects and consequent difficulty in defining and predicting them.

Harbor seals exposed to seal scarers (i.e., acoustic harassment devices) used to deter seals from fishing nets did not respond at levels of 109–134 dB re 1 µPa and demonstrated minor responses by occasionally hauling out at 128–138 dB re 1 µPa (Kastelein et al., 2015c). Pingers have also been used to deter marine mammals from fishing nets; in some cases, this has led to the “dinner bell effect,” where the pinger becomes an attractant rather than a deterrent (Carretta & Barlow, 2011). Steller sea lions were exposed to a variety of tonal, sweep, impulse and broadband sounds. The broadband sounds did not cause a response, nor did the tones at levels below 165 dB re 1 µPa at 1 m, but the 8 kHz tone and 1–4 kHz sweep at source levels of 165 dB re 1 µPa caused the sea lions to haul out (Akamatsu et al., 1996).

Similar to the other taxonomic groups assessed, pinniped behavioral responses to sonar and other transducers seem to be mediated by the contextual factors of the exposure, including the proximity of the source, the characteristics of the signal, and the behavioral state of the animal. However, all pinniped behavioral response studies have been conducted in captivity, so while these results may be broadly applied to real-world exposure situations, it must be done with caution. Based on exposures to other sound sources in the wild (e.g., impulsive sounds and vessels), pinnipeds are not likely to respond strongly to Navy sonar that is not in close proximity to the animal or approaching the animal.

Sea Otters

There is no research on the effects of sonar on sea otters. Sea otters spend approximately 80 percent of their time on the surface of the water (Curland, 1997) with their heads above the surface, which reduces their exposure to underwater sounds; however, they may show similar reactions to those of pinnipeds which are also amphibious hearers. However, underwater hearing sensitivities are significantly reduced in sea otters when compared to pinnipeds (Ghoul & Reichmuth, 2014a, 2014b), so any reactions may have lower overall severity. Pinnipeds may haul out, swim faster, or increase their respiration rate in response to sonar (Houser et al., 2013; Kastelein et al., 2015d). Pinnipeds also showed that they may avoid an area temporarily, but may habituate to sounds quickly (Kvadsheim et al., 2010a; Kvadsheim et al., 2010b). Sea otters may also habituate to sonar signals. However, sea otters live too far inshore to likely be exposed to or impacted by Navy sonar or other transducers, and live out of the area of pierside activity.

Behavioral Reactions to Vessels

Sound emitted from large vessels, such as cargo ships, is the principal source of low-frequency noise in the ocean today, and marine mammals are known to react to or be affected by that noise (Hatch & Wright, 2007; Hildebrand, 2005; Richardson et al., 1995b). For example, Erbe et al. (2012) estimated the maximum annual underwater SEL from vessel traffic near Seattle was 215 dB re 1 µPa^2-s, and Bassett et al. (2010) measured mean SPLs at Admiralty Inlet from commercial shipping at 117 dB re 1 µPa with a maximum exceeding 135 dB re 1 µPa on some occasions. Similarly, Veirs et al. (2015) found average broadband noise levels in Haro Strait to be 110 dB re 1 µPa that extended up to 40 kHz, well into the hearing range of odontocetes.

Many studies of behavioral responses by marine mammals to vessels have been focused on the short-and long-term impacts of whale watching vessels. In short-term studies, researchers noted changes in resting and surface behavior states of cetaceans to whale watching vessels (Acevedo, 1991; Aguilar de Soto et al., 2006; Arcangeli & Crosti, 2009; Au & Green, 2000; Christiansen et al., 2010; Erbe, 2002; Noren et al., 2009; Stockin et al., 2008; Williams et al., 2009). Received levels were often not reported so it is difficult to distinguish responses to the presence of the vessel from responses to the vessel noise. Most studies examined the short-term response to vessel sound and vessel traffic (Magalhães et al., 2002; Richardson et al., 1995b; Watkins, 1981), with behavioral and vocal responses occurring when received levels were over 20 dB greater than ambient noise levels. Other research has attempted to quantify the effects of whale watching using focused experiments (Meissner et al., 2015; Pirotta et al., 2015b).

The impact of vessel noise has received increased consideration, particularly as whale watching and shipping traffic has risen (McKenna et al., 2012; Pirotta et al., 2015b; Veirs et al., 2015). Odontocetes and mysticetes in particular have received increased attention relative to vessel noise and vessel traffic, with pinnipeds less so. Still, not all species in all taxonomic groups have been studied, and so results do have to be extrapolated across these broad categories in order to assess potential impacts.

Mysticetes

Baleen whales demonstrate a variety of responses to vessel traffic and noise, from not responding at all to both horizontal (swimming away) and vertical (increased diving) avoidance (Baker et al., 1983; Gende et al., 2011; Watkins, 1981). Other common responses include changes in vocalizations, surface time, swimming speed, swimming angle or direction, respiration rates, dive times, feeding behavior, and social interactions (Au & Green, 2000; Machernis et al., 2018; Richter et al., 2003; Williams et al., 2002a).

The likelihood of response may be driven by the distance or speed of the vessel, the animal's behavioral state, or by the prior experience of the individual or population. For example, in one study fin and humpback whales largely ignored vessels that remained 100 m or more away (Watkins, 1981). In another study, minke whales in the Antarctic did not show any apparent response to a survey vessel moving at normal cruising speeds (about 12 knots) at a distance of 5.5 NM. However, when the vessel drifted or moved at very slow speeds (about 1 knot), many whales approached it (Leatherwood et al., 1982). Similarly, Bernasconi et al. (2012) observed the reactions of six individual baleen whales of unknown species at distances of 50–400 m from a fishing vessel conducting an acoustic survey of pelagic fisheries, with only a slight change in swim direction when the vessel began moving around the whales. Gray whales were likely to continue feeding when approached by a vessel in areas with high motorized vessel traffic, but in areas with less motorized vessel traffic they were more likely to change behaviors, either indicating habituation to vessels in high traffic area, or indicating possible startle reactions to close-approaching non-motorized vessels (e.g., kayaks) in quieter areas (Sullivan & Torres, 2018). Changes in behavior of humpback whales when vessels came within 500 m were also dependent on behavioral state such that they would keep feeding but were more likely to start traveling if they were surface active when approached; changes in behavior were also affected by time of day or season (Di Clemente et al., 2018). Sei whales have been observed ignoring the presence of vessels entirely and even passing close to the vessel (Reeves et al., 1998), and North Atlantic right whales tend not to respond to the sounds of oncoming vessels and continue to use habitats in high vessel traffic areas (Nowacek et al., 2004). Studies show that North Atlantic right whales demonstrate little if any reaction to sounds of vessels approaching or the presence of the vessels themselves. This lack of response may be due to habituation to the presence and associated noise of vessels in right whale habitat, or may be due to propagation effects that may attenuate vessel noise near the surface (Nowacek et al., 2004; Terhune & Verboom, 1999).

When baleen whales do respond to vessels, responses can be as minor as a change in breathing patterns (e.g., Baker et al., 1983; Jahoda et al., 2003), or can be evidenced by a decrease in overall presence, as was observed during a construction project in the United Kingdom, when fewer minke whales were observed as vessel traffic increased (Anderwald et al., 2013). Avoidance responses can be as simple as an alteration in swim patterns or direction by increasing speed and heading away from the vessel (Jahoda et al., 2003), or by increasing swim speed, changing direction to avoid, and staying submerged for longer periods of time (Au & Green, 2000). For example, in the presence of approaching vessels, blue whales perform shallower dives accompanied by more frequent surfacing but otherwise do not exhibit strong reactions (Calambokidis et al., 2009c). In another study in Hawaii, humpback whales exhibited two forms of behavioral avoidance: horizontal avoidance (changing direction or speed) when vessels were between 2,000 m and 4,000 m away, and vertical avoidance (increased dive times and change in diving pattern) when vessels were less than 2,000 m away (Baker et al., 1983). Similarly, humpback whales in Australia demonstrated variable responses to whale watching vessels, including both horizontal avoidance, approaching, and changes in dive and surface behavior (Stamation et al., 2009). Humpback whales avoided a Navy vessel by increasing their dive times and decreasing respiration rates at the surface (Smultea et al., 2009). Williamson et al. (2016) specifically looked at close approaches to humpback whales by small research boats for the purposes of tagging. They found that while dive behavior did not change for any groups, some groups did increase their speed and change their course during or right after the approach, but resumed pre-approach speed and heading shortly thereafter. Only mother-calf groups were found to increase their speed during the approach and maintain the increased speed for longer after the approach, but these groups too resumed normal swim speeds after about 40 minutes. It should be noted that there were no responses by any groups that were approached closely but with no attempts at tagging, indicating that the responses were not due to the vessel presence but to the tagging attempt. In addition, none of the observed changes in behavior were outside the normal range of swim speeds or headings for these migrating whales.

Mysticetes have been shown to both increase and decrease calling behavior in the presence of vessel noise. Based on passive acoustic recordings and in the presence of sounds from passing vessels, Melcón et al. (2012) reported that blue whales had an increased likelihood of producing certain types of calls. An increase in feeding call rates and repetition by humpback whales in Alaskan waters is associated with vessel noise (Doyle et al., 2008), while decreases in singing activity have been noted near Brazil due to boat traffic (Sousa-Lima & Clark, 2008). Frequency parameters of fin whale calls also decreased in the presence of increasing background noise due to shipping traffic (Castellote et al., 2012). Bowhead whales avoided the area around icebreaker ship noise and increased their time at the surface and number of blows (Richardson et al., 1995a). Right whales increase the amplitude or frequency of their vocalizations or call at a lower rate in the presence of increased vessel noise (Parks et al., 2007; Parks et al., 2011), and these vocalization changes may persist over long periods if background noise levels remained elevated.

The long-term consequences of vessel noise are not well understood (see Section 3.4.2.1.7, Long-Term Consequences). In a short-term study, minke whales on feeding grounds in Iceland responded to increased whale watching vessel traffic with a decrease in foraging, both during deep dives and at the surface (Christiansen et al., 2013). They also increased their avoidance of the boats while decreasing their respiration rates, likely leading to an increase in their metabolic rates. Christiansen and Lusseau

(2015) and Christiansen et al. (2014) followed up this study by modeling the cumulative impacts of whale watching boats on minke whales, but found that although the boats cause temporary feeding disruptions, there were not likely to be long-term consequences as a result. This suggests that short-term responses may not lead to long-term consequences and that over time animals may habituate to the presence of vessel traffic. However, in an area of high whale watch activity, vessels were within 2,000 m of blue whales 70 percent of the time, with a maximum of 8 vessels observed within 400 m of one whale at the same time. This study found reduced surface time, fewer breaths at the surfaced, and shorter dive times when vessels were within 400 m (Lesage et al., 2017). Since blue whales in this area forage 68 percent of the time, and their foraging dive depths are constrained by the location of prey patches, these reduced dive durations may indicate reduced time spent foraging by over 36 percent. In the short term this reduction may be compensated for, but prolonged exposure to vessel traffic could lead to long-term consequences. Using historical records, Watkins (1986) showed that the reactions of four species of mysticetes to vessel traffic and whale watching activities in Cape Cod had changed over the 25-year period examined (1957–1982). Reactions of minke whales changed from initially more positive reactions, such as coming towards the boat or research equipment to investigate, to more uninterested reactions towards the end of the study. Fin whales, the most numerous species in the area, showed a trend from initially more negative reactions, such as swimming away from the boat with limited surfacing, to more uninterested reactions (ignoring) allowing boats to approach within 30 m Right whales showed little change over the study period, with a roughly equal number of reactions judged to be negative and uninterested; no right whales were noted as having positive reactions to vessels. Humpback whales showed a trend from negative to positive reactions with vessels during the study period. The author concluded that the whales had habituated to the human activities over time (Watkins, 1986).

Overall baleen whale responses to vessel noise and traffic are varied but are generally minor, and habituation or disinterest seems to be the predominant long-term response. When baleen whales do avoid ships they do so by altering their swim and dive patterns to move away from the vessel, but no strong reactions have been observed. In fact, in many cases the whales do not appear to change their behavior at all. This may result from habituation by the whales, but may also result from reduced received levels near the surface due to propagation, or due to acoustic shadowing of the propeller cavitation noise by the ship's hull. Although a lack of response in the presence of a vessel may minimize potential disturbance from passing ships, it does increase the whales' vulnerability to vessel strike, which may be of greater concern for baleen whales than vessel noise (see Section 3.4.2.4, Impacts from Physical Disturbance and Strike).

Odontocetes

Most odontocetes react neutrally to vessels, although both avoidance and attraction behavior have been observed (Hewitt, 1985; Würsig et al., 1998). Würsig et al. (1998) found that Kogia whales and beaked whales were the most sensitive species to vessels, and reacted by avoiding marine mammal survey vessels in 73 percent of sightings, more than any other odontocetes. Avoidance reactions include a decrease in resting behavior or change in travel direction (Bejder et al., 2006a). Incidents of attraction include common, rough-toothed, and bottlenose dolphins bow riding and jumping in the wake of a vessel (Norris & Prescott, 1961; Ritter, 2002; Shane et al., 1986; Würsig et al., 1998). A study of vessel reactions by dolphin communities in the eastern tropical Pacific found that populations that were often the target of tuna purse-seine fisheries (spotted, spinner, and common dolphins) show evasive behavior when approached; however, populations that live closer to shore (within 100 NM; coastal spotted and bottlenose dolphins) that are not set on by purse-seine fisheries tend to be attracted to vessels (Archer et al., 2010). The presence of vessels has also been shown to interrupt feeding behavior in delphinids (Meissner et al., 2015; Pirotta et al., 2015b).

Short-term displacement of dolphins due to tourist boat presence has been documented (Carrera et al., 2008), while longer term or repetitive/chronic displacement for some dolphin groups due to chronic vessel noise has been noted (Haviland-Howell et al., 2007). Delphinid behavioral states also change in the presence of tourist boats that often approach animals, with travel increasing and foraging decreasing (Cecchetti et al., 2017; Meissner et al., 2015). Most studies of the behavioral reactions to vessel traffic of bottlenose dolphins have documented at least short-term changes in behavior, activities, or vocalization patterns when vessels are near, although the distinction between vessel noise and vessel movement has not been made clear (Acevedo, 1991; Arcangeli & Crosti, 2009; Berrow & Holmes, 1999; Fumagalli et al., 2018; Gregory & Rowden, 2001; Janik & Thompson, 1996; Lusseau, 2004; Marega et al., 2018; Mattson et al., 2005; Scarpaci et al., 2000). Steckenreuter (2011) found bottlenose dolphin groups to feed less, become more tightly clustered, and have more directed movement when approached to 50 m than groups approached to 150 m or approached in a controlled manner. Guerra et al. (2014) demonstrated that bottlenose dolphins subjected to chronic noise from tour boats responded to boat noise by alterations in group structure and in vocal behavior but also found the dolphins' reactions varied depending on whether the observing research vessel was approaching or moving away from the animals being observed. This demonstrates that the influence of the sound exposure cannot be decoupled from the physical presence of a surface vessel, thus complicating interpretations of the relative contribution of each stimulus to the response. Indeed, the presence of surface vessels, their approach, and speed of approach, seemed to be significant factors in the response of the Indo-Pacific humpback dolphins (Ng & Leung, 2003).

The effects of tourism and whale watching have highly impacted killer whales, such as the Northern and Southern Resident populations. These animals are targeted by numerous small whale watching vessels in the Pacific Northwest and, from 1998 to 2012 during the viewing season, have had an annual monthly average of nearly 20 vessels of various types within 0.5 miles of their location during daytime hours (Clark, 2015; Eisenhardt, 2014; Erbe et al., 2014). These vessels have source levels that ranged from 145 to 169 dB re 1 µPa and produce broadband noise up to 96 kHz. While new regulations on the distance boats had to maintain were implemented, there did not seem to be a concurrent reduction in the received levels of vessel noise, and noise levels were found to increase with more vessels and faster moving vessels (Holt et al., 2017). These noise levels have the potential to result in behavioral disturbance, interfere with communication, and affect the killer whales' hearing capabilities via masking (Erbe, 2002; Veirs et al., 2015). Killer whales foraged significantly less and traveled significantly more when boats were within 100 m of the whales (Kruse, 1991; Lusseau et al., 2009; Trites & Bain, 2000; Williams et al., 2002a; Williams et al., 2002b; Williams et al., 2009). These short-term feeding activity disruptions may have important long-term population-level effects (Lusseau et al., 2009; Noren et al., 2009). As with other delphinids, the reaction of the killer whales to whale watching vessels may be in response to the vessel pursuing them rather than to the noise of the vessel itself, or to the number of vessels in their proximity. Williams et al. (2014b) modeled behavioral responses of killer whales to vessel traffic by looking at their surface behavior relative to the received level of three large classes of ships. The authors found that the severity of the response was largely dependent on seasonal data (e.g., year and month) as well as the animal's prior experience with vessels (e.g., age and sex), and the number of other vessels present, rather than the received level of the larger ships (Williams et al., 2014b).

Sperm whales generally react only to vessels approaching within several hundred m; however, some individuals may display avoidance behavior, such as quick diving (Magalhães et al., 2002; Würsig et al., 1998) or a decrease in time spent at the surface (Isojunno & Miller, 2015). One study showed that after diving, sperm whales showed a reduced timeframe before they emitted the first click than prior to a vessel interaction (Richter et al., 2006). Smaller whale watching and research vessels generate more noise in higher frequency bands and are more likely to approach odontocetes directly, and to spend more time near an individual whale. Azzara et al. (2013) also found a reduction in sperm whale clicks while a vessel was passing, as well as up to a half hour after the vessel had passed. It is unknown whether the whales left the area, ceased to click, or surfaced during this period. However, some of the reduction in click detections may be due to masking of the clicks by the vessel noise, particularly during the closest point of approach.

Little information is available on the behavioral impacts of vessels or vessel noise on beaked whales (Cox et al., 2006), although it seems most beaked whales react negatively to vessels by quick diving and other avoidance maneuvers (Würsig et al., 1998). Limited evidence suggests that beaked whales respond to vessel noise, anthropogenic noise in general, and mid-frequency sonar at similar sound levels (Aguilar de Soto et al., 2006; Tyack et al., 2011; Tyack, 2009). An observation of vocal disruption of a foraging dive by a Cuvier's beaked whale when a large, noisy vessel passed suggests that some types of vessel traffic may disturb foraging beaked whales (Aguilar de Soto et al., 2006). Tyack et al. (2011) noted the result of a controlled exposure to pseudorandom noise suggests that beaked whales would respond to vessel noise at similar received levels to those noted previously for mid-frequency sonar. Pirotta et al. (2012) found that while the distance to a vessel did not change the duration of a foraging dive, the proximity of the vessel may have restricted the movement of the group. The maximum distance at which this change was significant was 5.2 km, with an estimated received level of 135 dB re 1 µPa.

Small dolphins and porpoises may also be more sensitive to vessel noise. Both finless porpoises (Li et al., 2008) and harbor porpoises (Polacheck & Thorpe, 1990) routinely avoid and swim away from large motorized vessels, and harbor porpoises may click less when near large ships (Sairanen, 2014). A resident population of harbor porpoise in Swansea Bay are regularly near vessel traffic, but only 2 percent of observed vessels had interactions with porpoises in one study (Oakley et al., 2017). Of these, 74 percent of the interactions were neutral (no response by the porpoises) while vessels were 10 m–1 km away. Of the 26 percent of interactions in which there was an avoidance response, most were observed in groups of 1–2 animals to fast-moving or steady plane-hulling motorized vessels. Larger groups reacted less often, and few responses were observed to non-motorized or stationary vessels. Another study found that when vessels were within 50 m, harbor porpoises had an 80 percent probability of changing their swimming direction when vessels were fast moving; this dropped to 40 percent probability when vessels were beyond 400 m (Akkaya Bas et al., 2017). These porpoises also demonstrated a reduced proportion of feeding and shorter behavioral bout durations in general, if vessels were in close proximity, 62 percent of the time. Although most vessel noise is constrained to lower frequencies below 1 kHz, at close range vessel noise can extend into mid- and high-frequencies (into the tens of kHz) (Hermannsen et al., 2014; Li et al., 2015); these frequencies are what harbor porpoises are likely responding to, at M-weighted received SPLs with a mean of 123 dB re 1 µPa (Dyndo et al., 2015). Foraging harbor porpoises also have fewer prey capture attempts and have disrupted foraging when vessels pass closely and noise levels are higher (Wisniewska et al., 2018).

Odontocetes have been shown to make short-term changes to vocal parameters such as intensity as an immediate response to vessel noise, as well as increase the pitch, frequency modulation, and length of whistling (May-Collado & Wartzok, 2008), with whistle frequency increasing in the presence of low-frequency noise and whistle frequency decreasing in the presence of high-frequency noise (Gospić & Picciulin, 2016). For example, bottlenose dolphins in Portuguese waters decrease their call rates and change the frequency parameters of whistles in the presence of boats (Luís et al., 2014), while dolphin groups with calves increase their whistle rates when tourist boats are within 200 m and when the boats increase their speed (Guerra et al., 2014). Likewise, modification of multiple vocalization parameters was shown in belugas residing in an area known for high levels of commercial traffic. These animals decreased their call rate, increased certain types of calls, and shifted upward in frequency content in the presence of small vessel noise (Lesage et al., 1999). Another study detected a measurable increase in the amplitude of their vocalizations when ships were present (Scheifele et al., 2005). Killer whales are also known to modify their calls during increased noise. For example, the source level of killer whale vocalizations was shown to increase with higher background noise levels associated with vessel traffic (the Lombard effect) (Holt et al., 2008). In addition, calls with a high-frequency component have higher source levels than other calls, which may be related to behavioral state, or may reflect a sustained increase in background noise levels (Holt et al., 2011). On the other hand, long-term modifications to vocalizations may be indicative of a learned response to chronic noise, or of a genetic or physiological shift in the populations. This type of change has been observed in killer whales off the northwestern coast of the United States between 1973 and 2003. This population increased the duration of primary calls once a threshold in observed vessel density (e.g., whale watching) was reached, which is suggested as being a long-term response to increased masking noise produced by the vessels (Foote et al., 2004).

The long-term and cumulative implications of ship sound on odontocetes is largely unknown (National Academies of Sciences Engineering and Medicine, 2017; National Marine Fisheries Service, 2007b), although some long-term consequences have been reported (Lusseau & Bejder, 2007). Repeated exposure to acoustic and other anthropogenic stimuli has been studied in several cases, especially as related to vessel traffic and whale watching. Common dolphins in New Zealand responded to dolphin-watching vessels by interrupting foraging and resting bouts, and took longer to resume behaviors in the presence of the vessel (Stockin et al., 2008). The authors speculated that repeated interruptions of the dolphins' foraging behaviors could lead to long-term implications for the population. Bejder et al. (2006a) studied responses of bottlenose dolphins to vessel approaches and found stronger and longer lasting reactions in populations of animals that were exposed to lower levels of vessel traffic overall. The authors indicated that lesser reactions in populations of dolphins regularly subjected to high levels of vessel traffic could be a sign of habituation, or it could be that the more sensitive animals in this population previously abandoned the area of higher human activity.

Similar to mysticetes, odontocete responses to vessel noise are varied, although many odontocete species seem to be more sensitive to vessel presence and vessel noise, and these two factors are difficult to tease apart. Some species, in particular killer whales and porpoises, may be sensitized to vessels and respond at further distances and lower received levels than other delphinids. In contrast, many odontocete species also approach vessels to bow ride, indicating either that these species are less sensitive to vessels, or that the behavioral drive to bow ride supersedes any impact of the associated noise. With these broad and disparate responses, it is difficult to assess the impacts of vessel noise on odontocetes.

Pinnipeds

Pinniped reactions to vessels are variable and reports include a wide spectrum of possibilities from avoidance and alert, to cases where animals in the water are attracted, and cases on land where there is lack of significant reaction suggesting habituation to or tolerance of vessels (Richardson et al., 1995b). Specific case reports in Richardson et al. (1995b) vary based on factors such as routine anthropogenic activity, distance from the vessel, engine type, wind direction, and ongoing subsistence hunting. As with reactions to sound reviewed by Southall et al. (2007), pinniped responses to vessels are affected by the context of the situation and by the animal's experience.

Anderwald et al. (2013) investigated grey seal reactions to an increase in vessel traffic off Ireland's coast in association with construction activities, and their data suggests the number of vessels had an indeterminate effect on the seals' presence. Harbor seals haul out on tidewater glaciers in Alaska, and most haul outs occur during pupping season. Blundell & Pendleton (2015) found that the presence of any vessel reduces haul out time, but cruise ships and other large vessels in particular shorten haul out times. Another study of reactions of harbor seals hauled out on ice to cruise ship approaches in Disenchantment Bay, Alaska, revealed that animals are more likely to flush and enter the water when cruise ships approach within 500 m and four times more likely when the cruise ship approaches within 100 m (Jansen et al., 2010). Karpovich et al. (2015) also found that harbor seal heart rates increased when vessels were present during haul out periods, and increased further when vessels approached and animals re-entered the water. Harbor seals responded more to vessels passing by haul out sites in areas with less overall vessel activity, and the model best predicting their flushing behavior included the number of boats, type of boats, and distance to boats. More flushing occurred to non-motorized vessels (e.g., kayaks), likely because they tended to occur in groups rather than as single vessels, and tended to pass closer (25–184 m) to the haul out sites than motorized vessels (55–591 m) (Cates & Acevedo-Gutiérrez, 2017). Jones et al. (2017) also modeled the spatial overlap of vessel traffic and grey and harbor seals in the UK, and found most overlap to occur within 50 km of the coast, and high overlap occurring within 5 of 13 grey seal Special Areas of Conservation and within 6 of 12 harbor seal Special Areas of Conservation. They also estimated received levels of shipping noise and found maximum daily M-weighted cumulative SEL values from 170 to 189 dB, with the upper confidence intervals of those estimates sometimes exceeding TTS values. However, there was no evidence of reduced population size in an of these high overlap areas.

Sea Otters

Sea otters that live far inshore and may be exposed to noise from recreational boats and commercial and military ships transiting in and out of port areas. Sea otters have similar in-air hearing sensitivities as pinnipeds (Ghoul & Reichmuth, 2014a, 2014b), and may react in a similar fashion when approached by vessels. However, underwater hearing sensitivities are significantly reduced in sea otters when compared to pinnipeds (Ghoul & Reichmuth, 2014a, 2014b), so while reactions to underwater vessel noise may occur, they will have lower overall severity to those of pinnipeds. Sea otters in Monterey, CA that were living in areas of disturbance from human activity such as recreational boating spent more time engaged in travel than resting (Curland, 1997). Sea otters in undisturbed areas spent 5 percent of their time travelling; otters in areas of disturbance due to vessels were shown to spend 13 percent of their time travelling. However, sea otters may habituate quickly. Even when purposefully harassed in an effort to cause a behavioral response, sea otters generally moved only a short distance (100 to 200 m) before resuming normal activity, and nearby boats, nets, and floating oil containment booms were sometimes an attractant (Davis et al., 1988).

Behavioral Reactions to Aircraft Noise

The following paragraphs summarize what is known about the reaction of various marine mammal species to overhead flights of many types of fixed-wing aircraft and rotary-wing aircraft (i.e., helicopters), as well as unmanned aerial systems. Thorough reviews of the subject and available information is presented in Richardson et al. (1995b) and elsewhere (e.g., Efroymson et al., 2001; Holst et al., 2011; Luksenburg & Parsons, 2009; Smith et al., 2016). The most common responses of cetaceans to overflights were short surfacing durations, abrupt dives, and percussive behavior (breaching and tail slapping) (Nowacek et al., 2007). Other behavioral responses such as flushing and fleeing the area of the source of the noise have also been observed (Holst et al., 2011; Manci et al., 1988). Richardson et al. (1995b) noted that marine mammal reactions to aircraft overflight largely consisted of opportunistic and anecdotal observations lacking clear distinction between reactions potentially caused by the noise of the aircraft and the visual cue an aircraft presents. In addition, it was suggested that variations in the responses noted were due to generally other undocumented factors associated with overflights (Richardson et al., 1995b). These factors could include aircraft type (single engine, multi-engine, jet turbine), flight path (altitude, centered on the animal, off to one side, circling, level and slow), environmental factors (e.g., wind speed, sea state, cloud cover), and locations where native subsistence hunting continues and animals are more sensitive to anthropogenic impacts, including the noise from aircraft. Christiansen et al. (2016b) measured the in-air and underwater noise levels of two unmanned aerial vehicles, and found that in air, the broadband source levels were around 80 dB re 20 µPa, while at a meter underwater received levels were 95−100 dB re 1 µPa when the vehicle was only 5−10 m above the surface, and were not quantifiable above ambient noise levels when the vehicle was higher. Therefore, if an animal is near the surface and the unmanned aerial vehicle is low, it may be detected, but in most cases these vehicles are operated at much higher altitudes (e.g., over 30 m) and so are not likely to be heard.

The impact of aircraft overflights is one of the least well-known sources of potential behavioral response by any species or taxonomic group, and so many generalities must be made based on the little data available. There is some data for each taxonomic group; taken together it appears that in general, marine mammals have varying levels of sensitivity to overflights depending on the species and context.

Mysticetes

Mysticetes either ignore or occasionally dive in response to aircraft overflights (Koski et al., 1998). Richardson (1985; 1995b) found no evidence that single or occasional aircraft flying above mysticetes causes long-term displacement of these mammals.

Bowhead whales in the Beaufort Sea exhibited a transient behavioral response to fixed-wing aircraft and vessels. Reactions were frequently observed at less than 1,000 ft. above sea level, infrequently observed at 1,500 ft., and not observed at all at 2,000 ft. (Richardson et al., 1985). Bowhead whales reacted to helicopter overflights by diving, breaching, changing direction or behavior, and altering breathing patterns. Behavioral reactions decreased in frequency as the altitude of the helicopter increased to 150 m or higher. The bowheads exhibited fewer behavioral changes than did the odontocetes in the same area (Patenaude et al., 2002). It should be noted that bowhead whales in this study may have more acute responses to anthropogenic activity than many other marine mammals since these animals were presented with restricted egress due to limited open water between ice floes. Additionally, these animals are hunted by Alaska Natives, which could lead to animals developing additional sensitivity to human noise and presence.

A pilot study was conducted on the use of unmanned aerial systems to observe bowhead whales; flying at altitudes between 120 to 210 m above the surface, no behavioral responses were observed in any animals (Koski et al., 1998; Koski et al., 2015). Similarly, Christiansen et al. (2016a) did not observe any responses to an unmanned aerial vehicle flown 30–120 m above the water when taking photos of humpback whales to conduct photogrammetry and assess fitness. Acevedo-Whitehouse et al. (2010) successfully maneuvered a remote controlled helicopter over large baleen whales to collect samples of their blows, with no more avoidance behavior than noted for typical photo-identification vessel approaches. These vehicles are much smaller and quieter than typical aircraft and so are less likely to cause a behavioral response, although they may fly at much lower altitudes (Smith et al., 2016).

Odontocetes

Variable responses to aircraft have been observed in toothed whales, though overall little change in behavior has been observed during flyovers. Some toothed whales dove, slapped the water with their flukes or flippers, or swam away from the direction of the aircraft during overflights; others did not visibly react (Richardson et al., 1995b). Würsig et al. (1998) found that beaked whales were the most sensitive cetacean and reacted by avoiding marine mammal survey aircraft in 89 percent of sightings and at more than twice the rate as Kogia whales, which was the next most reactive of the odontocetes in 39 percent of sightings; these are the same species that were sensitive to vessel traffic.

During standard marine mammal surveys at an altitude of 750 ft., some sperm whales remained on or near the surface the entire time the aircraft was in the vicinity, while others dove immediately or a few minutes after being sighted. Other authors have corroborated the variability in sperm whales' reactions to fixed-wing aircraft or helicopters (Green et al., 1992; Richter et al., 2003; Richter et al., 2006; Smultea et al., 2008; Würsig et al., 1998). In one study, sperm whales showed no reaction to a helicopter until they encountered the downdrafts from the rotors (Richardson et al., 1995b). A group of sperm whales responded to a circling aircraft (altitude of 800 to 1,100 ft.) by moving closer together and forming a defensive fan-shaped semicircle, with their heads facing outward. Several individuals in the group turned on their sides, apparently to look up toward the aircraft (Smultea et al., 2008). Whale watching aircraft (fixed-wing airplanes and helicopters) apparently caused sperm whales to turn more sharply but did not affect blow interval, surface time, time to first click, or the frequency of aerial behavior (Richter et al., 2003).

Smaller delphinids generally react to overflights either neutrally or with a startle response (Würsig et al., 1998). The same species that show strong avoidance behavior to vessel traffic (Kogia species and beaked whales) show similar reactions to aircraft (Würsig et al., 1998). Beluga whales reacted to helicopter overflights by diving, breaching, changing direction or behavior, and altering breathing patterns to a greater extent than mysticetes in the same area (Patenaude et al., 2002). These reactions increased in frequency as the altitude of the helicopter dropped below 150 m. A change in travel direction was noted in a group of pilot whales as the aircraft circled while conducting monitoring (State of Hawaii, 2015).

Much like mysticetes, odontocetes have demonstrated no responses to unmanned aerial systems. For example, Durban et al. (2015) conducted photogrammetry studies of killer whales using a small helicopter flown 35−40 m above the animals with no disturbance noted. However, odontocete responses may increase with reduced altitude, due either to noise or the shadows created by the vehicle (Smith et al., 2016). Bottlenose dolphins responded to a small portion of unmanned aerial vehicles by briefly orienting when the vehicle was relatively close (10–30 m high), but in most cases did not respond at all (Ramos et al., 2018).

Pinnipeds

Richardson et al. (1995b) noted that responsiveness to aircraft overflights generally was dependent on the altitude of the aircraft, the abruptness of the associated aircraft sound, and life cycle stage (breeding, molting, etc.). In general pinnipeds are unresponsive to overflights, and may startle, orient towards the sound source or increase vigilance, or may briefly re-enter the water, but typically remain hauled out or immediately return to their haul out location (Blackwell et al., 2004; Gjertz & Børset, 1992). Adult females, calves and juveniles are more likely to enter the water than males, and stampedes resulting in mortality to pups (by separation or crushing) can occur when disturbance is severe, although they are rare (Holst et al., 2011). Responses may also be dependent on the distance of the aircraft. For example, reactions of walruses on land varied in severity and included minor head raising at a distance of 2.5 km, orienting toward or entering the water at less than 150 m and 1.3 km in altitude, to full flight reactions at horizontal ranges of less than 1 km at altitudes as high as 1,000–1,500 m (Richardson et al., 1995b).

Helicopters are used in studies of several species of seals hauled out and are considered an effective means of observation (Bester et al., 2002; Gjertz & Børset, 1992), although they have been known to elicit behavioral reactions such as fleeing (Hoover, 1988). For California sea lions and Steller sea lions at a rocky haulout off Crescent City in northern California, helicopter approaches to landing sites typically caused the most severe response of diving into the water (National Oceanic and Atmospheric Administration, 2010). Responses were also dependent on the species, with Steller sea lions being more sensitive and California sea lions more tolerant. Depending on the time between subsequent approaches, animals hauled out in between and fewer animals reacted upon subsequent exposures (National Oceanic and Atmospheric Administration, 2010).

Pinniped reactions to rocket launches and overflight at San Nicolas Island were studied from August 2001 to October 2008 (Holst et al., 2011). California sea lions startled and increased vigilance for up to two minutes after a rocket overflight, with some individuals moving down the beach or returning to the water. Northern elephant seals showed little reaction to any overflight. Harbor seals had the most pronounced reactions of the three species observed with most animals within approximately 4 km of the rocket trajectory leaving their haulout sites for the water and not returning for several hours. The authors concluded that the effects of the rocket launches were minor with no effects on local populations evidenced by the growing populations of pinnipeds on San Nicolas Island (Holst et al., 2011).

Pinnipeds may be more sensitive to unmanned aerial systems, especially those flying at low altitudes, due to their possible resemblance to predatorial birds (Smith et al., 2016), which could lead to flushing behavior (Olson, 2013). Responses may also vary by species, age class, behavior, and habituation to other anthropogenic noise, as well as by the type, size, and configuration of unmanned aerial vehicle used (Pomeroy et al., 2015). However, in general pinnipeds have demonstrated little to no response to unmanned aerial systems, with some orienting towards the vehicle, other alerting behavior, or short-term flushing possible (Moreland et al., 2015; Sweeney et al., 2015).

Sea Otters

Sea otters spend approximately 80 percent of their time on the surface of the water (Curland, 1997) with their heads above the surface, and will most likely be exposed to noise from aircraft. Sea otters have similar in-air hearing sensitivities as pinnipeds (Ghoul & Reichmuth, 2014a, 2014b), and may react in a similar fashion when exposed to aircraft noise. Pinnipeds in general are unresponsive but may react depending on the altitude of the aircraft or the abruptness of the associated sound (Richardson et al., 1995b), with reactions ranging from unresponsiveness to flushing into the water location (Blackwell et al., 2004; Gjertz & Børset, 1992). Sea otters may dive below the surface of the water or flush into the water to avoid aircraft noise. However, there has been no evidence that any aircraft has had adverse effects on a well-monitored translocated colony of sea otters at San Nicolas Island, which has a landing field operated by the U.S. Navy (U.S. Fish and Wildlife Service, 2012, 2015).

Behavioral Reactions to Impulsive Noise

See Section 3.4.2.2.1.5 (Behavioral Reactions) under Section 3.4.2.2 (Explosive Stressors) for a summary of information on marine mammal reactions to impulsive sounds.

3.4.2.1.1.6 Stranding

Marine mammals are subjected to a variety of natural and anthropogenic factors, acting alone or in combination, which may cause a marine mammal to strand (Geraci et al., 1999; Geraci & Lounsbury, 2005). When a marine mammal (alive or dead) swims or floats onto shore and becomes beached or incapable of returning to sea, the event is termed a “stranding” (Geraci et al., 1999; Geraci & Lounsbury, 2005; Perrin & Geraci, 2002). A stranding can also occur away from the shore if the animal is unable to cope in its present situation (e.g., disabled by a vessel strike, out of habitat) (Geraci & Lounsbury, 2005). Specifically, under U.S. law, a stranding is an event in the wild in which: “ (A) a marine mammal is dead and is (i) on a beach or shore of the United States; or (ii) in waters under the jurisdiction of the United States (including any navigable waters); or (B) a marine mammal is alive and is (i) on a beach or shore of the United States and is unable to return to the water; (ii) on a beach or shore of the United States and, although able to return to the water, is in need of medical attention; or (iii) in the waters under the jurisdiction of the United States (including any navigable waters), but is unable to return to its natural habitat under its own power or without assistance” (16 U.S.C. section 1421h).

Natural factors related to strandings include limited food availability or following prey inshore, predation, disease, parasitism, natural toxins, echolocation disturbance, climatic influences, and aging (Bradshaw et al., 2006; Culik, 2004; Geraci et al., 1999; Geraci & Lounsbury, 2005; Huggins et al., 2015; National Research Council, 2006; Perrin & Geraci, 2002; Walker et al., 2005). Anthropogenic factors include pollution (Hall et al., 2006; Jepson et al., 2005), vessel strike (Geraci & Lounsbury, 2005; Laist et al., 2001), fisheries interactions (Read et al., 2006), entanglement (Baird & Gorgone, 2005; Saez et al., 2012; Saez et al., 2013), human activities (e.g., feeding, gunshot) (Dierauf & Gulland, 2001; Geraci & Lounsbury, 2005), and noise (Cox et al., 2006; National Research Council, 2003; Richardson et al., 1995b). For some stranding events, environmental factors (e.g., ocean temperature and wind speed and geographic conditions) can be utilized in predictive models to aid in understanding why marine mammals strand in certain areas more than others (Berini et al., 2015). In most instances, even for the more thoroughly investigated strandings involving post-stranding data collection and necropsies, the cause (or causes) for strandings remains undetermined.

Along the coasts of the continental United States and Alaska between 2001 and 2009, there were on average approximately 12,545 cetacean strandings and 39,104 pinniped strandings (51,649 total) per year (National Marine Fisheries Service, 2016a). Several mass strandings (strandings that involve two or more individuals of the same species, excluding a single mother-calf pair) that have occurred over the past two decades have been associated with anthropogenic activities that introduced sound into the marine environment such as naval operations and seismic surveys. An in-depth discussion of strandings is in the Navy’s technical report titled *Marine Mammal Strandings Associated with U.S. Navy Sonar Activities* (U.S. Department of the Navy, 2017c).

Sonar use during exercises involving the U.S. Navy has been identified as a contributing cause or factor in five specific mass stranding events: Greece in 1996; the Bahamas in March 2000; Madeira Island, Portugal in 2000; the Canary Islands in 2002, and Spain in 2006 (Cox et al., 2006; Fernandez, 2006; U.S. Department of the Navy, 2017c). These five mass strandings have resulted in about 40 known cetacean deaths consisting mostly of beaked whales and with close linkages to mid-frequency active sonar activity. In these circumstances, exposure to non-impulsive acoustic energy was considered a potential indirect cause of death of the marine mammals (Cox et al., 2006). Strandings of other marine mammal species have not been as closely linked to sonar exposure, but rather, have typically been attributed to natural or other anthropogenic factors. The Navy has reviewed training requirements, standard operating procedures, and potential mitigation measures, and has implemented changes to reduce the potential for acoustic related strandings to occur in the future. Discussions of procedures associated with these and other training and testing events are presented in Chapter 5 (Mitigation).

Multiple hypotheses regarding the relationship between non-impulsive sound exposure and stranding have been proposed. These range from direct impact of the sound on the physiology of the marine mammal, to behavioral reactions contributing to altered physiology (e.g., "gas and fat embolic syndrome") (Fernandez et al., 2005; Jepson et al., 2003; Jepson et al., 2005), to behaviors directly contributing to the stranding (e.g., beaching of fleeing animals). Unfortunately, without direct observation of not only the event but also the underlying process, and given the potential for artefactual evidence (e.g., chronic condition, previous injury) to complicate conclusions from the post-mortem analyses of stranded animals (Cox et al., 2006), it has not been possible to determine with certainty the exact mechanism underlying these strandings.

Historically, stranding reporting and response efforts have been inconsistent, although they have improved considerably over the last 25 years. Although reporting forms have been standardized nationally, data collection methods, assessment methods, detail of reporting and procedures vary by region and are not yet standardized across the United States. Conditions such as weather, time, location, and decomposition state may also affect the ability to thoroughly examine a specimen (Carretta et al., 2016b; Moore et al., 2013). Because of this, the current ability to interpret long-term trends in marine mammal stranding is limited. While the investigation of stranded animals provides insight into the types of threats marine mammal populations face, investigations are only conducted on a small fraction of the total number of strandings that occur, limiting our understanding of the causes of strandings (Carretta et al., 2016a).

Between May 2 and June 2, 2003, approximately 16 strandings involving 15 harbor porpoises (*Phocoena phocoena*) and one Dall's porpoise (*Phocoenoides dalli*) had been reported to the Northwest Marine Mammal Stranding Network. Given that the USS SHOUP was known to have operated sonar in the strait on May 5, and that behavioral reactions of killer whales (*Orcinus orca*) had been supposedly linked to these sonar operations (National Marine Fisheries Service, 2005), NMFS undertook an analysis of whether sonar caused the strandings of the harbor porpoises. It was subsequently determined that those 2003 strandings and similar harbor porpoise strandings over the following years were normal given a number of factors as described in Huggins et al. (2015). In the 2015 NWTT Final EIS/OEIS, a comprehensive review of all strandings and the events involving USS SHOUP on May 5, 2003, were discussed. Additional information on this event is available in the Navy's Technical Report on Marine Mammal Strandings Associated with U.S. Navy Sonar Activities (U.S. Department of the Navy, 2017c). It is important to note that in the years since the SHOUP incident, annual numbers of stranded porpoises not only increased, but also showed similar causes of death (when determinable) to the causes of death noted in the SHOUP investigation (Huggins et al., 2015).

Stranded marine mammals are reported along the entire western coast of the United States each year. Although many marine mammals likely strand due to natural or anthropogenic causes, the majority of reported type of occurrences in marine mammal strandings in this region include fishery interactions, illness, predation, and vessel strikes (Carretta et al., 2017b; Helker et al., 2017; National Marine Fisheries

Service, 2016g). It is important to note that the mass stranding of pinnipeds along the west coast considered part of a NMFS declared Unusual Morality Event are still being evaluated. The likely cause of this event is the lack of available prey near rookeries due to warming ocean temperatures (National Oceanic and Atmospheric Administration, 2018b). Carretta et al. (2013a; 2016b) provide additional information and data on the threats from human-related activities and the potential causes of strandings for the U.S. Pacific coast marine mammal stocks.

3.4.2.1.1.7 Long-Term Consequences

Long-term consequences to a population are determined by examining changes in the population growth rate (see Section 3.0.3.7, Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities). 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 or chronic masking, which could impact navigation, foraging, predator avoidance, or communication. The long-term consequences due to individual behavioral reactions and short-term or chronic instances of physiological stress are especially difficult to predict because individual experience over time can create complex contingencies, especially for long-lived animals like marine mammals. For example, a lost reproductive opportunity could be a measurable cost to the individual, or for very small populations to the population as a whole (e.g., Southern resident killer whale); however, short-term costs may be recouped during the life of an otherwise healthy individual. These factors are taken into consideration when assessing risk of long-term consequences. 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 exposure to many sound-producing activities over significant periods.

Marine mammals exposed to high levels of human activities may leave the area, habituate to the activity, or tolerate the disturbance and remain in the area (Wartzok et al., 2003). Highly resident or localized populations may also stay in an area of disturbance because the cost of displacement may be higher than the cost of remaining (Forney et al., 2017). Longer term displacement can lead to changes in abundance or distribution patterns of the species in the affected region (Bejder et al., 2006b; Blackwell et al., 2004; Teilmann et al., 2006). Gray whales in Baja California abandoned a historical breeding lagoon in the mid-1960s due to an increase in dredging and commercial shipping operations. However, whales did repopulate the lagoon after shipping activities had ceased for several years (Bryant et al., 1984). Mysticetes in the northeast tended to adjust to vessel traffic over a number a of years, trending towards more neutral responses to passing vessels (Watkins, 1986), indicating that some animals may habituate or otherwise learn to cope with high levels of human activity. Bejder et al. (2006a) studied responses of bottlenose dolphins to vessel approaches and found that lesser reactions in populations of dolphins regularly subjected to high levels of vessel traffic could be a sign of habituation, or it could be that the more sensitive animals in this population previously abandoned the area of higher human activity.

Moore and Barlow (2013) noted a decline in the overall beaked whale population in a broad area of the Pacific Ocean along the U.S. West Coast. Moore and Barlow (2013) provide several hypotheses for the decline of beaked whales in those waters, one of which is anthropogenic sound including the use of sonar by the U.S. Navy; however, new data has been published raising uncertainties over whether a decline in the beaked whale population occurred off the U.S. West Coast between 1996 and 2014 (Barlow, 2016). Moore and Barlow (2017) have since incorporated information from the entire 1991 to

2014 time series, which suggests an increasing abundance trend and a reversal of the declining trend along the U.S. West Coast that had been noted in their previous (2013) analysis.

In addition, studies on the Atlantic Undersea Test and Evaluation Center instrumented range in the Bahamas have shown that some Blainville's beaked whales may be resident during all or part of the year in the area. Individuals may move off the range for several days during and following a sonar event, but return within a few days (McCarthy et al., 2011; Tyack et al., 2011). Photo-identification n studies in the Southern California Range Complex have identified approximately 100 individual Cuvier's beaked whale individuals, with 40 percent having been seen in one or more prior years and re-sightings up to seven years apart (Falcone et al., 2009; Falcone & Schorr, 2014). These results indicate long-term residency by individuals in an intensively used Navy training and testing area, which may suggest a lack of long-term consequences as a result of exposure to Navy training and testing activities, but could also be indicative of high-value resources that exceed the cost of remaining in the area. Long-term residency does not mean there has been no impact to population growth rates and there are no data existing on the reproductive rates of populations inhabiting the Navy range area around San Clemente Island as opposed to beaked whales from other areas. In that regard however, recent results from photo-identifications are beginning to provide critically needed calving and weaning rate data for resident animals on the Navy's Southern California range. Three adult females that had been sighted with calves in previous years were again sighted in 2016, one of these was associated with her second calf, and a fourth female that was first identified in 2015 without a calf, was sighted in 2016 with a calf (Schorr et al., 2017). Resident females documented with and without calves from year to year will provide the data for this population that can be applied to future research questions.

Research involving three tagged Cuvier's beaked whales in the Southern California Range Complex reported on by Falcone and Schorr (2012, 2014) has documented movements in excess of hundreds of kilometers by some of those animals. Schorr et al. (2014) reported the results for an additional eight tagged Cuvier's beaked whales in the same area. Five of these eight whales made journeys of approximately 250 km from their tag deployment location, and one of these five made an extra-regional excursion over 450 km south to Mexico and back again. Given that some beaked whales may routinely move hundreds of kilometers as part of their normal pattern (Schorr et al., 2014), temporarily leaving an area to avoid sonar or other anthropogenic activity may have little cost.

Another approach to investigating long-term consequences of anthropogenic noise exposure has been an attempt to link short-term effects to individuals from anthropogenic stressors with long-term consequences to populations using population models. Population models are well known from many fields in biology including fisheries and wildlife management. These models accept inputs for the population size and changes in vital rates of the population, such as the mean values for survival age, lifetime reproductive success, and recruitment of new individuals into the population. Unfortunately, for acoustic and explosive impacts on marine mammal populations, many of the inputs required by population models are not known. Nowacek et al. (2016) reviewed new technologies, including passive acoustic monitoring, tagging, and the use of unmanned aerial vehicles that can improve scientists' abilities to study these model inputs and link behavioral changes to individual life functions and ultimately population-level effects. The linkage between immediate behavioral or physiological effects to an individual due to a stressor such as sound, the subsequent effects on that individual's vital rates (growth, survival, and reproduction), and in turn the consequences for the population have been reviewed in National Research Council (2005).

The Population Consequences of Acoustic Disturbance model (National Research Council 2005) proposes a conceptual model for determining how changes in the vital rates of individuals (i.e., a biologically significant consequence to the individual) translates into biologically significant consequences to the population. In 2009, the U.S. Office of Naval Research set up a working group to transform the Population Consequences of Acoustic Disturbance framework into a mathematical model and include other stressors potentially causing disturbance in addition to noise. The model, now called Population Consequences of Disturbance, has been used for case studies involving bottlenose dolphins, North Atlantic right whales, beaked whales, southern elephant seals, California sea lions, blue whales, humpback whales, and harbor porpoise (Costa et al., 2016a; Costa et al., 2016b; Harwood & King, 2014; Hatch et al., 2012; King et al., 2015; McHuron et al., 2018; New et al., 2013a; New et al., 2014; Pirotta et al., 2018; Pirotta et al., In Press). Currently, the Population Consequences of Disturbance model provides a theoretical framework and identifies types of data that would be needed to assess population-level impacts using this process. The process is complicated and provides a foundation for the type of data that is needed, which is currently lacking for many marine mammal species. Relevant data needed for improving these analytical approaches for population-level consequences resulting from disturbances will continue to be collected during projects funded by the Navy's marine species monitoring program.

Costa et al. (2016a) emphasized taking into account the size of an animal's home range, whether populations are resident and non-migratory or if they migrate over long areas and share their feeding or breeding areas with other populations. These factors, coupled with the extent, location, and duration of a disturbance can lead to markedly different impact results. For example, Costa et al. (2016a) modeled seismic surveys with different radii of impacts on the foraging grounds of Bering Sea humpback whales, West Antarctic Peninsula humpback whales, and California Current blue whales, and used data from tagged whales to determine foraging locations and effort on those grounds. They found that for the blue whales and the West Antarctic humpback whales, less than 19 percent and 16 percent (respectively) of each population would be exposed, and less than 19 percent and 6 percent (respectively) of foraging behavior would be disturbed. This was likely due to the fact that these populations forage for krill over large areas. In contrast, the Bering Sea population of humpback whales had over 90 percent of the population exposed when the disturbance zones extended beyond 50 km, but 100 percent of their foraging time would occur during an exposure when the zone was 25 km or more. These animals forage for fish over a much smaller area, thereby having a limited range for foraging that can be disturbed. Similarly, Costa et al. (2016b) placed disturbance zones in the foraging and transit areas of northern elephant seals and California sea lions. Again, the location and radius of disturbance impacted how many animals were exposed and for how long, with California sea lions disturbed for a longer period than elephant seals, which extend over a broader foraging and transit area. However, even the animals exposed for the longest periods had negligible modeled impacts on their reproduction and pup survival rates. Energetic costs were estimated for western gray whales that migrated to possible wintering grounds near China or to the Baja California wintering grounds of eastern gray whales versus the energetic costs of the shorter migration of eastern gray whales (Villegas-Amtmann et al., 2017). Researchers found that when the time spent on the breeding grounds was held constant for both populations, the energetic requirements for the western gray whales were estimated to be 11 and 15 percent greater during the migration to Baja California and China, respectively, than for the migration of eastern gray whales, and therefore this population would be more sensitive to energy lost through disturbance.

Pirotta et al. (2018) modeled one reproductive cycle of a female North Pacific blue whale, starting with leaving the breeding grounds off Baja California to begin migrating north to feeding grounds off

California, and ending with her returning to the breeding grounds, giving birth, and lactating. They modeled this scenario with no disturbance and found 95 percent calf recruitment; under a "normal" environmental perturbation (El Niño-Southern Oscillation) there was a very small reduction in recruitment, and, under an "unprecedented" environmental change, recruitment was reduced to 69 percent. An intense, localized anthropogenic disturbance was modeled (although the duration of the event was not provided); if the animals were not allowed to leave the area, they did not forage and recruitment dropped to 63 percent. However, if animals could leave the area of the disturbance then there was almost no change to the recruitment rate. Finally, a weak but broader spatial disturbance, where foraging was reduced by 50 percent, caused only a small decrease in calf recruitment to 94 percent.

Using the Population Consequences of Disturbance framework, modeling of the long-term consequences of exposure has been conducted for a variety of marine mammal species and stressors. Even when high and frequent exposure levels are included, few long-term consequences have been predicted. For example, De Silva et al. (2014) conducted a population viability analysis on the long-term impacts of pile driving and construction noise on harbor porpoises and bottlenose dolphins. Despite including the extreme and unlikely assumptions that 25 percent of animals that received PTS would die, and that behavioral displacement from an area would lead to breeding failure, the model only found short-term impacts on the population size and no long-term effects on population viability. Similarly, King et al. (2015) developed a Population Consequences of Disturbance framework using expert elicitation data on impacts from wind farms on harbor porpoises, and even under the worst case scenarios predicted less than a 0.5 percent decline in harbor porpoise populations. Nabe-Nelson et al. (2014) also modeled the impact of noise from wind farms on harbor porpoises and predicted that even when assuming a 10 percent reduction in population size if prey is impacted up to two days, the presence of ships and wind turbines did not deplete the population. In contrast, Heinis and De Jong (2015) used the Population Consequences of Disturbance framework to estimate impacts from both pile driving and seismic exploration on harbor porpoises and found a 23 percent decrease in population size over six years, with an increased risk for further reduction with additional disturbance days. These seemingly contradictory results demonstrate that refinements to models need to be investigated to improve consistency and interpretation of model results.

The Population Consequences of Disturbance model developed by New et al. (2013b) predicted that beaked whales require energy dense prey and high quality habitat, and that non-lethal disturbances that displace whales from that habitat could lead to long-term impacts on fecundity and survival; however, the authors were forced to use many conservative assumptions within their model since many parameters are unknown for beaked whales. As discussed above in Schorr et al. (2014), beaked whales have been tracked roaming over distances of 250 km or more, indicating that temporary displacement from a small area may not preclude finding energy dense prey or high quality habitat. Farmer et al. (2018) developed a bioenergetics framework to examine the impact of foraging disruption on body reserves of individual sperm whales. The authors examined rates of daily foraging disruption to predict the number of days to terminal starvation for various life stages, assuming exposure to seismic surveys. Mothers with calves were found to be most vulnerable to disruptions.

Another Population Consequences of Disturbance model developed in New et al. (2014) predicted elephant seal populations to be relatively robust even with a greater than 50 percent reduction in foraging trips (only a 0.4 percent population decline in the following year). McHuron et al. (2018) modeled the introduction of a generalized disturbance at different times throughout the breeding cycle of California sea lions, with the behavior response being an increase in the duration of a foraging trip by the female. Very short duration disturbances or responses led to little change, particularly if the disturbance was a single event, and changes in the timing of the event in the year had little effect. However, with even relatively short disturbances or mild responses, when a disturbance was modeled as recurring there were resulting reductions in population size and pup recruitment. Often, the effects weren't noticeable for several years, as the impacts on pup recruitment did not affect the population until those pups were mature.

It should be noted that, in all of these models, assumptions were made and many input variables were unknown and so were estimated using available data. It is still not possible to utilize individual short-term behavioral responses to estimate long-term or population-level effects.

The best assessment of long-term consequences from Navy training and testing activities will be to monitor the populations over time within the Study Area. A U.S. workshop on Marine Mammals and Sound (Fitch et al., 2011) indicated a critical need for baseline biological data on marine mammal abundance, distribution, habitat, and behavior over sufficient time and space to evaluate impacts from human-generated activities on long-term population survival. The Navy has developed and implemented comprehensive monitoring plans since 2009 for protected marine mammals occurring on Navy ranges with the goal of assessing the impacts of training and testing activities on marine species and the effectiveness of the Navy's mitigation measures. The results of this long-term monitoring are now being compiled and analyzed for trends in occurrence or abundance over time (e.g., Martin et al., 2017); preliminary results of this analysis at Pacific Missile Range Facility off Kauai, Hawaii indicate no changes in detection rates for several species over the past decade, demonstrating that Navy activities may not be having long-term population-level impacts. This type of analysis can be expanded to the other Navy ranges, such as in the Pacific Northwest. Continued analysis of this 15-year dataset and additional monitoring efforts over time are necessary to fully understand the long-term consequences of exposure to military readiness activities.

3.4.2.1.2 Impacts from Sonar and Other Transducers

Sonar and other transducers proposed for use could be used 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).

Sonar-induced acoustic resonance and bubble formation phenomena are very unlikely to occur under realistic conditions, as discussed in Section 3.4.2.1.1.1 (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.

The most probable impacts from exposure to sonar and other transducers are PTS, TTS, behavioral reactions, masking, and physiological stress (Sections 3.4.2.1.1.2, Hearing Loss; 3.4.2.1.1.3, Physiological Stress; 3.4.2.1.1.4, Masking; and 3.4.2.1.1.5, Behavioral Reactions).

3.4.2.1.2.1 Methods for Analyzing Impacts from Sonars and Other Transducers

The Navy performed a quantitative analysis to estimate the number of times that marine mammals could be affected by sonars and other transducers used during Navy training and testing activities. The Navy's quantitative analysis to determine impacts on marine mammals uses the Navy Acoustic Effects Model to produce initial estimates of the number of times that animals may experience these effects; these estimates are further refined by considering animal avoidance of sound-producing activities and implementation of procedural mitigation measures. The steps of this quantitative analysis are described in Section 3.0.1.2 (Navy's Quantitative Analysis to Determine Impacts to Sea Turtles and Marine Mammals), which takes into account:

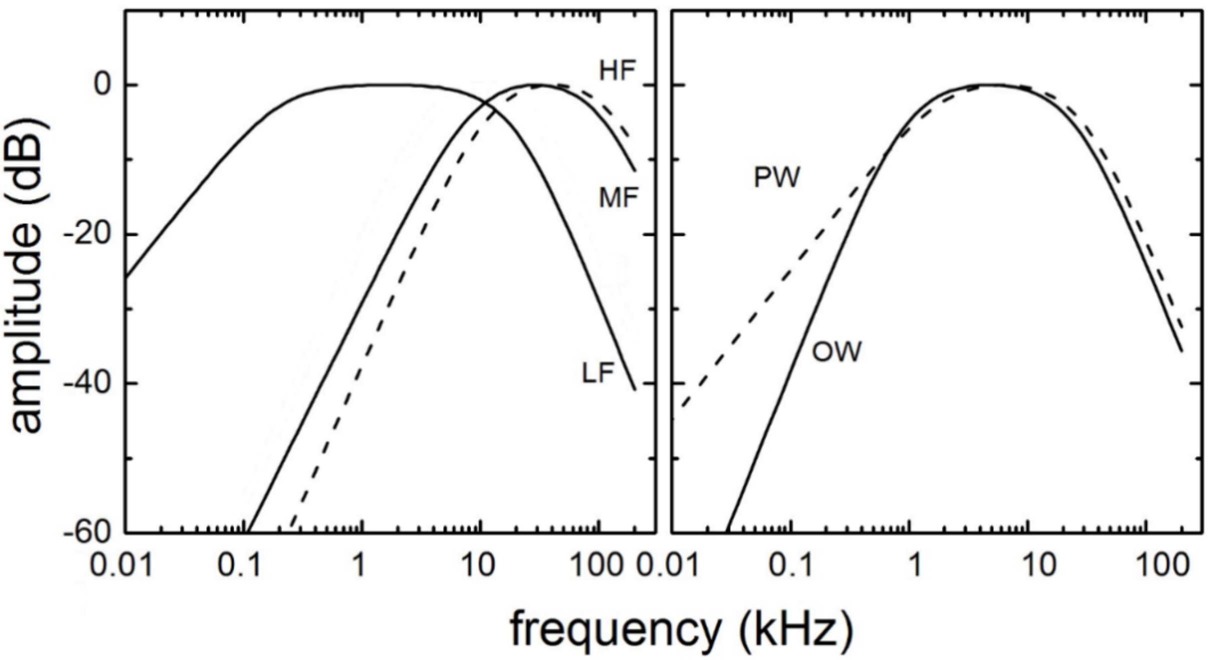
- criteria and thresholds used to predict impacts from sonar and other transducers (see below)
- the density and spatial distribution of marine mammals
- the influence of environmental parameters (e.g., temperature, depth, salinity) on sound propagation when estimating the received sound level on the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

A 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, 2018b).

Criteria and Thresholds Used to Estimate 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 (Figure 3.4-5). 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. They are based on a generic band pass filter and incorporates species-specific hearing abilities to calculate a weighted received sound level in units SPL or SEL. Due to the band pass nature of auditory weighting functions, they resemble an inverted "U" shape with amplitude plotted as a function of frequency. The flatter portion of the plotted function, where the amplitude is closest to zero, is the emphasized frequency range (i.e., the pass-band), while the frequencies below and above this range (where amplitude declines) are de-emphasized.

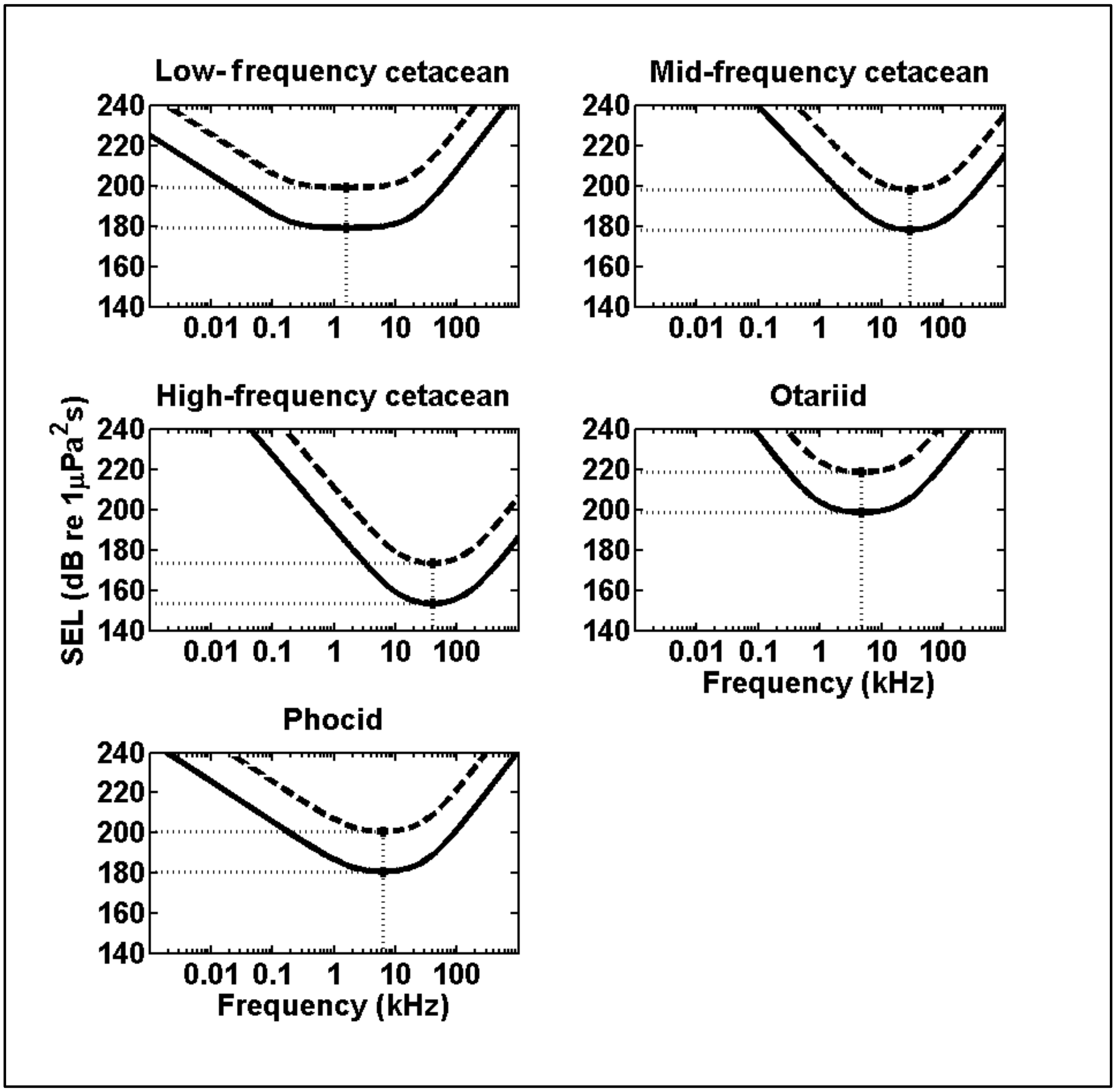


Source: For parameters used to generate the functions and more information on weighting function derivation, see the *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* technical report U.S. Department of the Navy (2017a)
Notes: HF = high-frequency cetacean, LF = low-frequency cetacean, MF = mid-frequency cetacean, PW = phocid (in-water), and OW = otariid (in-water).

Figure 3.4-5: Navy Auditory Weighting Functions for All Species Groups

Hearing Loss from Sonar and Other Transducers

Defining the TTS and PTS exposure functions (Figure 3.4-6) requires identifying the weighted exposures necessary for TTS and PTS onset from sounds produced by sonar and other transducers. The criteria used to define threshold shifts from non-impulsive sources (e.g., sonar) determines TTS onset as the SEL necessary to induce 6 dB of threshold shift. An SEL 20 dB above the onset of TTS is used in all hearing groups of marine mammals underwater to define the PTS threshold (Southall et al., 2007).



Notes: The solid curve is the exposure function for TTS onset and the large dashed curve is the exposure function for PTS onset. Small dashed lines and asterisks indicate the SEL threshold for TTS and PTS onset in the frequency range of best hearing.

Figure 3.4-6: TTS and PTS Exposure Functions for Sonar and Other Transducers

Behavioral Responses from Sonar and Other Transducers

Behavioral response criteria are used to estimate the number of animals that may exhibit a behavioral response to sonar and other transducers. See the *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* technical report for detailed information on how the Behavioral Response Functions were derived (U.S. Department of the Navy, 2017a). Developing the new behavioral criteria involved multiple steps. All peer-reviewed published behavioral response studies conducted both in the field and on captive animals were examined in order to understand the breadth of behavioral responses of marine mammals to sonar and other transducers.

The data from the behavioral studies were analyzed by looking for significant responses, or lack thereof, for each experimental session. The terms "significant response" or "significant behavioral response" are used in describing behavioral observations from field or captive animal research that may rise to the level of "harassment" for military readiness activities. Under the MMPA, for military readiness activities, such as Navy training and testing, behavioral "harassment" is: "any act that *disturbs* or is likely to *disturb* a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering*, to a point where such behavioral patterns are abandoned or significantly altered*" (16 U.S.C. section 1362(3)(18)(B)).

The likelihood of injury due to disruption of normal behaviors would depend on many factors, such as the duration of the response, from what the animal is being diverted, and life history of the animal. Due to the nature of behavioral response research to date, it is not currently possible to ascertain the types of observed reactions that would lead to an abandonment or significant alteration of a natural behavior pattern. Therefore, the Navy has developed a methodology to estimate the possible significance of behavioral reactions and impacts on natural behavior patterns.

Behavioral response severity is described herein as "low," "moderate," or "high." These are derived from the Southall et al. (2007) severity scale. Low severity responses are those behavioral responses that fall within an animal's range of typical (baseline) behaviors and are unlikely to disrupt an individual to a point where natural behavior patterns are significantly altered or abandoned. Low severity responses include an orientation or startle response, change in respiration, change in heart rate, and change in group spacing or synchrony.

Moderate severity responses could become significant if sustained over a longer duration. What constitutes a long-duration response is different for each situation and species, although it is likely dependent upon the magnitude of the response and species characteristics such as age, body size, feeding strategy, and behavioral state at the time of the exposure. In general, a response could be considered "long-duration" if it lasted for tens of minutes to a few hours, or enough time to significantly disrupt an animal's daily routine.

Moderate severity responses included:

- alter migration path
- alter locomotion (speed, heading)
- alter dive profiles
- stop/alter nursing
- stop/alter breeding
- stop/alter feeding/foraging
- stop/alter sheltering/resting
- stop/alter vocal behavior if tied to foraging or social cohesion
- avoid area near sound source

For the derivation of behavioral criteria, a significant duration was defined as a response that lasted for the duration of exposure or longer, regardless of how long the exposure session may have been. This assumption was made because it was not possible to tell if the behavioral responses would have continued if the exposure had continued. The costs associated with these observed behavioral reactions were not measured so it is not possible to judge whether reactions would have risen to the level of significance as defined above, although it was conservatively assumed the case. High severity responses include those responses with immediate consequences (e.g., stranding, mother-calf separation), and were always considered significant behavioral reactions regardless of duration.

Marine mammal species were placed into behavioral criteria groups based on their known or suspected behavioral sensitivities to sound (Figure 3.4-7 through Figure 3.4-10). In most cases, these divisions are driven by taxonomic classifications (e.g., mysticetes, pinnipeds). The Odontocete group combines most of the mid- and high-frequency cetaceans, without the beaked whales or harbor porpoises, while the Pinniped group combines the otariids and phocids. These groups are combined as there is not enough data to separate them for behavioral responses.

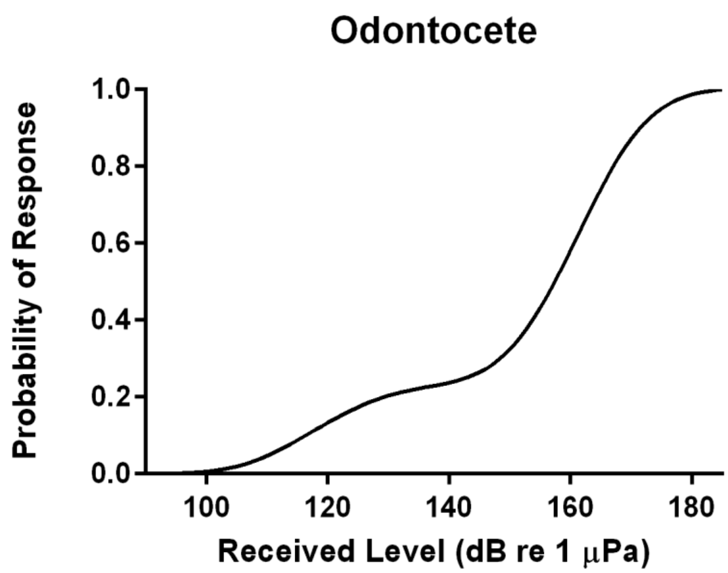


Figure 3.4-7: Behavioral Response Function for Odontocetes

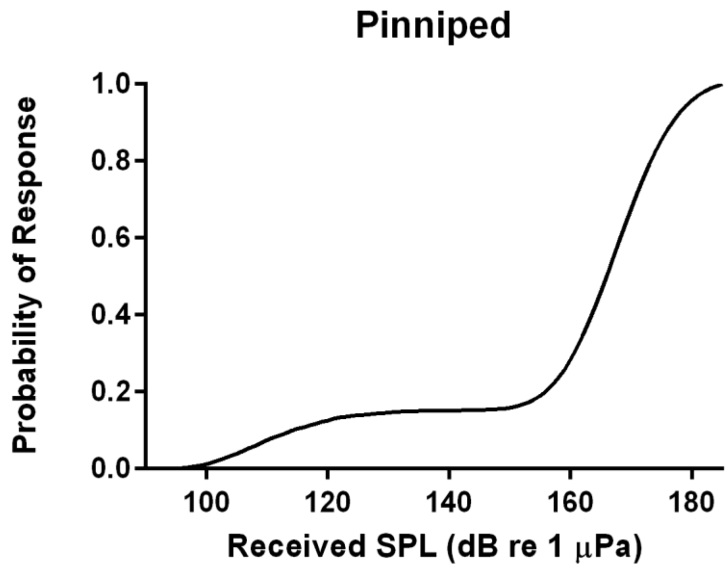


Figure 3.4-8: Behavioral Response Function for Pinnipeds

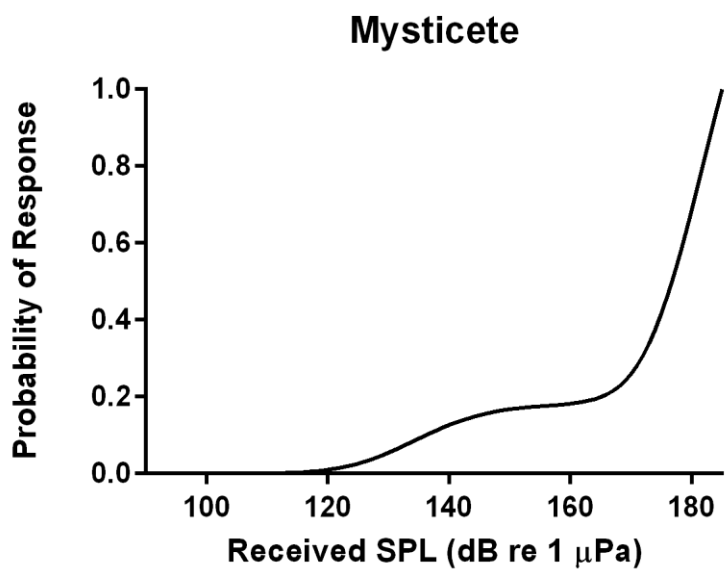


Figure 3.4-9: Behavioral Response Function for Mysticetes

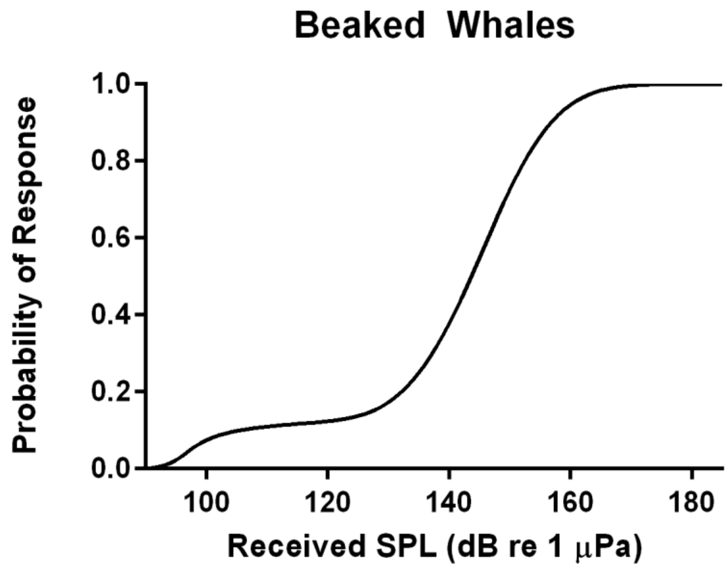


Figure 3.4-10: Behavioral Response Function for Beaked Whales

The information currently available regarding harbor porpoises suggests a very low threshold level of response for both captive and wild animals. Threshold levels at which both captive (Kastelein et al., 2000; Kastelein et al., 2005) and wild harbor porpoises (Johnston, 2002) responded to sound (e.g., acoustic harassment devices, acoustic deterrent devices, or other non-impulsive sound sources) are very low, approximately 120 dB re 1 µPa. Therefore, a SPL of 120 dB re 1 µPa is used in this analysis as a threshold for predicting behavioral responses in harbor porpoises.

For all taxa, distances beyond which significant behavioral responses to sonar and other transducers are unlikely to occur, denoted as "cutoff distances," were defined based on existing data (Table 3.4-4). The distance between the animal and the sound source is a strong factor in determining that animal's potential reaction (e.g., DeRuiter et al., 2013b). For training and testing activities that contain multiple platforms or tactical sonar sources that exceed 215 dB re 1 µPa at 1 m, this cutoff distance is substantially increased (i.e., doubled) from values derived from the literature. The use of multiple platforms and intense sound sources are factors that probably increase responsiveness in marine mammals overall. There are currently few behavioral observations under these circumstances; therefore, the Navy will conservatively predict significant behavioral responses at further ranges for these more intense activities.

Table 3.4-4: Cutoff Distances for Moderate Source Level, Single Platform Training and Testing Events and for All Other Events with Multiple Platforms or Sonar with Source Levels at or Exceeding 215 dB re 1 µPa @ 1 m

Criteria Group	*Moderate SL/Single Platform Cutoff Distance*	*High SL/Multi-Platform Cutoff Distance*
Odontocetes	10 km	20 km
Pinnipeds and Mustelids	5 km	10 km
Mysticetes	10 km	20 km
Beaked Whales	25 km	50 km
Harbor Porpoise	20 km	40 km

Notes: dB re 1 µPa @ 1 m= decibels referenced to 1 micropascal at 1 meter, km= kilometer, SL= source level

Assessing the Severity of Behavioral Responses from Sonar under Military Readiness

As discussed above, the terms "significant response" or "significant behavioral response" are used in describing behavioral reactions that may lead to an abandonment or significant alteration of a natural behavior pattern. Due to the limited amount of behavioral response research to date and relatively short durations of observation, it is not possible to ascertain the true significance of the majority of the observed reactions. When deriving the behavioral criteria, it was assumed that most reactions that lasted for the duration of the sound exposure or longer were significant, even though many of the exposures lasted for 30 minutes or less. Furthermore, the experimental designs used during many of the behavioral response studies were unlike Navy activities in many important ways. These differences include tagging subject animals, following subjects for sometimes hours before the exposure, vectoring towards the subjects after animals began to avoid the sound source, and making multiple close passes on focal groups. This makes the estimated behavioral impacts from Navy activities using the criteria derived from these experiments difficult to interpret. While the state of science does not currently support definitively distinguishing between significant and insignificant behavioral reactions, as described in the technical report titled *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (U.S. Department of the Navy, 2017a), Navy's analysis incorporates conservative assumptions to account for this uncertainty and therefore likely overestimates the potential impacts.

The estimated behavioral reactions from the Navy's quantitative analysis are grouped into several categories based on the most powerful sonar source, the number of platforms, the duration, and geographic extent of each Navy activity attributed to the predicted impact. Activities that occur on Navy instrumented ranges or within Navy homeports require special consideration due to the repeated nature of activities in these areas.

Low severity responses are within an animal's range of typical (baseline) behaviors and are unlikely to disrupt an individual to a point where natural behavior patterns are significantly altered or abandoned. Although the derivation of the Navy's behavioral criteria did not count low severity responses as significant behavioral responses, in practice, some reactions estimated using the behavioral criteria are likely to be low severity (Figure 3.4-11).

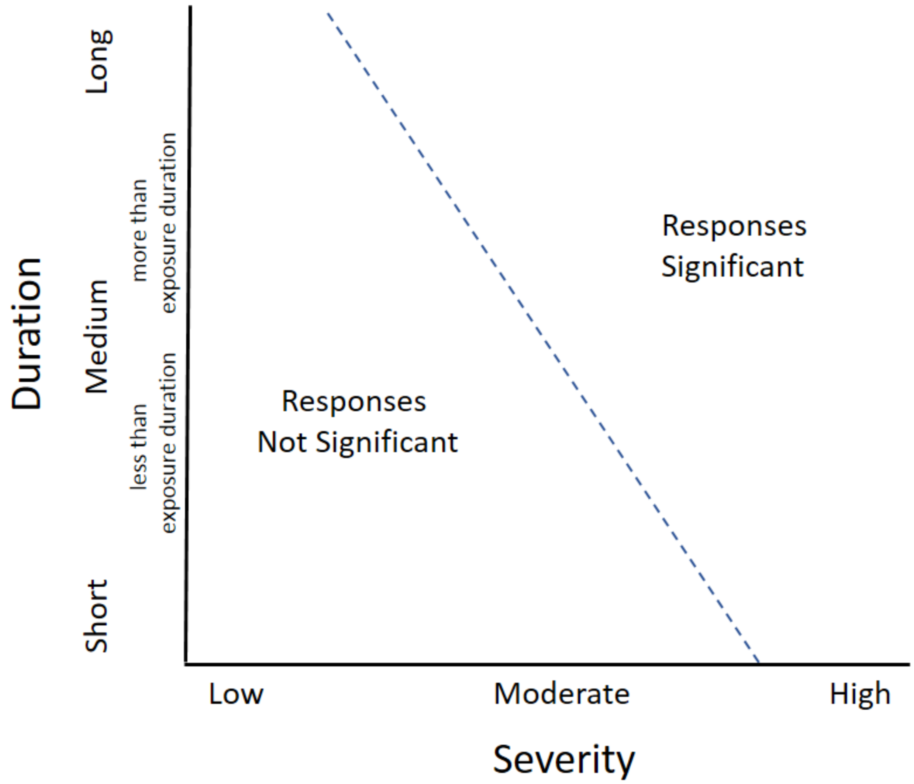


Figure 3.4-11: Relative Likelihood of a Response Being Significant Based on the Duration and Severity of Behavioral Reactions

High severity responses are those with a higher potential for direct consequences to growth, survivability, or reproduction. Examples include prolonged separation of females and dependent offspring, panic, flight, stampede, or stranding. High severity reactions would always be considered significant; however, these types of reactions are probably rare under most conditions and may still not lead to direct consequences on survivability. For example, a separation of a killer whale mother-calf pair was observed once during a behavioral response study to an active sonar source (Miller et al., 2014), but the animals were rejoined as soon as the ship had passed. Therefore, although this was a severe response, it did not lead to a negative outcome. Five beaked whale strandings have also occurred associated with U.S. Navy active sonar use as discussed above (see Section 3.4.2.1.1.6, Stranding), but the confluence of factors that contributed to those strandings is now better understood, and the avoidance of those factors has resulted in no known marine mammal strandings associated with U.S. Navy sonar activities for over a decade. The Navy is unable to predict these high severity responses for any activities since the probability of occurrence is apparently very low, although the Navy acknowledges that severe reactions could occasionally occur. In fact, no significant behavioral responses such as panic, stranding or other severe reactions have been observed during monitoring of actual training or testing activities.

Many of the responses estimated using the Navy's quantitative analysis are most likely to be moderate severity. Moderate severity responses would be considered significant if they were sustained for a duration long enough that it caused an animal to be outside of normal daily variations in feeding, reproduction, resting, migration/movement, or social cohesion. As mentioned previously, the behavioral response functions used within the Navy's quantitative analysis were primarily derived from experiments using short-duration sound exposures lasting, in many cases, for less than 30 minutes. If animals exhibited moderate severity reactions for the duration of the exposure or longer, then it was conservatively assumed that the animal experienced a significant behavioral reaction. However, the experiments did not include measurements of costs to animals beyond the immediately observed reactions, and no direct correlations exist between an observed behavioral response and a cost that may result in long-term consequences. Within the Navy's quantitative analysis, many behavioral reactions are estimated from exposure to sonar that may exceed an animal's behavioral threshold for only a single ping to several minutes. While the state of science does not currently support definitively distinguishing between significant and insignificant behavioral reactions, as described in the technical report titled *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (U.S. Department of the Navy, 2017a), the Navy's analysis incorporates conservative assumptions to account for this uncertainty and therefore likely overestimates the potential impacts.

Accounting for Mitigation

The Navy will implement mitigation measures to avoid or reduce potential impacts from active sonar on marine mammals, 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 marine mammal is observed in a mitigation zone. The mitigation zones for active sonar activities were designed to avoid the potential for marine mammals 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 for active sonar extend beyond the respective average ranges to auditory injury (including PTS). Therefore, the impact analysis quantifies the potential for procedural mitigation to reduce the risk of PTS. Two factors are considered when quantifying the effectiveness of procedural 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, 2018b).

In the quantitative analysis, consideration of mitigation measures means that, for activities that implement mitigation, 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 ranges to PTS was estimated for each training or testing event. The ability of Navy Lookouts to detect marine mammals within a mitigation zone is dependent on the animal's presence at the surface and the characteristics of the animal that influence its sightability (such as group size or surface active behavior). The behaviors and characteristics of some species may make them easier to detect. Certain behaviors, such as leaping and breaching, are visible from a great distance and likely increase sighting distances and detections of those species. Environmental conditions under which the training or testing activity could take place are also considered, such as 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). The benefits of mitigation areas are discussed qualitatively and have not been factored into the quantitative analysis process or reductions in take for the MMPA and ESA impact estimates. Mitigation areas are designed to help avoid or reduce impacts during biologically important life processes within particularly important habitat areas. Therefore, mitigation area benefits are discussed in terms of the context of impact avoidance or reduction.

Marine Mammal Avoidance of Sonar and other Transducers

Because a marine mammal is assumed to initiate avoidance behavior after an initial startle reaction when exposed to relatively high received levels of sound, a marine mammal could reduce its cumulative sound energy exposure over a sonar event with multiple pings (i.e., sound exposures). This would reduce risk of both PTS and TTS, although the quantitative analysis conservatively only considers the potential to reduce instances of PTS by accounting for marine mammals swimming away to avoid repeated high-level sound exposures. All reductions in PTS impacts from likely avoidance behaviors are instead considered TTS impacts.

3.4.2.1.2.2 Impact Ranges for Sonar and Other Transducers

The following section provides range to effects for sonar and other transducers to specific criteria determined using the Navy Acoustic Effects Model. Marine mammals within these ranges would be predicted to receive the associated effect. Range to effects is important information in not only predicting acoustic impacts, but also in verifying the accuracy of model results against real-world situations and assessing the level of impact that will likely be mitigated within applicable mitigation zones.

The ranges to the PTS threshold for an exposure of 30 seconds are shown in Table 3.4-5 relative to the marine mammal's functional hearing group. This period (30 seconds) was chosen based on examining the maximum amount of time a marine mammal would realistically be exposed to levels that could cause the onset of PTS based on platform (e.g., ship) speed and a nominal animal swim speed of approximately 1.5 meters per second. The ranges provided in the table include the average range to PTS, as well as the range from the minimum to the maximum distance at which PTS is possible for each hearing group. Since any hull-mounted sonar, such as the SQS-53, engaged in anti-submarine warfare training would be moving at between 10 and 15 knots and nominally pinging every 50 seconds, the vessel will have traveled a minimum distance of approximately 257 m during the time between those pings (note: 10 knots is the speed used in the Navy Acoustic Effects Model). As a result, there is little overlap of PTS footprints from successive pings, indicating that in most cases, an animal predicted to receive PTS would do so from a single exposure (i.e., ping). For all other bins (besides MF1), PTS ranges are short enough that marine mammals (with a nominal swim speed of approximately 1.5 meters per second) should be able to avoid higher sound levels capable of causing onset PTS within this 30-second period.

For all other functional hearing groups (low-frequency cetaceans, mid-frequency cetaceans, phocid, seals, otariids, and mustelids), 30-second average PTS zones are substantially shorter. A scenario could occur where an animal does not leave the vicinity of a ship or travels a course parallel to the ship, however, the close distances required make PTS exposure unlikely. For a Navy vessel moving at a nominal 10 knots, it is unlikely a marine mammal could maintain the speed to parallel the ship and receive adequate energy over successive pings to suffer PTS.

The tables below illustrate the range to TTS for 1, 30, 60, and 120 seconds from five representative sonar systems (see Table 3.4-6 through Table 3.4-10). Due to the lower acoustic thresholds for TTS versus PTS, ranges to TTS are longer. Therefore, successive pings can be expected to add together, further increasing the range to onset-TTS.

Table 3.4-5: Range to Permanent Threshold Shift for Five Representative Sonar Systems

Hearing Group	*Approximate PTS (30 seconds) Ranges (meters)*[1]				
	Sonar bin HF4	*Sonar bin LF4*	*Sonar bin MF1*	*Sonar bin MF4*	*Sonar bin MF5*
High-frequency cetaceans	38 (22–85)	0 (0–0)	195 (80–330)	30 (30–40)	9 (8–11)
Low-frequency cetaceans	0 (0–0)	2 (1–3)	67 (60–110)	15 (15–17)	0 (0–0)
Mid-frequency cetaceans	1 (0–3)	0 (0–0)	16 (16–19)	3 (3–3)	0 (0–0)
Otariids and Mustelids	0 (0–0)	0 (0–0)	6 (6–6)	0 (0–0)	0 (0–0)
Phocids	0 (0–0)	0 (0–0)	46 (45–75)	11 (11–12)	0 (0–0)

[1] PTS ranges extend from the sonar or other transducer sound source to the indicated distance. The average range to PTS is provided as well as the range from the estimated minimum to the maximum range to PTS in parenthesis.
Notes: HF = high-frequency, LF = low-frequency, MF = mid-frequency, PTS = permanent threshold shift

Table 3.4-6: Ranges to Temporary Threshold Shift for Sonar Bin HF4 over a Representative Range of Environments Within the Study Area

Hearing Group	*Approximate TTS Ranges (meters)*[1]			
	Sonar Bin HF4			
	1 second	*30 seconds*	*60 seconds*	*120 seconds*
High-frequency cetaceans	236 (60–675)	387 (60–875)	503 (60–1,025)	637 (60–1,275)
Low-frequency cetaceans	2 (0–3)	3 (1–6)	5 (3–8)	8 (5–12)
Mid-frequency cetaceans	12 (7–20)	21 (12–40)	29 (17–60)	43 (24–90)
Otariids and Mustelids	0 (0–0)	0 (0–0)	0 (0–0)	1 (0–1)
Phocids	3 (0–5)	6 (4–10)	9 (5–15)	14 (8–25)

[1] Ranges to TTS represent the model predictions in different areas and seasons within the Study Area. The zone in which animals are expected to suffer TTS extend from onset-PTS to the distance indicated. The average range to TTS is provided as well as the range from the estimated minimum to the maximum range to TTS in parenthesis.
Notes: HF = high frequency, TTS = temporary threshold shift

Table 3.4-7: Ranges to Temporary Threshold Shift for Sonar Bin LF4 over a Representative Range of Environments Within the Study Area

Hearing Group	*Approximate TTS Ranges (meters)*[1]			
	Sonar Bin LF4			
	1 second	*30 seconds*	*60 seconds*	*120 seconds*
High-frequency cetaceans	0 (0–0)	0 (0–0)	0 (0–0)	1 (0–1)
Low-frequency cetaceans	22 (19–30)	32 (25–230)	41 (30–230)	61 (45–100)
Mid-frequency cetaceans	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)
Otariids and Mustelids	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)
Phocids	2 (1–3)	4 (3–4)	4 (4–5)	7 (6–9)

[1] Ranges to TTS represent the model predictions in different areas and seasons within the Study Area. The zone in which animals are expected to suffer TTS extend from onset-PTS to the distance indicated. The average range to TTS is provided as well as the range from the estimated minimum to the maximum range to TTS in parenthesis.

Notes: LF = low-frequency, TTS = temporary threshold shift

Table 3.4-8: Ranges to Temporary Threshold Shift for Sonar Bin MF1 over a Representative Range of Environments Within the Study Area

Hearing Group	*Approximate TTS Ranges (meters)*[1]			
	Sonar Bin MF1			
	1 second	*30 seconds*	*60 seconds*	*120 seconds*
High-frequency cetaceans	2,466 (80–6,275)	2,466 (80–6,275)	3,140 (80–10,275)	3,740 (80–13,525)
Low-frequency cetaceans	1,054 (80–2,775)	1,054 (80–2,775)	1,480 (80–4,525)	1,888 (80–5,275)
Mid-frequency cetaceans	225 (80–380)	225 (80–380)	331 (80–525)	411 (80–700)
Otariids and Mustelids	67 (60–110)	67 (60–110)	111 (80–170)	143 (80–250)
Phocids	768 (80–2,025)	768 (80–2,025)	1,145 (80–3,275)	1,388 (80–3,775)

[1] Ranges to TTS represent the model predictions in different areas and seasons within the Study Area. The zone in which animals are expected to suffer TTS extend from onset-PTS to the distance indicated. The average range to TTS is provided as well as the range from the estimated minimum to the maximum range to TTS in parenthesis. Ranges for 1-second and 30-second periods are identical for Bin MF1 because this system nominally pings every 50 seconds; therefore, these periods encompass only a single ping.

Notes: MF = mid-frequency, TTS = temporary threshold shift

Table 3.4-9: Ranges to Temporary Threshold Shift for Sonar Bin MF4 over a Representative Range of Environments Within the Study Area

Hearing Group	***Approximate TTS Ranges (meters)[1]***			
	Sonar Bin MF4			
	1 second	***30 seconds***	***60 seconds***	***120 seconds***
High-frequency cetaceans	279 (220–600)	647 (420–1,275)	878 (500–1,525)	1,205 (525—2,275)
Low-frequency cetaceans	87 (85–110)	176 (130–320)	265 (190–575)	477 (290–975)
Mid-frequency cetaceans	22 (22–25)	35 (35–45)	50 (45–55)	71 (70–85)
Otariids and Mustelids	8 (8–8)	15 (15–17)	19 (19–23)	25 (25–30)
Phocids	66 (65–80)	116 (110–200)	173 (150–300)	303 (240–675)

[1] Ranges to TTS represent the model predictions in different areas and seasons within the Study Area. The zone in which animals are expected to suffer TTS extend from onset-PTS to the distance indicated. The average range to TTS is provided as well as the range from the estimated minimum to the maximum range to TTS in parenthesis.

Notes: MF = mid-frequency, TTS = temporary threshold shift

Table 3.4-10: Ranges to Temporary Threshold Shift for Sonar Bin MF5 over a Representative Range of Environments Within the Study Area

Hearing Group	***Approximate TTS Ranges (meters)[1]***			
	Sonar Bin MF5			
	1 second	***30 seconds***	***60 seconds***	***120 seconds***
High-frequency cetaceans	115 (110–180)	115 (110–180)	174 (150–390)	292 (210–825)
Low-frequency cetaceans	11 (10–13)	11 (10–13)	17 (16–19)	24 (23–25)
Mid-frequency cetaceans	6 (0–9)	6 (0–9)	12 (11–14)	18 (17–22)
Otariids and Mustelids	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)
Phocids	9 (8–11)	9 (8–11)	15 (14–17)	22 (21–25)

[1] Ranges to TTS represent the model predictions in different areas and seasons within the Study Area. The zone in which animals are expected to suffer TTS extend from onset-PTS to the distance indicated. The average range to TTS is provided as well as the range from the estimated minimum to the maximum range to TTS in parenthesis.

Notes: MF = mid-frequency, TTS = temporary threshold shift

The range to received sound levels in 6-dB steps from five representative sonar bins and the percentage of animals that may exhibit a significant behavioral response under each behavioral response function (or step function in the case of the harbor porpoise) are shown in Table 3.4-11 through Table 3.4-15, respectively. See Section 3.4.2.1.2.1 (Methods for Analyzing Impacts from Sonars and Other Transducers) for details on the derivation and use of the behavioral response functions, thresholds, and the cutoff distances.

Table 3.4-11: Ranges to a Potentially Significant Behavioral Response for Sonar Bin HF4 over a Representative Range of Environments Within the Study Area

Received Level (dB re 1 µPa)	*Mean Range (meters) with Minimum and Maximum Values in Parentheses*	*Probability of Behavioral Response for Sonar Bin HF4*				
		Odontocete	*Mysticete*	*Pinniped & Mustelid*	*Beaked Whale*	*Harbor Porpoise*
196	4 (0–7)	100%	100%	100%	100%	100%
190	10 (0–16)	100%	98%	99%	100%	100%
184	20 (0–40)	99%	88%	98%	100%	100%
178	42 (0–85)	97%	59%	92%	100%	100%
172	87 (0–270)	91%	30%	76%	99%	100%
166	177 (0–650)	78%	20%	48%	97%	100%
160	338 (25–825)	58%	18%	27%	93%	100%
154	577 (55–1,275)	40%	17%	18%	83%	100%
148	846 (60–1,775)	29%	16%	16%	66%	100%
142	1,177 (60–2,275)	25%	13%	15%	45%	100%
136	1,508 (60–3,025)	23%	9%	15%	28%	100%
130	1,860 (60–3,525)	20%	5%	15%	18%	100%
124	2,202 (60–4,275)	17%	2%	14%	14%	100%
118	2,536 (60–4,775)	12%	1%	13%	12%	0%
112	2,850 (60–5,275)	6%	0%	9%	11%	0%
106	3,166 (60–6,025)	3%	0%	5%	11%	0%
100	3,470 (60–6,775)	1%	0%	2%	8%	0%

Notes: dB re 1 µPa = decibels referenced to 1 micropascal, HF = high-frequency

Table 3.4-12: Ranges to a Potentially Significant Behavioral Response for Sonar Bin LF4 over a Representative Range of Environments Within the Study Area

Received Level (dB re 1 µPa)	*Mean Range (meters) with Minimum and Maximum Values in Parentheses*	*Probability of Behavioral Response for Sonar Bin LF4*				
		Odontocete	*Mysticete*	*Pinniped & Mustelid*	*Beaked Whale*	*Harbor Porpoise*
196	1 (0–1)	100%	100%	100%	100%	100%
190	3 (0–3)	100%	98%	99%	100%	100%
184	6 (0–8)	99%	88%	98%	100%	100%
178	13 (0–30)	97%	59%	92%	100%	100%
172	29 (0–230)	91%	30%	76%	99%	100%
166	64 (0–100)	78%	20%	48%	97%	100%
160	148 (0–310)	58%	18%	27%	93%	100%
154	366 (230–850)	40%	17%	18%	83%	100%
148	854 (300–2,025)	29%	16%	16%	66%	100%
142	1,774 (300–5,025)	25%	13%	15%	45%	100%
136	3,168 (300–8,525)	23%	9%	15%	28%	100%
130	5,167 (300–30,525)	20%	5%	15%	18%	100%
124	7,554 (300–93,775)	17%	2%	14%	14%	100%
118	10,033 (300–100,000*)	12%	1%	13%	12%	0%
112	12,700 (300–100,000*)	6%	0%	9%	11%	0%
106	15,697 (300–100,000*)	3%	0%	5%	11%	0%
100	17,846 (300–100,000*)	1%	0%	2%	8%	0%

* Indicates maximum range to which acoustic model was run, a distance of approximately 100 km from the sound source.

Notes: Cells are shaded if the mean range value for the specified received level exceeds the distance cutoff range for a particular hearing group. Any impacts within the cutoff range for a criteria group are included in the estimated impacts. Cut-off ranges in this table are for activities with high source levels and/or multiple platforms (see Table 3.4-4 for behavioral cut-off distances). dB re 1 µPa = decibels referenced to 1 micropascal, LF = low-frequency

Table 3.4-13: Ranges to a Potentially Significant Behavioral Response for Sonar Bin MF1 over a Representative Range of Environments Within the Study Area

Received Level (dB re 1 µPa)	*Mean Range (meters) with Minimum and Maximum Values in Parentheses*	*Probability of Behavioral Response for Sonar Bin MF1*				
		Odontocete	*Mysticete*	*Pinniped and Mustelid*	*Beaked Whale*	*Harbor Porpoise*
196	112 (80–170)	100%	100%	100%	100%	100%
190	262 (80–410)	100%	98%	99%	100%	100%
184	547 (80–1,025)	99%	88%	98%	100%	100%
178	1,210 (80–3,775)	97%	59%	92%	100%	100%
172	2,508 (80–7,525)	91%	30%	76%	99%	100%
166	4,164 (80–16,025)	78%	20%	48%	97%	100%
160	6,583 (80–28,775)	58%	18%	27%	93%	100%
154	10,410 (80–47,025)	40%	17%	18%	83%	100%
148	16,507 (80–63,525)	29%	16%	16%	66%	100%
142	21,111 (80–94,025)	25%	13%	15%	45%	100%
136	26,182 (80–100,000*)	23%	9%	15%	28%	100%
130	31,842 (80–100,000*)	20%	5%	15%	18%	100%
124	34,195 (80–100,000*)	17%	2%	14%	14%	100%
118	36,557 (80–100,000*)	12%	1%	13%	12%	0%
112	38,166 (80–100,000*)	6%	0%	9%	11%	0%
106	39,571 (80–100,000*)	3%	0%	5%	11%	0%
100	41,303 (80–100,000*)	1%	0%	2%	8%	0%

* Indicates maximum range to which acoustic model was run, a distance of approximately 100 km from the sound source.

Notes: Cells are shaded if the mean range value for the specified received level exceeds the distance cutoff range for a particular hearing group. Any impacts within the cutoff range for a criteria group are included in the estimated impacts. Cut-off ranges in this table are for activities with high source levels and/or multiple platforms (see Table 3.4-4 for behavioral cut-off distances). dB re 1 µPa = decibels referenced to 1 micropascal, MF = mid-frequency

Table 3.4-14: Ranges to a Potentially Significant Behavioral Response for Sonar Bin MF4 over a Representative Range of Environments Within the Study Area

Received Level (dB re 1 µPa)	*Mean Range (meters) with Minimum and Maximum Values in Parentheses*	*Probability of Behavioral Response for Sonar Bin MF4*				
		Odontocete	*Mysticete*	*Pinniped and Mustelid*	*Beaked Whale*	*Harbor Porpoise*
196	8 (0–8)	100%	100%	100%	100%	100%
190	16 (0–20)	100%	98%	99%	100%	100%
184	34 (0–40)	99%	88%	98%	100%	100%
178	68 (0–85)	97%	59%	92%	100%	100%
172	155 (120–300)	91%	30%	76%	99%	100%
166	501 (290–975)	78%	20%	48%	97%	100%
160	1,061 (480–2,275)	58%	18%	27%	93%	100%
154	1,882 (525–4,025)	40%	17%	18%	83%	100%
148	2,885 (525–7,525)	29%	16%	16%	66%	100%
142	4,425 (525–14,275)	25%	13%	15%	45%	100%
136	9,902 (525–48,275)	23%	9%	15%	28%	100%
130	20,234 (525–56,025)	20%	5%	15%	18%	100%
124	23,684 (525–91,775)	17%	2%	14%	14%	100%
118	28,727 (525–100,000*)	12%	1%	13%	12%	0%
112	37,817 (525–100,000*)	6%	0%	9%	11%	0%
106	42,513 (525–100,000*)	3%	0%	5%	11%	0%
100	43,367 (525–100,000*)	1%	0%	2%	8%	0%

*Indicates maximum range to which acoustic model was run, a distance of approximately 100 km from the sound source.

Notes: Cells are shaded if the mean range value for the specified received level exceeds the distance cutoff range for a particular hearing group. Any impacts within the cutoff range for a criteria group are included in the estimated impacts. Cut-off ranges in this table are for activities with high source levels and/or multiple platforms (see Table 3.4-4 for behavioral cut-off distances). dB re 1 µPa = decibels referenced to 1 micropascal, MF = mid-frequency

Table 3.4-15: Ranges to a Potentially Significant Behavioral Response for Sonar Bin MF5 over a Representative Range of Environments Within the Study Area

Received Level (dB re 1 µPa)	*Mean Range (meters) with Minimum and Maximum Values in Parentheses*	*Probability of Behavioral Response for Sonar Bin MF5*				
		Odontocete	*Mysticete*	*Pinniped and Mustelid*	*Beaked Whale*	*Harbor Porpoise*
196	0 (0–0)	100%	100%	100%	100%	100%
190	1 (0–3)	100%	98%	99%	100%	100%
184	5 (0–7)	99%	88%	98%	100%	100%
178	14 (0–18)	97%	59%	92%	100%	100%
172	29 (0–35)	91%	30%	76%	99%	100%
166	58 (0–70)	78%	20%	48%	97%	100%
160	127 (0–280)	58%	18%	27%	93%	100%
154	375 (0–1,000)	40%	17%	18%	83%	100%
148	799 (490–1,775)	29%	16%	16%	66%	100%
142	1,677 (600–3,525)	25%	13%	15%	45%	100%
136	2,877 (675–7,275)	23%	9%	15%	28%	100%
130	4,512 (700–12,775)	20%	5%	15%	18%	100%
124	6,133 (700–19,275)	17%	2%	14%	14%	100%
118	7,880 (700–26,275)	12%	1%	13%	12%	0%
112	9,673 (700–33,525)	6%	0%	9%	11%	0%
106	12,095 (700–45,275)	3%	0%	5%	11%	0%
100	18,664 (700–48,775)	1%	0%	2%	8%	0%

Notes: Cells are shaded if the mean range value for the specified received level exceeds the distance cutoff range for a particular hearing group. Any impacts within the cutoff range for a criteria group are included in the estimated impacts. Cut-off ranges in this table are for activities with high source levels and/or multiple platforms (see Table 3.4-4 for behavioral cut-off distances). dB re 1 µPa = decibels referenced to 1 micropascal, MF = mid-frequency

3.4.2.1.2.3 Impacts from Sonar and Other Transducers Under the Action Alternatives

Sonar and other transducers emit sound waves into the water to detect objects, safely navigate, and communicate. Use of sonar and other transducers would typically be transient and temporary. General categories and characteristics of sonar systems and the number of hours these sonars would be operated during training under Alternative 1 and 2 are described in Section 3.0.3.1 (Acoustic Stressors). Activities using sonars and other transducers would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activities Descriptions).

Anti-submarine warfare activities include unit-level training and testing activities, and anti-submarine warfare sonar systems would be active when conducting surface ship and submarine sonar maintenance. Submarine and surface ship sonar maintenance activities involve the use of a single system in a limited manner; therefore, significant reactions to maintenance are less likely than with most other anti-submarine warfare activities. Furthermore, sonar maintenance activities typically occur either pierside or within entrances to harbors where higher levels of anthropogenic activity, including elevated noise levels, already exist. Unit-level training activities typically involve the use of a single vessel or aircraft and last for only a few hours over a small area of ocean. These unit-level training and sonar maintenance activities are limited in scope and duration; therefore, significant behavioral reactions are less likely than with other anti-submarine warfare activities with greater intensity and duration. Unit-level training activities are more likely to occur close to homeports and in the same general locations each time, so resident animals could be more frequently exposed to these types of activities. Coordinated/integrated exercises involve multiple assets and can last for several days transiting across large areas of a range complex. Repeated exposures to some individual marine mammals are likely during coordinated/integrated exercises.

Anti-submarine warfare testing activities are typically similar to unit-level training. Vessel evaluation testing activities also use the same anti-submarine warfare sonars on ships and submarines. Testing activities that use anti-submarine warfare sonars typically occur in water deeper than approximately 200 m and therefore out of most nearshore habitats where productivity is typically higher (i.e., more food) and many marine mammals have higher abundances. Therefore, significant reactions to anti-submarine warfare and vessel evaluation testing activities are less likely than with larger anti-submarine warfare training activities discussed above in Impacts from *Sonar and Other Transducers Under Alternative 1 for Training Activities*. Anti-submarine warfare and vessel evaluation testing activities are more likely to occur close to homeports and testing facilities and in the same general locations each time, so resident animals could be more frequently exposed to these types of activities. These testing activities are limited in scope and duration; therefore, many of the impacts estimated by the quantitative analysis are unlikely to rise to the level of a significant behavioral response.

Mine warfare training activities typically involve a ship, helicopter, or unmanned vehicle using a mine-hunting sonar to locate mines. Most mine warfare sonar systems have a lower source level, higher frequency, and narrower, often downward facing beam pattern as compared to most anti-submarine warfare sonars. Significant reactions in marine mammals have not been reported due to exposure to mine warfare sonars. While individual animals could show short-term and minor responses to mine warfare sonar training activities, these reactions are very unlikely to lead to any costs or long-term consequences for individuals or populations.

Acoustic and Oceanographic Science and Research uses a number of different sonar systems and other transducers to sense and measure the parameters of the ocean (e.g., temperature) and conduct research on the ways sound travels underwater. Many of these systems generate only moderate sound levels and are stationary. Significant reactions in marine mammals have not been reported due to exposure to the sonars and other transducers typically used in these activities. Animals are most likely to show short-term and minor to moderate responses to these testing activities; therefore, many of the impacts estimated by the quantitative analysis are unlikely to rise to the level of a significant behavioral response.

Other testing activities include testing of individual sonar systems and other transducers for performance and acoustic signature. Most sources used during these exercises have moderate source levels between 160 and 200 dB re 1 µPa @ 1m and are used for a limited duration, up to a few hours in most cases. Significant reactions in marine mammals have not been reported due to exposure to the sonars and other transducers typically used in these activities. Animals are most likely to show short-term and minor to moderate responses to these testing activities; therefore, many of the impacts estimated by the quantitative analysis are unlikely to rise to the level of a significant behavioral response.

Presentation of Estimated Impacts from the Quantitative Analysis

The results of the analysis of potential impacts on marine mammals from sonars and other transducers (Section 3.4.2.1.2.1, Methods for Analyzing Impacts from Sonars and Other Transducers) are discussed below. The numbers of potential impacts estimated for individual species and stocks of marine mammals from exposure to sonar for training and testing activities under each action alternative are shown in Appendix E (Estimated Marine Mammal and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors under Navy Training and Testing Activities) and presented below in figures for each species of marine mammal with any estimated effects (e.g., Figure 3.4-12). The Activity Categories that are most likely to cause impacts and the most likely region in which impacts could occur are represented in the impact graphics for each species. There is a potential for impacts on occur anywhere within the Study Area where sound from sonar and the species overlap, although only regions or activity categories where 0.5 percent of the impacts or greater are estimated to occur are graphically represented below. All (i.e., grand total) estimated impacts for that species are included, regardless of region or category.

Regions within the NWTT Study Area include (see Study Area maps in Chapter 2, Description of Proposed Action and Alternatives) NWTT Offshore, Dabob Bay Range Complex, Northeast Puget Sound, Southwest Puget Sound, and Southeast Alaska. Note that the numbers of activities planned under Alternative 1 can vary from year-to-year. Results are presented for a "representative sonar use year" and a "maximum sonar use year" to provide a range of potential impacts that could occur. Planned activities for Alternative 2 are more consistent from year to year so only maximum annual impacts are presented. The number of hours these sonars would be operated under each alternative are described in Section 3.0.3.1 (Acoustic Stressors).

It is important to note when examining the results of the quantitative analysis that the behavioral response functions used to predict the numbers of reactions in this analysis are largely derived from several studies (see Section 3.4.2.1.1.5, Behavioral Reactions). The best available science, including behavioral response studies, was used for deriving these criteria; however, many of the factors inherent in these studies that potentially increased the likelihood and severity of observed responses (e.g., close approaches by multiple vessels, tagging animals, and vectoring towards animals that have already begun avoiding the sound source) would not occur during Navy activities. Because the Navy purposely avoids approaching marine mammals, many of the behavioral responses estimated by the quantitative analysis are unlikely to occur or unlikely to rise to the severity observed during many of the behavioral response studies.

Although the statutory definition of Level B harassment for military readiness activities under the MMPA requires that the natural behavior patterns of a marine mammal be significantly altered or abandoned, the current state of science for determining those thresholds is somewhat unsettled. Therefore, in its analysis of impacts associated with acoustic sources, the Navy is adopting a conservative approach that overestimates the number of takes by Level B harassment. The responses estimated using the Navy's quantitative analysis are most likely to be moderate severity. Moderate severity responses would be considered significant if they were sustained for a duration long enough that it caused an animal to be outside of normal daily variations in feeding, reproduction, resting, migration/movement, or social cohesion. As discussed in Section 3.4.2.1.2.1 (Methods for Analyzing Impacts from Sonars and Other Transducers), the behavioral response functions used within the Navy's quantitative analysis were primarily derived from experiments using short-duration sound exposures lasting, in many cases, for less than 30 minutes. If animals exhibited moderate severity reactions for the duration of the exposure or longer, then it was conservatively assumed that the animal experienced a significant behavioral reaction. However, the experiments did not include measurements of costs to animals beyond the immediately observed reactions, and no direct correlations exist between an observed behavioral response and a cost that may result in long-term consequences. Within the Navy's quantitative analysis, many behavioral reactions are estimated from exposure to sound that may exceed an animal's behavioral threshold for only a single exposure to several minutes. It is likely that many of the estimated behavioral reactions within the Navy's quantitative analysis would not constitute significant behavioral reactions; however, the numbers of significant verses non-significant behavioral reactions are currently impossible to predict. Consequently, there is a high likelihood that significant numbers of marine mammals exposed to acoustic sources are not significantly altering or abandoning their natural behavior patterns. As such, the overall impact of acoustic sources from military readiness activities on marine mammal species and stocks is negligible (i.e., cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stocks through effects on annual rates of recruitment or survival).

Mysticetes

Mysticetes may be exposed to sound from sonar and other transducers associated with training and testing activities throughout the year, although many species are not present in the NWTT Study Area in the summer months. Most low- (less than 1 kHz) and mid- (1–10 kHz) frequency sonars and other transducers produce sounds that are likely to be within the hearing range of mysticetes (Section 3.4.1.6, Hearing and Vocalization). Some high-frequency sonars (greater than 10 kHz) also produce sounds that should be audible to mysticetes, although only smaller species of mysticetes such as minke whales are likely to be able to hear higher frequencies, presumably up to 30 kHz. Therefore, some high-frequency sonars and other transducers with frequency ranges between 10 and 30 kHz may also be audible to some mysticetes. If a sound is within an animal's hearing range then behavioral reactions, physiological stress, masking and hearing loss are potential impacts that must be analyzed. If a marine mammal cannot hear a sound, then behavioral reactions, physiological stress, masking, or hearing loss is not likely to occur. Impact ranges for mysticetes are discussed under low-frequency cetaceans in Section 3.4.2.1.2 (Impacts from Sonar and Other Transducers).

A few behavioral reactions in mysticetes resulting from exposure to sonar could take place at distances of up to 20 km. Behavioral reactions, however, are much more likely within a few kilometers of the sound source. As discussed above in *Assessing the Severity of Behavioral Responses from Sonar and other Transducers*, the quantitative analysis very likely overestimated the numbers of behavioral reactions due to the underlying nature of the data used to derive the behavioral response functions. Research shows that if mysticetes do respond they may react in a number of ways, depending on the characteristics of the sound source, their experience with the sound source, and whether they are migrating or on seasonal grounds (i.e., breeding or feeding). Behavioral reactions may include alerting, breaking off feeding dives and surfacing, or diving or swimming away. Overall, mysticetes have been observed to be more reactive to acoustic disturbance when a noise sources is located directly on their migration route. Mysticetes disturbed while migrating could pause their migration or route around the disturbance. Animals disturbed while engaged in other activities such as feeding or reproductive behaviors may be more likely to ignore or tolerate the disturbance and continue their natural behavior patterns. Therefore, behavioral reactions from mysticetes are likely to be short-term and low to moderate severity.

Behavioral research indicates that mysticetes most likely avoid sound sources at levels that would cause any hearing loss (i.e., TTS) (Section 3.4.2.1.1.5, Behavioral Reactions). Therefore, it is likely that the quantitative analysis overestimates TTS in marine mammals because it does not account for animals avoiding sound sources at closer ranges. Mysticetes that do experience PTS or TTS from sonar sounds may have reduced ability to detect biologically important sounds around the frequency band of the sonar until their hearing recovers. Recovery from hearing loss begins almost immediately after the noise exposure ceases and can take a few minutes to a few days to fully recover, depending on the magnitude of the initial threshold shift. TTS would be recoverable and PTS would leave some residual hearing loss. Most TTS, if it does actually occur, would be more likely to be minor to moderate (i.e., less than 20 dB of TTS directly after the exposure) and would recover within a matter of minutes to hours (see Section 3.4.2.1.1.2, Hearing Loss). Threshold shifts do not necessarily affect all hearing frequencies equally, and typically manifest themselves at the exposure frequency or within an octave above the exposure frequency. During the period that a mysticete had hearing loss, social calls from conspecifics could be more difficult to detect or interpret if they fell in the octave band of the sonar frequency. Killer whales are a primary predator of mysticetes. Some hearing loss could make killer whale calls more difficult to detect at farther ranges until hearing recovers. It is unclear how or if mysticetes use sound for finding prey or feeding; therefore, it is unknown whether hearing loss would affect a mysticete's ability to locate prey or rate of feeding. A single or even a few minor TTS (less than 20 dB of TTS) to an individual mysticete per year are unlikely to have any long-term consequences for that individual.

Research and observations of masking in marine mammals are discussed in Section 3.4.2.1.1.4 (Masking). Most anti-submarine warfare sonars and countermeasures use mid-frequency ranges and a few use low-frequency ranges. Most of these sonar signals are limited in the temporal, frequency, and spatial domains. The duration of most individual sounds is short, lasting up to a few seconds each. Systems typically operate with low-duty cycles for most tactical sources, but some systems may operate nearly continuously or with higher duty cycles. Nevertheless, masking may be more prevalent at closer ranges to these high-duty cycle and continuous active sonar systems. Most anti-submarine warfare activities are geographically dispersed and last for only a few hours, often with intermittent sonar use even within this period. Most anti-submarine warfare sonars also have a narrow frequency band (typically less than one-third octave). These factors reduce the likelihood of sources causing significant masking in mysticetes. High-frequency (greater than 10 kHz) sonars fall outside of the best hearing and vocalization ranges of mysticetes (see Section 3.4.1.6, Hearing and Vocalization). Furthermore, high frequencies (above 10 kHz) attenuate more rapidly in the water due to absorption than do lower frequency signals, thus producing only a small zone of potential masking. High-frequency sonars are typically used for mine hunting, navigation, and object detection (avoidance). Masking in mysticetes due to exposure to high-frequency sonar is unlikely. Potential costs to mysticetes from masking are similar to those discussed above for mild to moderate levels of TTS, with the primary difference being that the effects of masking are only present when the sound source (i.e., sonar) is actively pinging and the effect is over the moment the sound has ceased. By contrast, hearing loss lasts beyond the exposure for a period. Nevertheless, mysticetes that do experience some masking for a short period from low- or mid-frequency sonar may have their ability to communicate with conspecifics reduced, especially at further ranges. However, larger mysticetes (e.g., blue whale, fin whale, sei whale) communicate at frequencies below those of mid-frequency sonar and even most low-frequency sonars. Mysticetes that communicate at higher frequencies (e.g., minke whale) may be affected by some short-term and intermittent masking. Sounds from mid-frequency sonar could mask killer whale vocalizations making them more difficult to detect, especially at further ranges. It is unknown whether masking would affect a mysticete's ability to feed since it is unclear how or if mysticetes use sound for finding prey or feeding. A single or even a few short periods of masking, if it were to occur, to an individual mysticete per year are unlikely to have any long-term consequences for that individual.

Many activities such as submarine under ice certification and most mine hunting exercises use only high-frequency sonars that are not within mysticetes' hearing range; therefore, there were no predicted effects. Section 3.4.1.6 (Hearing and Vocalization) discusses low-frequency cetacean (i.e., mysticetes) hearing abilities.

North Pacific Right Whales (Endangered Species Act-Listed)

North Pacific right whales are extremely rare in the Study Area. Data on right whale presence is insufficient to develop density estimates for use in the Navy Acoustic Effects Model for estimating the number of animals that may be exposed to sonars and other transducers. Based on the highly unlikely presence of North Pacific right whales in the offshore portion of the Study Area and no records of occurrence in the inland waters or Behm Canal portions of the Study Area, as well as the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), exposure of any North Pacific right whales to sonars and other transducers associated with training activities is highly unlikely.

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

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 would not result in the incidental taking of North Pacific right whales.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 1 may affect ESA-listed North Pacific right whales.

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

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 would not result in the incidental taking of North Pacific right whales.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 1 may affect ESA-listed North Pacific right whales.

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

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 would not result in the incidental taking of North Pacific right whales.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 2 may affect ESA-listed North Pacific right whales.

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

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 would not result in the incidental taking of North Pacific right whales.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 2 may affect ESA-listed North Pacific right whales.

Blue Whales (Endangered Species Act-Listed)

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

Blue whales may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions under Alternative 1 (see Figure 3.4-12 and Table 3.4-16 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the Eastern North Pacific Stock (see Table 3.4-16).

As described for mysticetes above, even a few minor to moderate behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of blue whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 1 may affect ESA-listed blue whales. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

<u>Impacts from Sonar and Other Transducers Under Alternative 1 for Testing Activities</u>

Blue whales may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-12 and Table 3.4-16 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the Eastern North Pacific Stock (see Table 3.4-16).

As described for mysticetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of blue whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 1 may affect ESA-listed blue whales. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-12: Blue Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-16: Estimated Impacts on Individual Blue Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
Eastern North Pacific	2	0	0	3	4	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Blue whales may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions under Alternative 2 (see Figure 3.4-13 and Table 3.4-17 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the Eastern North Pacific stock (see Table 3.4-17).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of blue whales incidental to those activities.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 2 may affect ESA-listed blue whales.

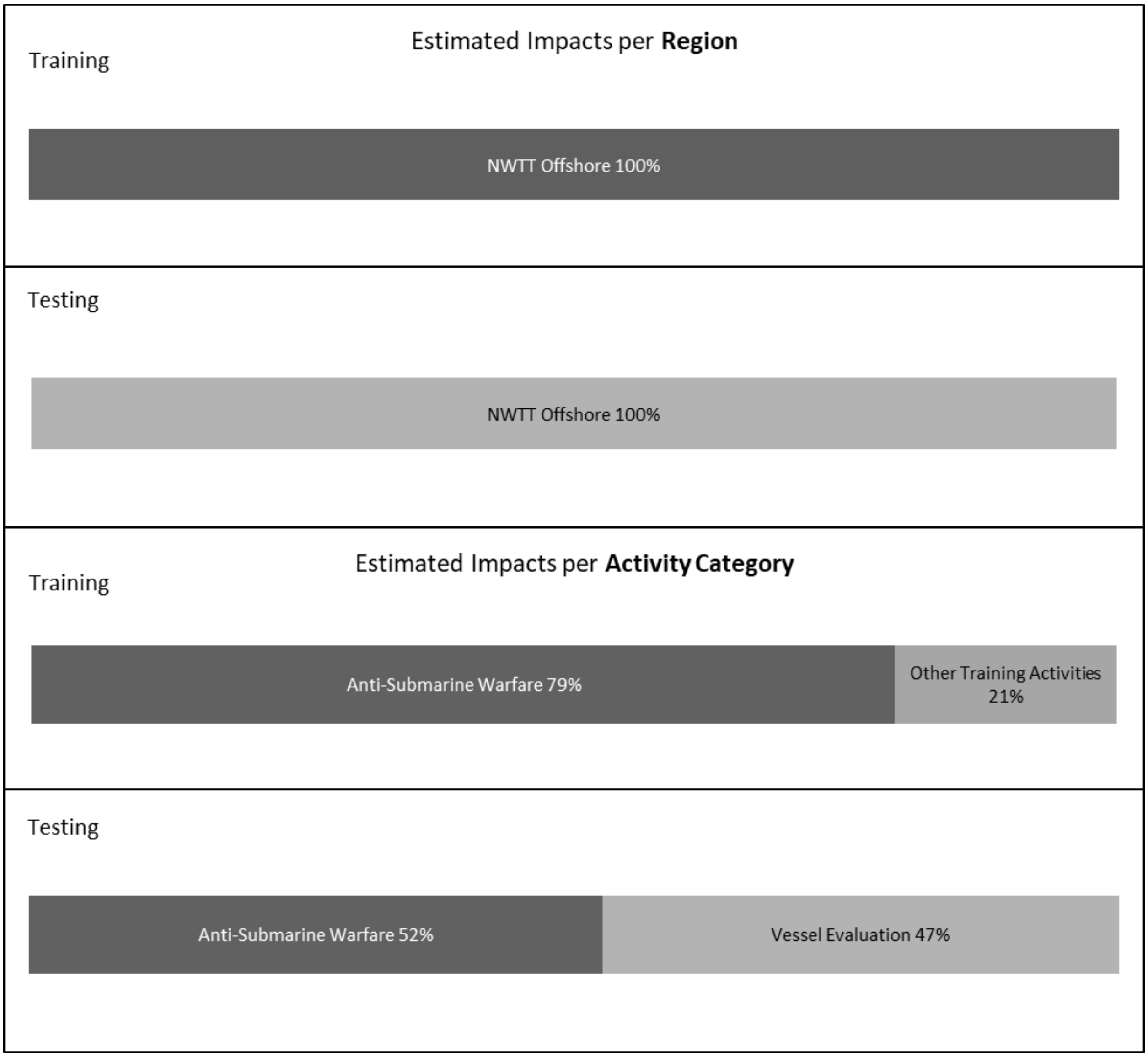
Impacts from Sonar and Other Transducers Under Alternative 2 for Testing Activities

Blue whales may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-13 and Table 3.4-17 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the Eastern North Pacific stock (see Table 3.4-17).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking of blue whales incidental to those activities.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 2 may affect ESA-listed blue whales.



Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-13: Blue Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-17: Estimated Impacts on Individual Blue Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
Eastern North Pacific	2	0	0	4	4	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Fin Whales (Endangered Species Act-Listed)

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

Fin whales may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-14 and Table 3.4-18 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-18).

As described for mysticetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of fin whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 1 may affect ESA-listed fin whales. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

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

Fin whales may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-14 and Table 3.4-18 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-18)

As described for mysticetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of fin whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 1 may affect ESA-listed fin whales. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-14: Fin Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-18: Estimated Impacts on Individual Fin Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Stock	Training			Testing		
	Behavioral	TTS	PTS	Behavioral	TTS	PTS
Northeast Pacific	0	0	0	1	1	0
California, Oregon, & Washington	41	13	0	44	29	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Fin whales may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-15 and Table 3.4-19 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-19).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of fin whales incidental to those activities.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 2 may affect ESA-listed fin whales.

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

Fin whales may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-15 and Table 3.4-19 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-19).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking of fin whales incidental to those activities.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 2 may affect ESA-listed fin whales.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-15: Fin Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-19: Estimated Impacts on Individual Fin Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
Northeast Pacific	0	0	0	1	1	0
California, Oregon, & Washington	42	13	0	58	36	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Sei Whales (Endangered Species Act-Listed)

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

Sei whales may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-16 and Table 3.4-20 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the Eastern North Pacific stock (see Table 3.4-20).

As described for mysticetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of sei whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 1 may affect ESA-listed sei whales. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

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

Sei whales may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-16 and Table 3.4-20 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the Eastern North Pacific stock (see Table 3.4-20).

As described for mysticetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of sei whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 1 may affect ESA-listed sei whales. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-16: Sei Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-20: Estimated Impacts on Individual Sei Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
Eastern North Pacific	16	14	0	17	36	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Sei whales may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-17 and Table 3.4-21 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the Eastern North Pacific stock (see Table 3.4-21).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of sei whales incidental to those activities.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 2 may affect ESA-listed sei whales.

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

Sei whales may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-17 and Table 3.4-21 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the Eastern North Pacific stock (see Table 3.4-21).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking of sei whales incidental to those activities.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 2 may affect ESA-listed sei whales.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-17: Sei Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-21: Estimated Impacts on Individual Sei Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
Eastern North Pacific	16	14	0	22	46	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Minke Whales

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

Minke whales may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-18 and Table 3.4-22 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-22).

As described for mysticetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of minke whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

<u>Impacts from Sonar and Other Transducers Under Alternative 1 for Testing Activities</u>

Minke whales may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-18 and Table 3.4-22 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-22).

As described for mysticetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of minke whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-18: Minke Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-22: Estimated Impacts on Individual Minke Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Stock	Training			Testing		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
Alaska	0	0	0	1	1	0
California, Oregon, & Washington	52	58	0	56	133	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Minke whales may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-19 and Table 3.4-23 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-23).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of minke whales incidental to those activities.

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

Minke whales may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-19 and Table 3.4-23 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-23).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking of minke whales incidental to those activities.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-19: Minke Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-23: Estimated Impacts on Individual Minke Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
Alaska	0	0	0	1	1	0
California, Oregon, & Washington	54	58	0	71	170	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Humpback Whales (some DPSs are Endangered Species Act-Listed)

Impacts have been modeled for the Hawaii (Central North Pacific stock) population of humpback whales, which are not Endangered Species Act-Listed, and for the Mexico (California, Oregon, and Washington stock), and Central America (California, Oregon, and Washington stock populations of humpback whales, which are Endangered Species Act listed. Western North Pacific humpback whales are not likely to be present in the Study Area during or in proximity to any of the proposed training or testing activities.

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

Humpback whales may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-20 and Table 3.4-24 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-24).

As described for mysticetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of humpback whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 1 may affect ESA-listed humpback whales. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

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

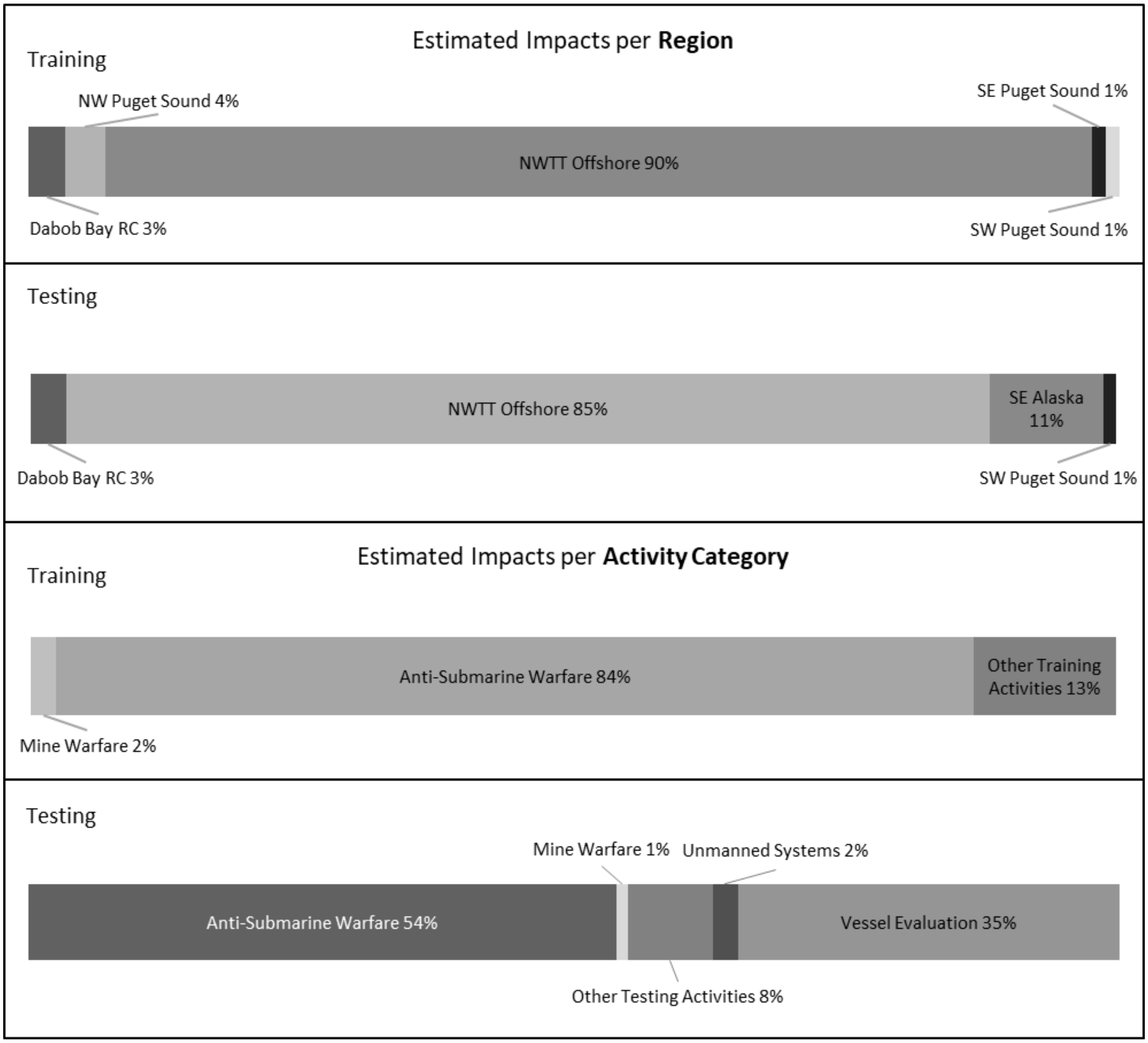
Humpback whales may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-20 and Table 3.4-24 below). Impact ranges for this species are discussed in

Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-24).

As described for mysticetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of humpback whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 1 may affect ESA-listed humpback whales. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.



Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-20: Humpback Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-24: Estimated Impacts on Individual Humpback Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts by Effect						
Stock	*Training*			*Testing*		
	Behavioral	*TTS*	*PTS*	*Behavioral*	*TTS*	*PTS*
Central North Pacific	3	2	0	46	71	0
California, Oregon, & Washington	3	2	0	38	56	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Humpback whales may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-21 and Table 3.4-25 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-25).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of humpback whales incidental to those activities.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 2 may affect ESA-listed humpback whales.

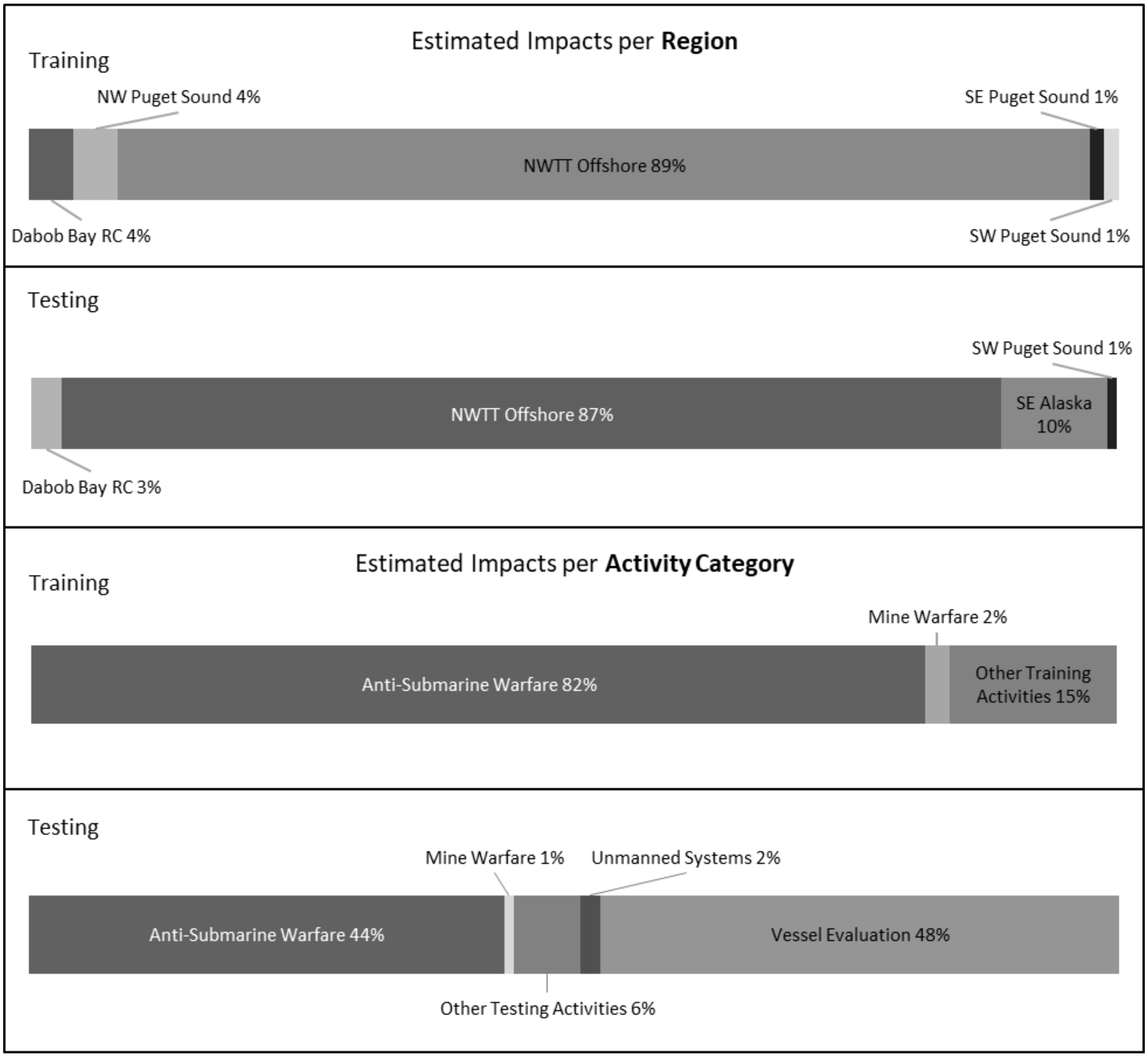
Impacts from Sonar and Other Transducers Under Alternative 2 for Testing Activities

Humpback whales may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-21 and Table 3.4-25 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-25).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking of humpback whales incidental to those activities.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 2 may affect ESA-listed humpback whales.



Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-21: Humpback Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-25: Estimated Impacts on Individual Humpback Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	*Training*			*Testing*		
	Behavioral	*TTS*	*PTS*	*Behavioral*	*TTS*	*PTS*
Central North Pacific	3	2	0	58	93	0
California, Oregon, & Washington	3	2	0	48	72	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Gray Whales (one DPS is Endangered Species Act-Listed)

The vast majority of gray whales in the Study Area are from the non-endangered Eastern North Pacific stock. On very rare occasions, Western North Pacific gray whales, which are Endangered Species Act-Listed, occur in the Study Area.

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

Gray whales may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions under Alternative 1 (see Figure 3.4-22 and Table 3.4-26 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the Eastern North Pacific stock (see Table 3.4-26).

As described for mysticetes above, even a few minor to moderate behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of gray whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 1 may affect ESA-listed gray whales.

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

Gray whales may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-22 and Table 3.4-26 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-26).

As described for mysticetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of gray whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 1 may affect ESA-listed gray whales.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-22: Gray Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-26: Estimated Impacts on Individual Gray Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
Eastern North Pacific	2	0	0	65	85	0
Western North Pacific	0	0	0	1	1	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Gray whales may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions under Alternative 2 (see Figure 3.4-23 and Table 3.4-27 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the Eastern North Pacific stock (see Table 3.4-27).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of gray whales incidental to those activities.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 2 may affect ESA-listed gray whales.

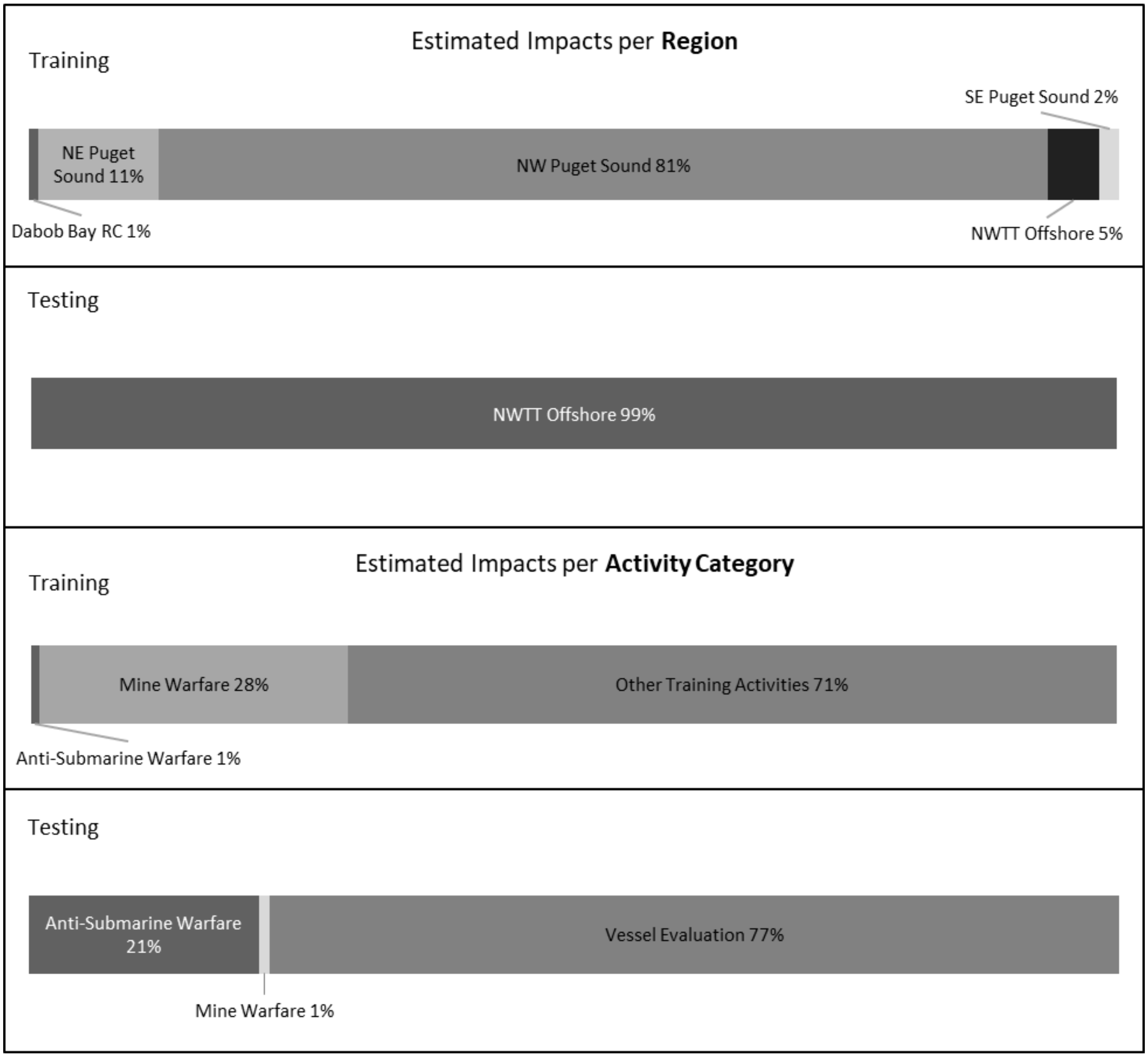
Impacts from Sonar and Other Transducers Under Alternative 2 for Testing Activities

Gray whales may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-23 and Table 3.4-27 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-27).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking of gray whales incidental to those activities.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 2 may affect ESA-listed gray whales.



Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-23: Gray Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-27: Estimated Impacts on Individual Gray Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Stock	Training			Testing		
	Behavioral	TTS	PTS	Behavioral	TTS	PTS
Eastern North Pacific	2	0	0	85	140	0
Western North Pacific	0	0	0	1	1	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Odontocetes

Odontocetes may be exposed to sound from sonar and other transducers associated with training and testing activities throughout the year. Low- (less than 1 kHz), mid- (1–10 kHz), high-frequency (10–100 kHz), and very high-frequency (100–200 kHz) sonars produce sounds that are likely to be within the audible range of odontocetes (see Section 3.4.1.6, Hearing and Vocalization). If a sound is within an animal's hearing range then behavioral reactions, physiological stress, masking and hearing loss are potential impacts that must be analyzed. If a marine mammal cannot hear a sound, then behavioral reactions, physiological stress, masking, or hearing loss could not occur. Impact ranges for odontocetes are discussed under mid-frequency cetaceans in Section 3.4.2.1.2 (Impacts from Sonar and Other Transducers).

A few behavioral reactions in odontocetes (except beaked whales and harbor porpoise) resulting from exposure to sonar could take place at distances of up to 20 km. Beaked whales and harbor porpoise have demonstrated a high level of sensitivity to human-made noise and activity; therefore, the quantitative analysis assumes that some harbor porpoises and some beaked whales could experience significant behavioral reactions at distance of up to 40 km and 50 km from the sound source, respectively. Behavioral reactions, however, are much more likely within a few kilometers of the sound source for most species of odontocetes such as delphinids and sperm whales. Even for harbor porpoise and beaked whales, as discussed above in *Assessing the Severity of Behavioral Responses from Sonar*, the quantitative analysis very likely overestimated the numbers of behavioral reactions due to the underlying nature of the data used to derive the behavioral response functions.

Research shows that if odontocetes do respond they may react in a number of ways, depending on the characteristics of the sound source and their experience with the sound source. Behavioral reactions may include alerting; breaking off feeding dives and surfacing; or diving or swimming away. Animals disturbed while engaged in other activities such as feeding or reproductive behaviors may be more likely to ignore or tolerate the disturbance and continue their natural behavior patterns. Therefore, most behavioral reactions from odontocetes are likely to be short-term and low to moderate severity.

Large odontocetes such as killer whales and pilot whales have been the subject of behavioral response studies (see Section 3.4.2.1.1.5, Behavioral Reactions). Based on these studies, a number of reactions could occur such as a short-term cessation of natural behavior such as feeding, avoidance of the sound source, or even attraction towards the sound source as seen in pilot whales. Due to the factors involved in Navy training and testing exercises versus the conditions under which pilot whales and killer whales were exposed during behavioral response studies, large odontocetes are unlikely to have more than short-term and moderate severity reactions to sounds from sonar or other human disturbance, and typically only at ranges within a few kilometers. Most estimated impacts are due to anti-submarine warfare activities, which could vary in duration and intensity. Anti-submarine warfare unit-level exercises and maintenance typically last for a matter of a few hours and involves a limited amount of sonar use so significant responses would be less likely than with longer and more intense exercises (more sonar systems and vessels). Coordinated/integrated anti-submarine warfare exercises involve multiple sonar systems and can last for a period of days, making significant response more likely. A single or few short-lived TTS or behavioral reactions per year are unlikely to have any significant costs or long-term consequences for individuals.

Small odontocetes have been the subject of behavioral response studies and observations in the field (see Section 3.4.2.1.1.5, Behavioral Reactions). Based on these studies, small odontocetes (dolphins) appear to be less sensitive to sound and human disturbance than other cetacean species. If reactions did occur, they could consist of a short-term behavior response such as cessation of feeding, avoidance of the sound source, or even attraction towards the sound source. Small odontocetes are unlikely to have more than short-term and moderate severity reactions to sounds from sonar or other human disturbance, and typically only at ranges within a few kilometers. Most estimated impacts are due to anti-submarine warfare activities, which could vary in duration and intensity. Anti-submarine warfare unit-level exercises and maintenance typically last for a matter of a few hours and involve a limited amount of sonar use so significant responses would be less likely than with longer and more intense exercises (more sonar systems and vessels). Coordinated/integrated anti-submarine warfare exercises involve multiple sonar systems and can last for a period of days, making significant response more likely. Some bottlenose dolphin estimated impacts could also occur due to navigation and object avoidance (detection) since these activities typically occur entering and leaving Navy homeports that overlap the distribution of coastal populations of this species. Navigation and object avoidance (detection) activities normally involve a single ship or submarine using a limited amount of sonar; therefore, significant reactions are unlikely. A single or few short-lived TTS or behavioral reactions per year are unlikely to have any significant costs or long-term consequences for individuals.

Behavioral research indicates that most odontocetes avoid sound sources at levels that would cause any temporary hearing loss (i.e., TTS) (see Section 3.4.2.1.1.5, Behavioral Reactions). TTS and even PTS is more likely for high-frequency cetaceans, such as harbor porpoises and Kogia whales, because hearing loss thresholds for these animals are lower than for all other marine mammals. These species, especially harbor porpoises, have demonstrated a high level of sensitivity to human-made sound and activities and may avoid at further distances. This increased distance could avoid or minimize hearing loss for these species as well, especially as compared to the estimates from the quantitative analysis. Therefore, it is likely that the quantitative analysis overestimates TTS and PTS in marine mammals because it does not account for animals avoiding sound sources at closer ranges. Recovery from hearing loss begins almost immediately after the noise exposure ceases and can take a few minutes to a few days to fully recover, depending on the magnitude of the initial threshold shift. TTS would be recoverable and PTS would leave some residual hearing loss. Most TTS, if it does actually occur, would be more likely to be minor to moderate (i.e., less than 20 dB of TTS directly after the exposure) and would recover within a matter of minutes to hours. Threshold shifts do not necessarily affect all hearing frequencies equally, and typically manifest themselves at the exposure frequency or within an octave above the exposure frequency. During the period that an odontocete had hearing loss, social calls from conspecifics could be more difficult to detect or interpret. Killer whales are a primary predator of odontocetes. Some hearing loss could make killer whale calls more difficult to detect at further ranges until hearing recovers.

Odontocetes use echolocation clicks to find and capture prey. These echolocation clicks and vocalizations are at frequencies above a few tens of kHz for delphinids, beaked whales, and sperm whales, and above 100 kHz for porpoises and Kogia whales. Therefore, echolocation associated with feeding and navigation in odontocetes is unlikely to be affected by threshold shift at lower frequencies and should not have any significant effect on an odontocete's ability to locate prey or navigate, even in the short term. Therefore, a single or even a few minor TTS (less than 20 dB of TTS) to an individual odontocete per year are unlikely to have any long-term consequences for that individual. Minor PTS (a few dB or less) in an individual could have no to minor long-term consequences for individuals.

Research and observations of masking in marine mammals are discussed in Section 3.4.2.1.1.4 (Masking). Many anti-submarine warfare sonars and countermeasures use low- and mid-frequency sonar. Most low- and mid-frequency sonar signals (i.e., sounds) are limited in their temporal, frequency, and spatial domains. The duration of most individual sounds is short, lasting up to a few seconds each. Some systems operate with higher duty cycles or nearly continuously, but typically use lower power. Nevertheless, masking may be more prevalent at closer ranges to these high-duty cycle and continuous active sonar systems. Most anti-submarine warfare activities are geographically dispersed and last for only a few hours, often with intermittent sonar use even within this period. Most anti-submarine warfare sonars also have a narrow frequency band (typically much less than one-third octave). These factors reduce the likelihood of sources causing significant masking in odontocetes due to exposure to sonar used during anti-submarine warfare activities. Odontocetes may experience some limited masking at closer ranges from high-frequency sonars and other transducers; however, the frequency band of the sonar is narrow, limiting the likelihood of masking. High-frequency sonars are typically used for mine hunting, navigation, and object detection (avoidance). Potential costs to odontocetes from masking are similar to those discussed above for mild to moderate levels of TTS, with the primary difference being that the effects of masking are only present when the sound source (i.e., sonar) is actively pinging and the effect is over the moment the sound has ceased.

Nevertheless, odontocetes that do experience some masking from sonar or other transducers may have their ability to communicate with conspecifics reduced, especially at further ranges. Sounds from mid-frequency sonar could mask killer whale vocalizations making them more difficult to detect, especially at further ranges. As discussed above for TTS, odontocetes use echolocation to find prey and navigate. The echolocation clicks of odontocetes are above the frequencies of most sonar systems, especially those used during anti-submarine warfare. Therefore, echolocation associated with feeding and navigation in odontocetes is unlikely to be masked by sounds from sonars or other transducers. A single or even a few short periods of masking, if it were to occur, to an individual odontocete per year are unlikely to have any long-term consequences for that individual.

Common Bottlenose Dolphins

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

Common bottlenose dolphins may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions under Alternative 1 (see Figure 3.4-24 and Table 3.4-28 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-28).

As described for odontocetes above, even a few minor to moderate behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of common bottlenose dolphins incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

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

Common bottlenose dolphins may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions under Alternative 1 (see Figure 3.4-24 and Table 3.4-28 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-28).

As described for odontocetes above, even a few minor to moderate behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of common bottlenose dolphins incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-24: Common Bottlenose Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-28: Estimated Impacts on Individual Common Bottlenose Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California, Oregon, & Washington, Offshore	5	0	0	3	0	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Common bottlenose dolphins may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions under Alternative 2 (see Figure 3.4-25 and Table 3.4-29 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-29).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of common bottlenose dolphins incidental to those activities.

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

Common bottlenose dolphins may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions under Alternative 2 (see Figure 3.4-25 and Table 3.4-29 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-29).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking of common bottlenose dolphins incidental to those activities.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-25: Common Bottlenose Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-29: Estimated Impacts on Individual Common Bottlenose Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California, Oregon, & Washington, Offshore	5	0	0	5	0	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Killer Whales (one DPS is Endangered Species Act-Listed)

For the populations of killer whales present in the Study Area, only the Southern Resident population is listed as endangered under the ESA and has designated critical habitat in the Inland Waters region of the Study Area.

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

Killer whales may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-26 and Table 3.4-30 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-30).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of killer whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 1 may affect ESA-listed killer whales and may overlap Southern Resident killer whale critical habitat. The Navy will consult with NMFS as required by section 7(a)(2).

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

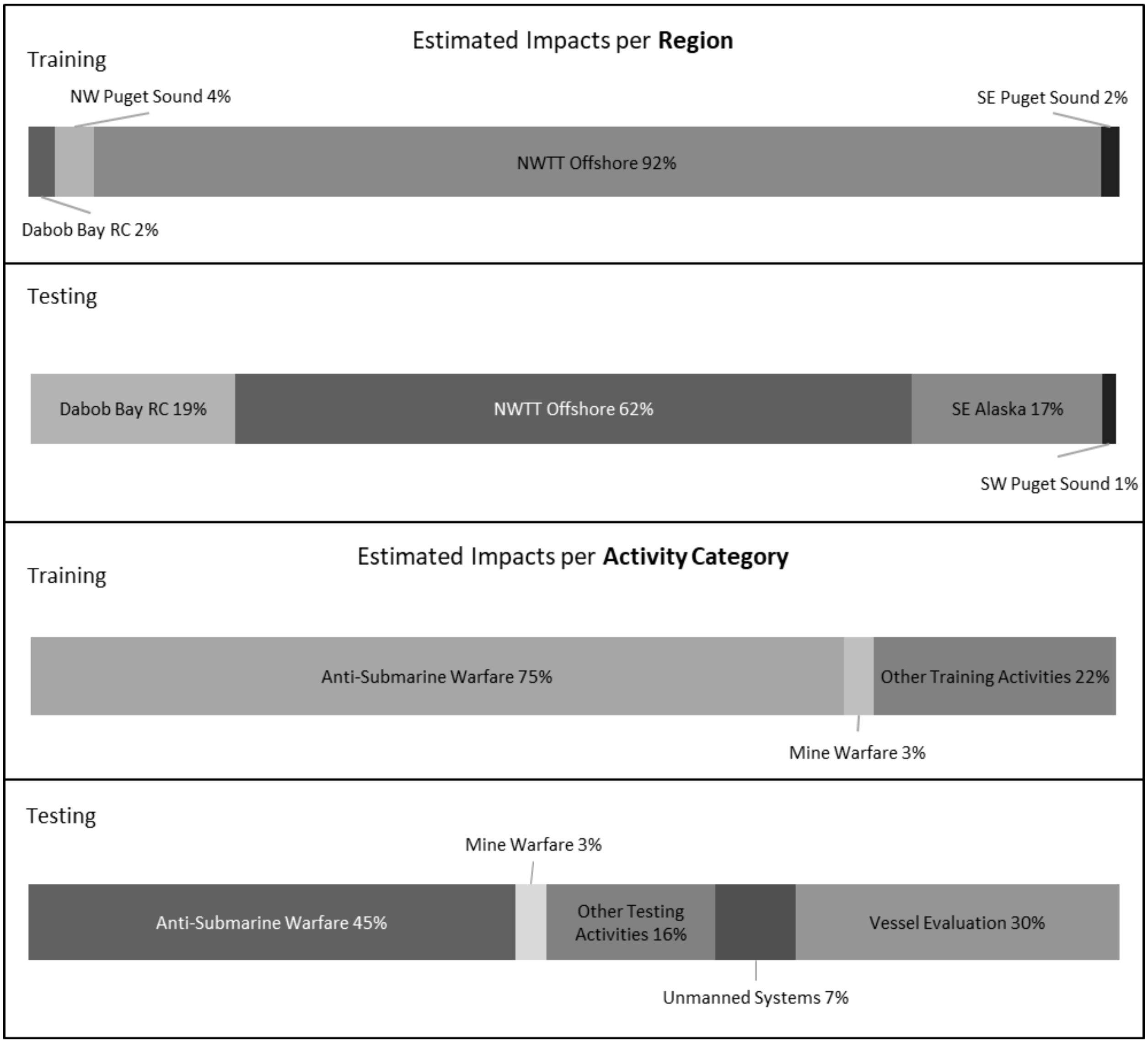
Killer whales may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-26 and Table 3.4-30 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-30).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Sound from sonars and other transducers could overlap Southern Resident killer whale critical habitat. Sonar and other transducers do not have the capacity to impact the physical nature of water quality as defined under critical habitat. Quantity, quality, and availability of prey species, as a primary constituent element defined under designated critical habitat, would not be impacted by the use of sonar and other transducers during testing activities. In the Inland Waters of the Study Area, Southern Resident killer whales prey primarily on salmon species. As described in Section 3.9.3.1.2 (Impacts from Sonar and Other Transducers) of the Fishes section, salmonids have some limited ability to detect low-frequency sounds. Although sonar and other transducers with frequency content at or below 2 kHz will operate in the NWTT Inland Waters during testing activities, some exposures of salmonids to limited sonar use in their hearing range would not affect the overall prey quantity, quality, and availability for Southern Resident killer whales. Lastly, intermittent sonar and other transducers used during testing activities would not obstruct waterways, thereby creating a barrier to passage.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of killer whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 1 may affect ESA-listed killer whales and may overlap Southern Resident killer whale critical habitat. The Navy will consult with NMFS as required by section 7(a)(2).



Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-26: Killer Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-30: Estimated Impacts on Individual Killer Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
Alaska Resident	0	0	0	34	0	0
Eastern North Pacific Offshore	67	1	0	86	4	0
Northern Resident	0	0	0	0	0	0
West Coast Transient	76	2	0	136	20	0
Southern Resident	2	0	0	0	0	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Killer whales may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-27 and Table 3.4-31 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-31).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of killer whales incidental to those activities.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 2 may affect ESA-listed killer whales and may overlap Southern Resident killer whale critical habitat.

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

Killer whales may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-27 and Table 3.4-31 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-31).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although potential for of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking of killer whales incidental to those activities.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 2 may affect ESA-listed killer whales and may overlap Southern Resident killer whale critical habitat.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-27: Killer Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-31: Estimated Impacts on Individual Killer Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
Alaska Resident	0	0	0	40	0	0
Eastern North Pacific Offshore	69	1	0	112	5	0
Northern Resident	0	0	0	0	0	0
West Coast Transient	79	2	0	168	22	0
Southern Resident	3	0	0	0	0	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Northern Right Whale Dolphins

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

Northern right whale dolphins may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-28 and Table 3.4-32 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-32).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of Northern right whale dolphins incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

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

Northern right whale dolphins may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions, TTS, and PTS under Alternative 1 (see Figure 3.4-28 and Table 3.4-32 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-32).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. PTS, if it were to occur, would leave some residual hearing loss after recovery from the initial threshold shift. Minor PTS (a few dB or less) in an individual could have no to minor long-term consequences for individuals. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of Northern right whale dolphins incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-28: Northern Right Whale Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-32: Estimated Impacts on Individual Northern Right Whale Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California, Oregon, & Washington	7,785	156	0	12,018	847	1

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Northern right whale dolphins may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-29 and Table 3.4-33 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-33).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of Northern right whale dolphins incidental to those activities.

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

Northern right whale dolphins may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions, TTS, and PTS under Alternative 2 (see Figure 3.4-29 and Table 3.4-33). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-33).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking of northern right whale dolphins incidental to those activities.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-29: Northern Right Whale Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-33: Estimated Impacts on Individual Northern Right Whale Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California, Oregon, & Washington	7,985	156	0	15,176	933	1

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Pacific White-Sided Dolphins

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

Pacific white-sided dolphins may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-30 and Table 3.4-34 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-34).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of Pacific white-sided dolphins incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

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

Pacific white-sided dolphins may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions, TTS, and PTS under Alternative 1 (see Figure 3.4-30 and Table 3.4-34 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-34).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. PTS, if it were to occur, would leave some residual hearing loss after recovery from the initial threshold shift. Minor PTS (a few dB or less) in an individual could have no to minor long-term consequences for individuals. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of Pacific white-sided dolphins incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-30: Pacific White-Sided Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-34: Estimated Impacts on Individual Pacific White-Sided Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
North Pacific	0	0	0	101	0	0
California, Oregon, & Washington	5,198	86	0	13,809	1,278	1

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Pacific white-sided dolphins may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-31 and Table 3.4-35 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-35).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of Pacific white-sided dolphins incidental to those activities.

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

Pacific white-sided dolphins may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions, TTS, and PTS under Alternative 2 (see Figure 3.4-31 and Table 3.4-35 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-35).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking of Pacific white-sided dolphins incidental to those activities.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-31: Pacific White-Sided Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-35: Estimated Impacts on Individual Pacific White-Sided Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
North Pacific	0	0	0	117	0	0
California, Oregon, & Washington	5,311	87	0	17,532	1,403	1

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Risso's Dolphins

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

Risso's dolphins may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-32 and Table 3.4-36 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-36).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

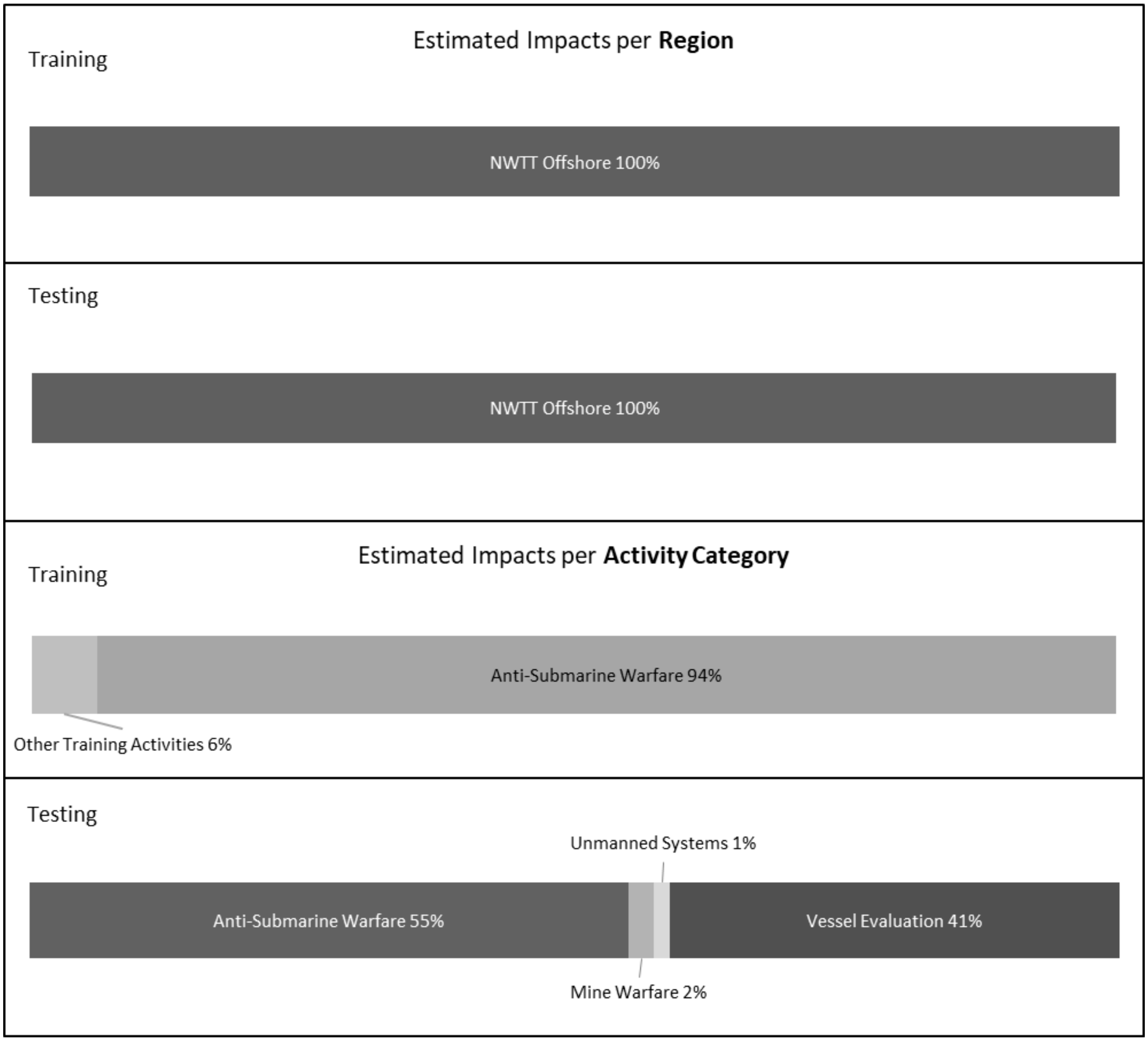
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of Risso's dolphins incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

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

Risso's dolphins may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-32 and Table 3.4-36 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-36).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of Risso's dolphins incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.



Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-32: Risso's Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-36: Estimated Impacts on Individual Risso's Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California, Oregon, & Washington	2,240	46	0	3,920	248	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Risso's dolphins may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-33 and Table 3.4-37 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-37).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

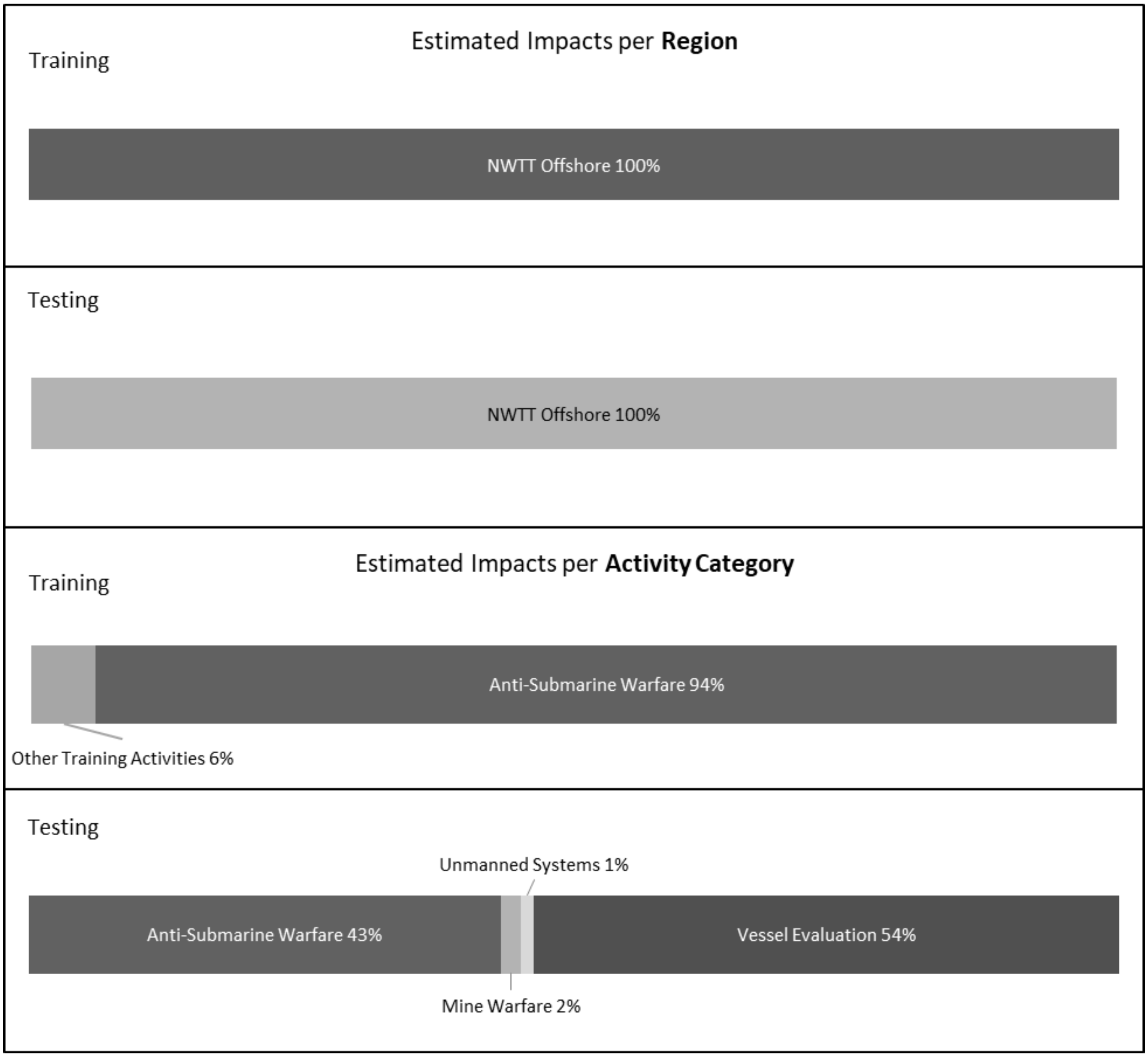
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of Risso's dolphins incidental to those activities.

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

Risso's dolphins may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-33 and Table 3.4-37 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-37).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking of Risso's dolphins incidental to those activities.



Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-33: Risso's Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-37: Estimated Impacts on Individual Risso's Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California, Oregon, & Washington	2,301	46	0	5,071	290	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Short-Beaked Common Dolphin

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

Short-beaked common dolphins may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. Under The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-34 and Table 3.4-38 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-38).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

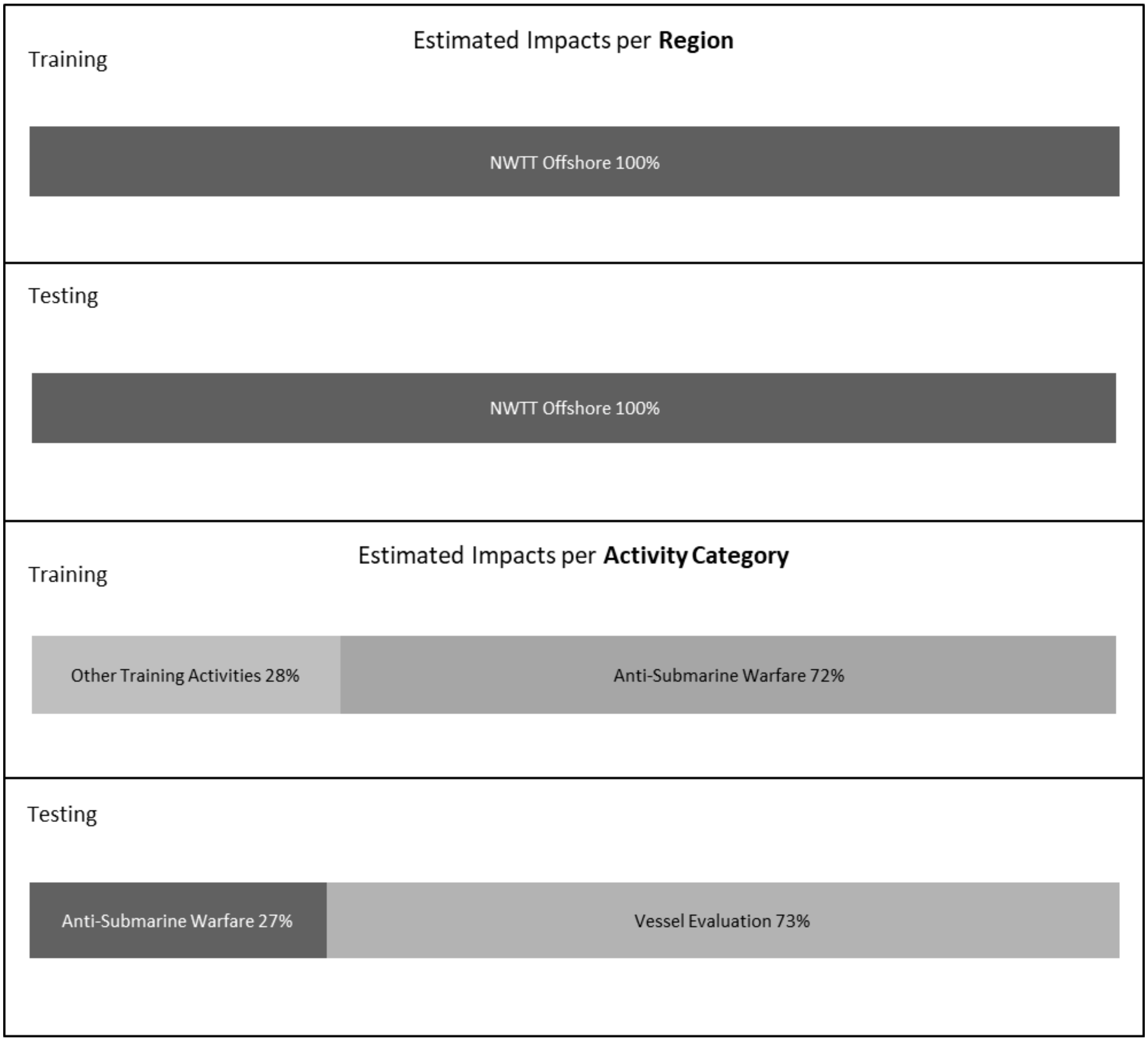
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of short-beaked common dolphins incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

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

Short-beaked common dolphins may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-34 and Table 3.4-38 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-38).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of short-beaked common dolphins incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.



Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-34: Short-Beaked Common Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-38: Estimated Impacts on Individual Short-Beaked Common Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California, Oregon, & Washington	1,140	25	0	963	21	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Short-beaked common dolphins may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-35 and

Table 3.4-39 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (See Table 3.4-39).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in *sonar use associated with training activities under Alternative 2.*

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of short-beaked common dolphins incidental to those activities.

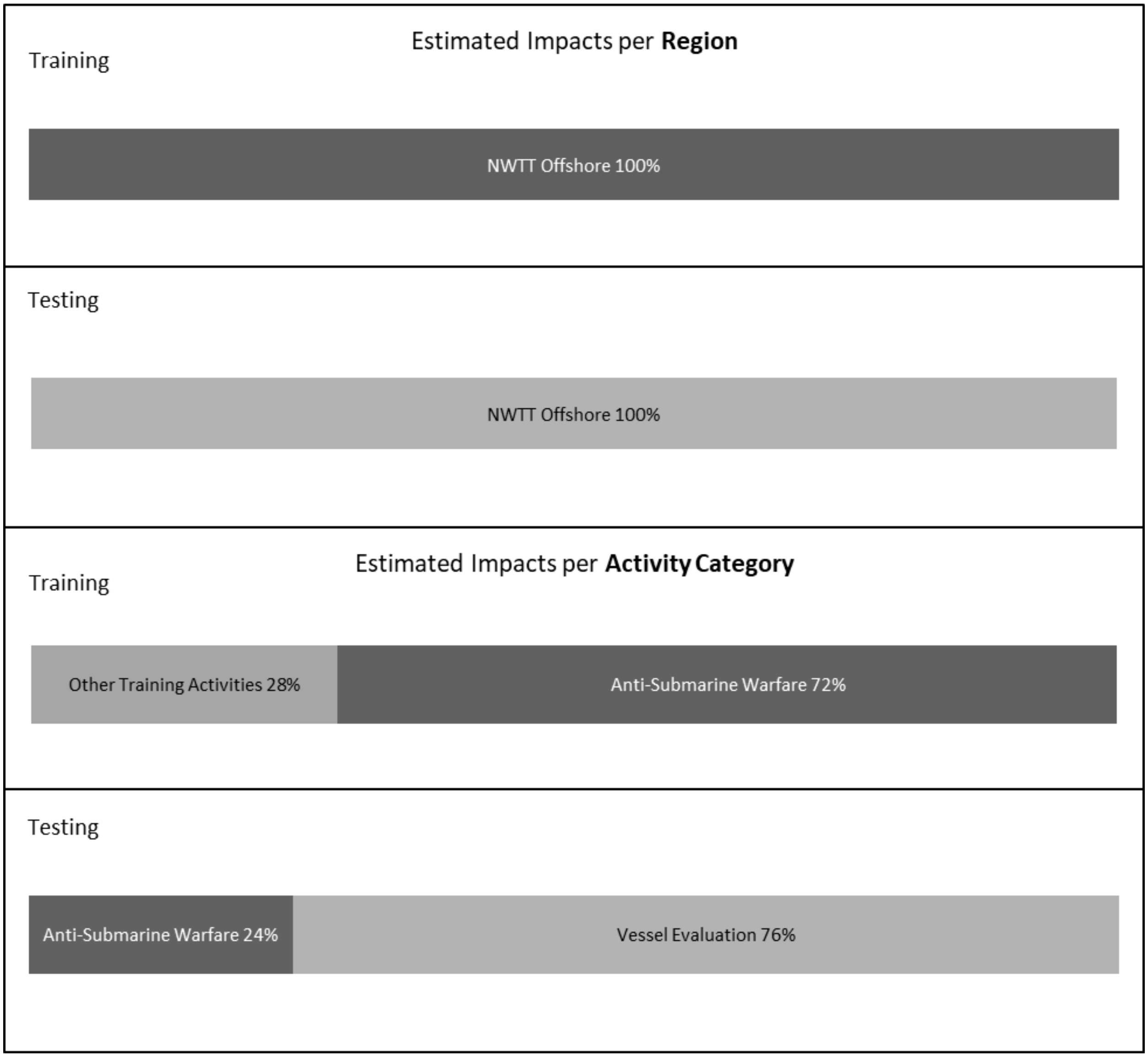
Impacts from Sonar and Other Transducers Under Alternative 2 for Testing Activities

Short-beaked common dolphins may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-35 and

Table 3.4-39 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-39).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking of short-beaked common dolphins incidental to those activities.



Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-35: Short-Beaked Common Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-39: Estimated Impacts on Individual Short-Beaked Common Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California, Oregon, & Washington	1,152	25	0	1,317	24	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Short-Finned Pilot Whales

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

Short-finned pilot whales may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions under Alternative 1 (see Figure 3.4-36 and Table 3.4-40 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-40).

As described for odontocetes above, even a few minor to moderate behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of short-finned pilot whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

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

Short-finned pilot whales may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-36 and Table 3.4-40 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-40).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of short-finned pilot whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-36: Short-Finned Pilot Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-40: Estimated Impacts on Individual Short-Finned Pilot Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California, Oregon, & Washington	57	0	0	31	1	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Short-finned pilot whales may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions under Alternative 2 (see Figure 3.4-37 and Table 3.4-41 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-41).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

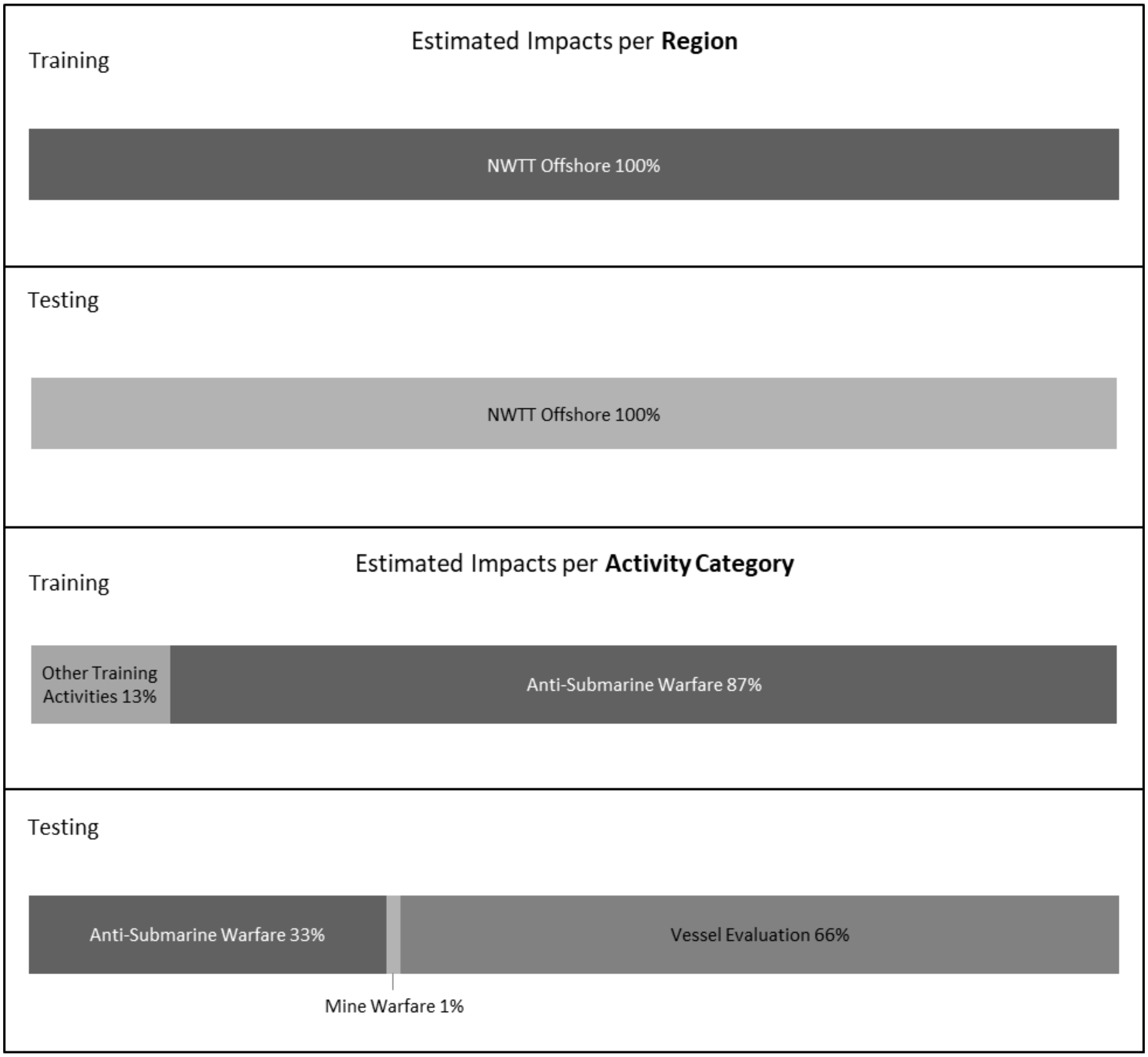
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of short-finned pilot whales incidental to those activities.

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

Short-finned pilot whales may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-37 and Table 3.4-41 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-41).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking of short-finned pilot whales incidental to those activities.



Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-37: Short-Finned Pilot Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-41: Estimated Impacts on Individual Short-Finned Pilot Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California, Oregon, & Washington	58	0	0	42	1	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Striped Dolphins

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

Striped dolphins may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-38 and Table 3.4-42 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-42).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

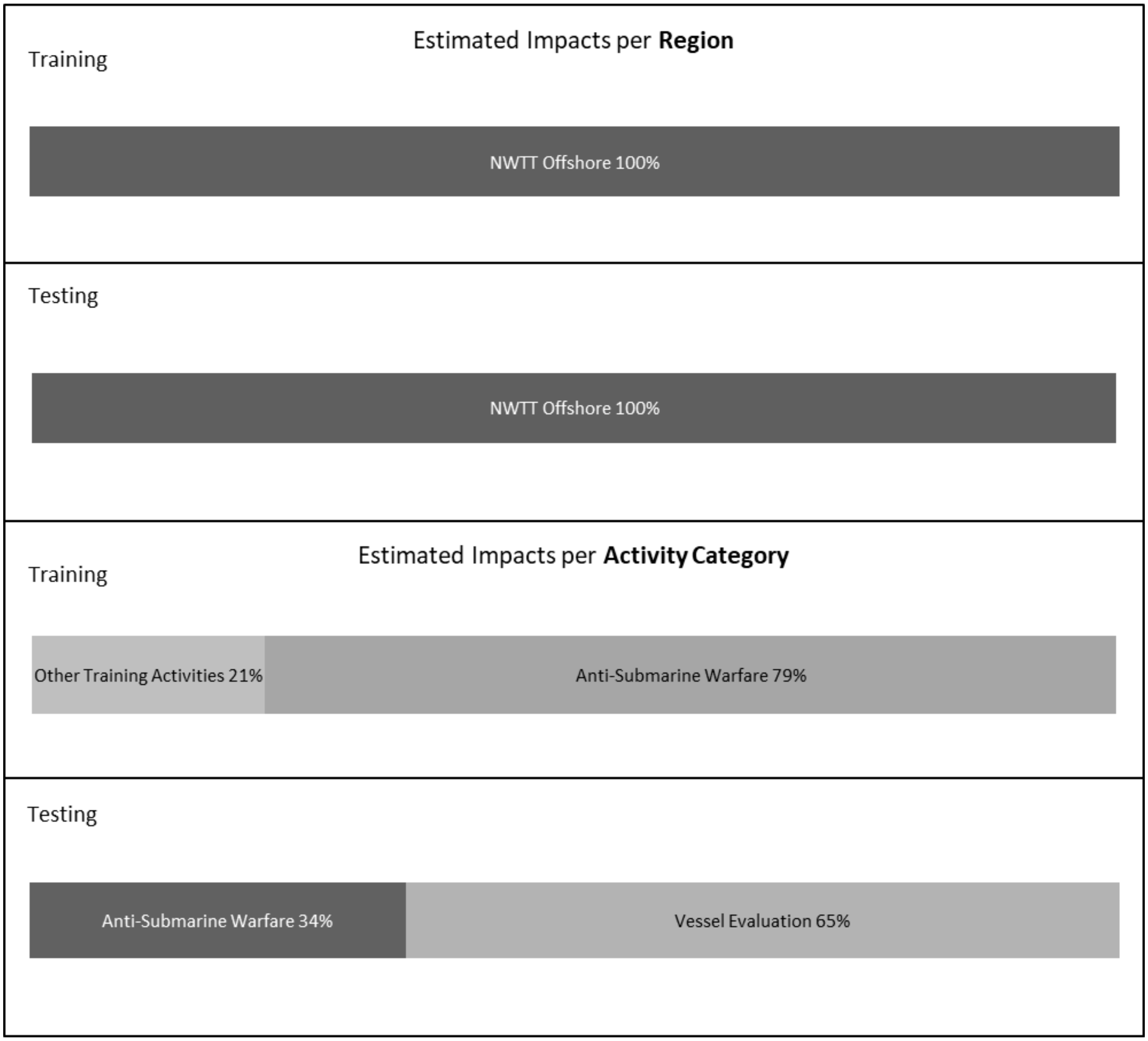
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of striped dolphins incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

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

Striped dolphins may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-38 and Table 3.4-42 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-42).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of striped dolphins incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.



Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-38: Striped Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-42: Estimated Impacts on Individual Striped Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California, Oregon, & Washington	426	13	0	336	7	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Striped dolphins may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-39 and Table 3.4-43 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-43).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

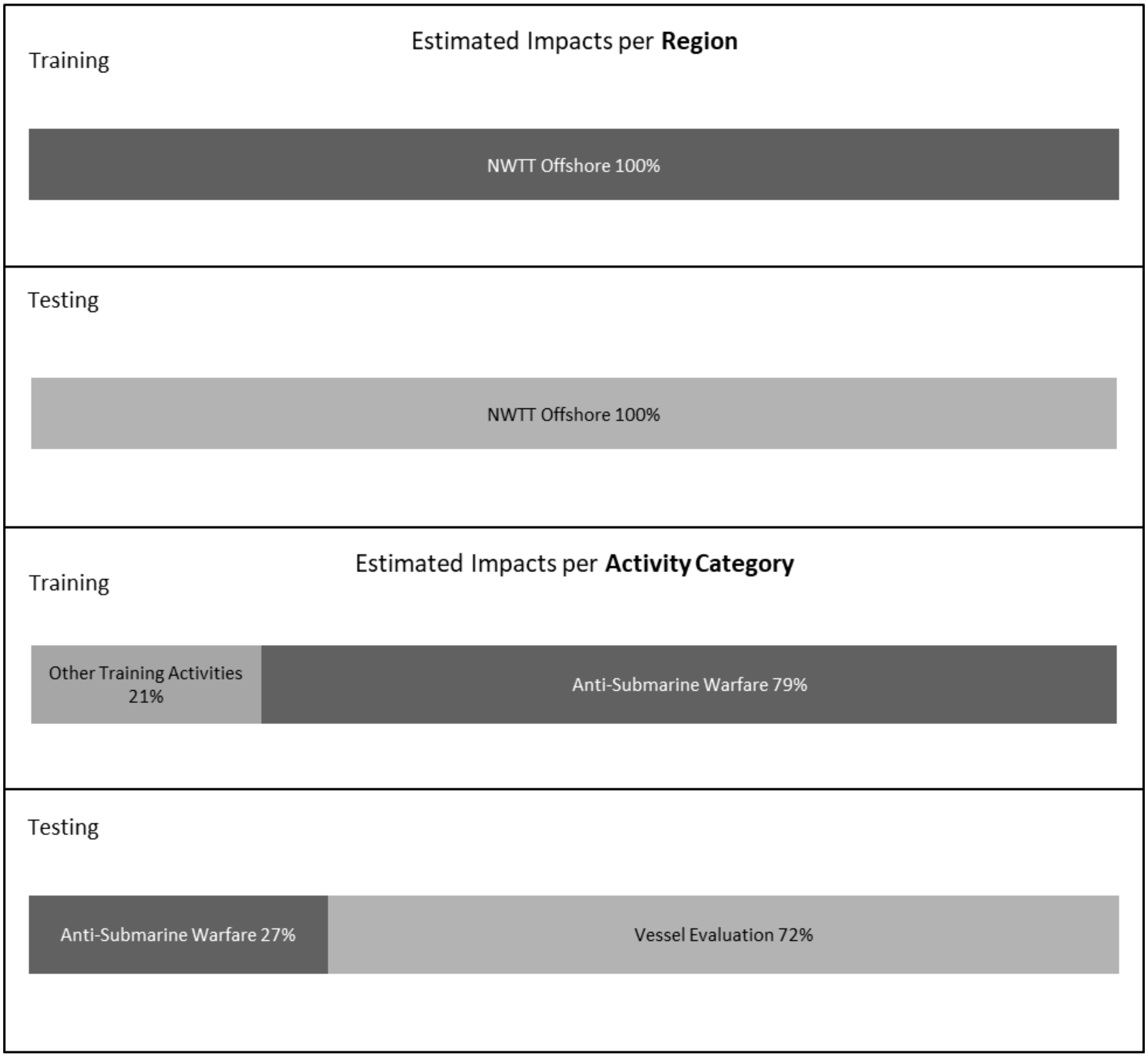
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of striped dolphins incidental to those activities.

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

Striped dolphins may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-39 and Table 3.4-43 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-43).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking of striped dolphins incidental to those activities.



Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-39: Striped Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-43: Estimated Impacts on Individual Striped Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California, Oregon, & Washington	432	13	0	465	9	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Kogia Whales

Kogia whales include two species that are often difficult to distinguish from one another: dwarf sperm whales and pygmy sperm whales; however, impacts to the populations of dwarf and pygmy sperm whales are modeled separately.

TTS and PTS thresholds for high-frequency cetaceans, such as Kogia whales are lower than for all other marine mammals, which leads to a higher number of estimated hearing loss impacts relative to the number of animals exposed to the sound as compared to other hearing groups (e.g., mid-frequency cetaceans).

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

Kogia whales may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-40, Figure 3.4-41, Table 3.4-44, and Table 3.4-45 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts to Kogia whales (pygmy and dwarf sperm whales) apply only to the California, Oregon, and Washington stock (see Table 3.4-44 and Table 3.4-45).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of Kogia whales (i.e., dwarf and pygmy sperm whales) incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

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

Kogia whales may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-40, Figure 3.4-41, Table 3.4-44, and Table 3.4-45 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts to Kogia whales (pygmy and dwarf sperm whales) apply only to the California, Oregon, and Washington stock (see Table 3.4-44 and Table 3.4-45).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of Kogia whales (i.e., dwarf and pygmy sperm whales) incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-40: Dwarf Sperm Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-44: Estimated Impacts on Individual Dwarf Sperm Whale Stocks Within the Study Area per Year from Explosions Used During Training and Testing Under Alternative 1.

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California, Oregon, & Washington	20	18	0	16	34	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-41: Pygmy Sperm Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-45: Estimated Impacts on Individual Pygmy Sperm Whale Stocks Within the Study Area per Year from Explosions Used During Training and Testing Under Alternative 1.

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California, Oregon, & Washington	183	160	0	145	306	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Kogia whales may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-42, Figure 3.4-43, Table 3.4-46, and Table 3.4-47 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts to Kogia whales (pygmy and dwarf sperm whales) apply only to the California, Oregon, and Washington stock (see Table 3.4-46 and Table 3.4-47).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of Kogia whales (i.e., dwarf and pygmy sperm whales) incidental to those activities.

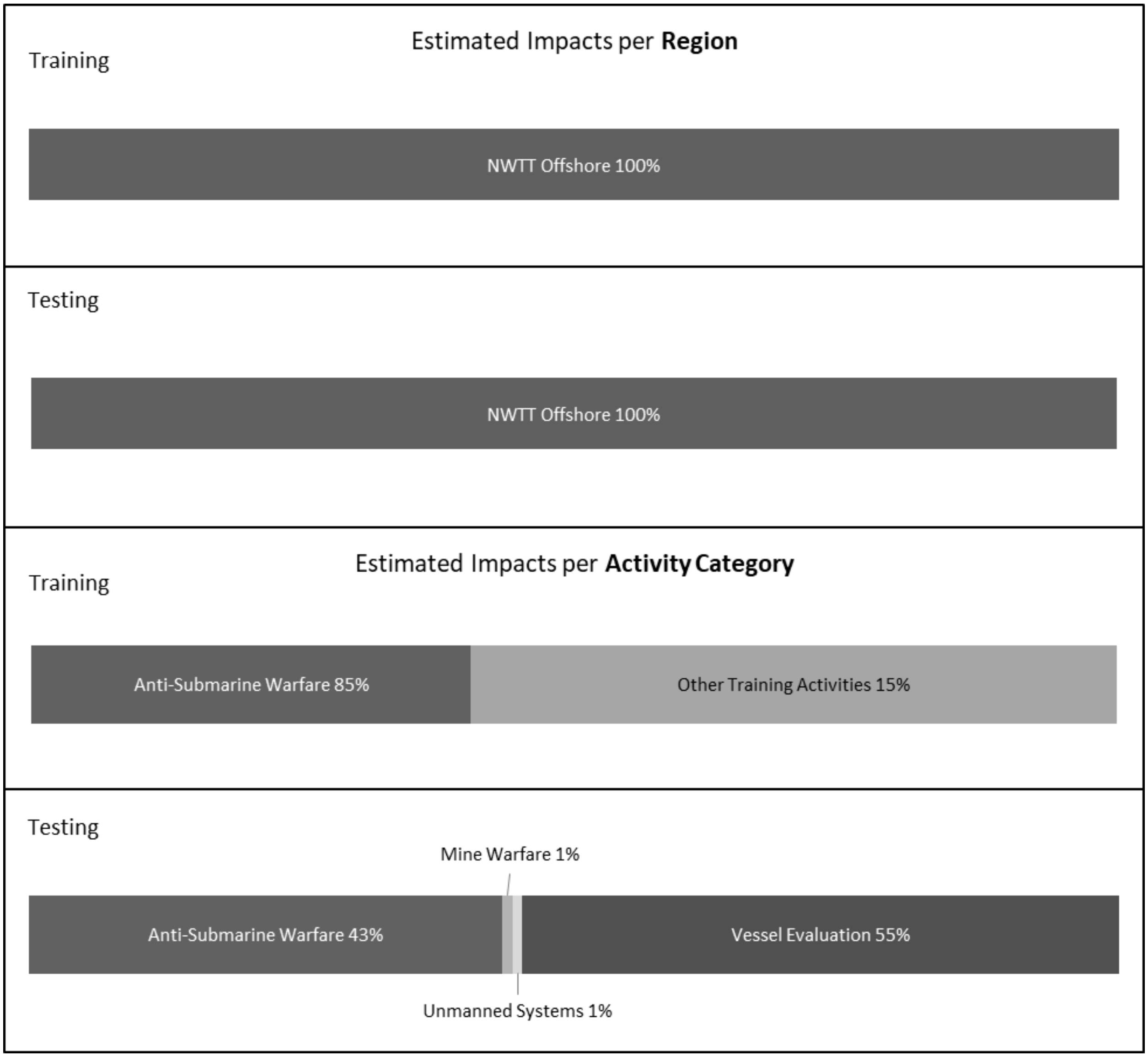
Impacts from Sonar and Other Transducers Under Alternative 2 for Testing Activities

Kogia whales may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions, TTS, and PTS under Alternative 2 (see Figure 3.4-42, Figure 3.4-43, Table 3.4-46, and Table 3.4-47 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts to Kogia whales (pygmy and dwarf sperm whales) apply only to the California, Oregon, and Washington stock (see Table 3.4-46 and Table 3.4-47).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. PTS could reduce an animal's ability to detect biologically important sounds; however, as discussed above, a small threshold shift due to exposure to sonar is unlikely to affect the hearing range that Kogia whales rely upon. Nevertheless, PTS could have minor long-term consequences for individuals. This minor consequence for an individual is unlikely to have any long-term consequences for the species or stock. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking of Kogia whales (i.e., dwarf and pygmy sperm whales) incidental to those activities.



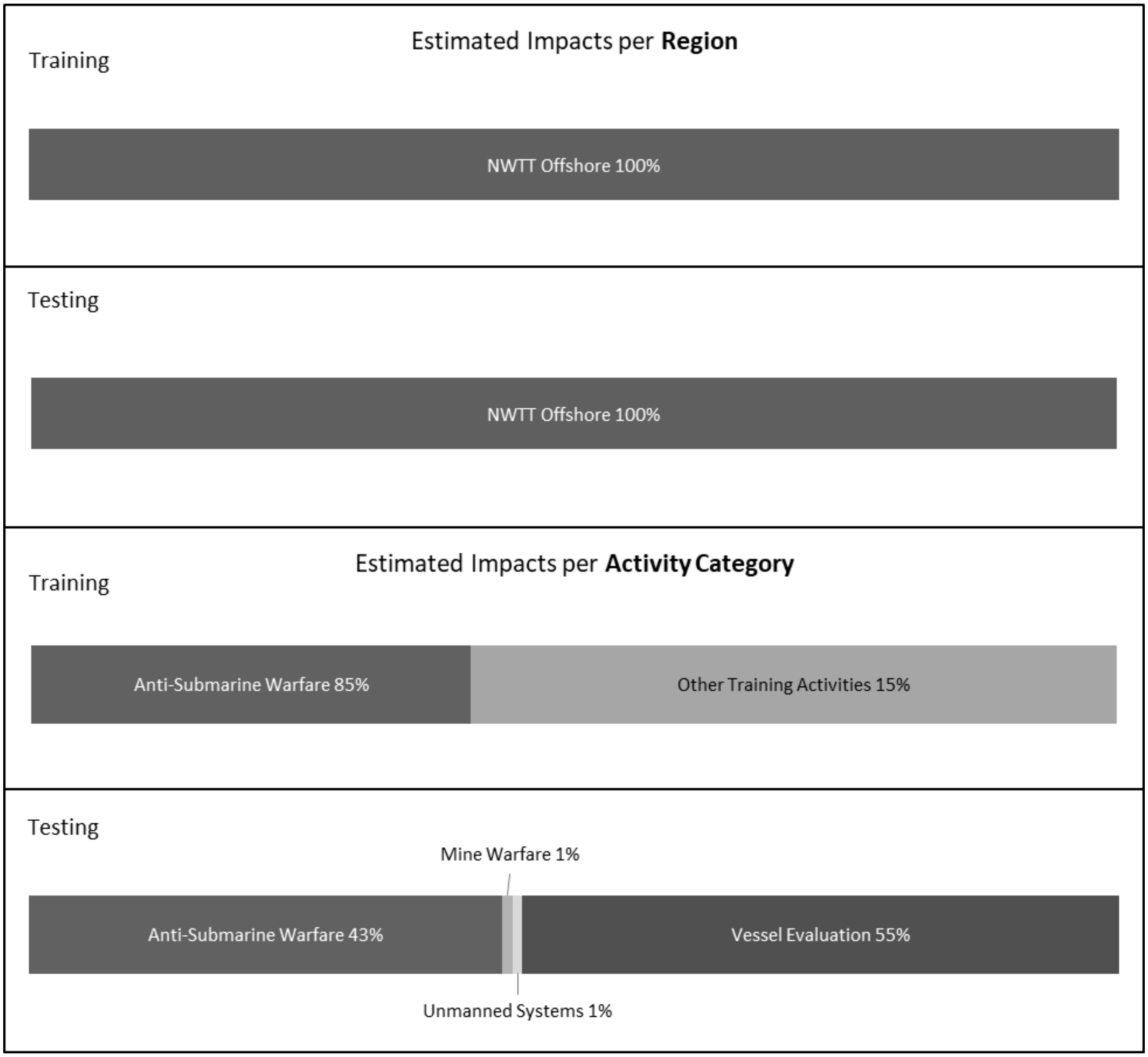
Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-42: Dwarf Sperm Whales Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-46: Estimated Impacts on Individual Dwarf Sperm Whale Stocks Within the Study Area per Year from Explosions Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	*Training*			*Testing*		
	Behavioral	*TTS*	*PTS*	*Behavioral*	*TTS*	*PTS*
California, Oregon, & Washington	21	18	0	20	45	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.



Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-43: Pygmy Sperm Whale Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-47: Estimated Impacts on Individual Pygmy Sperm Whale Stocks Within the Study Area per Year from Explosions Used During Training and Testing Under Alternative 2.

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California, Oregon, & Washington	188	161	0	178	407	1

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Dall's Porpoises

TTS and PTS thresholds for high-frequency cetaceans, including Dall's porpoises, are lower than for all other marine mammals, which leads to a higher number of estimated impacts relative to the number of animals exposed to the sound as compared to other hearing groups (e.g., mid-frequency cetaceans). The information available on harbor porpoise behavioral reactions to human disturbance (a closely related species) suggests that these species may be more sensitive and avoid human activity, and sound sources, to a longer range than most other odontocetes. This would make Dall's porpoises less susceptible to hearing loss; therefore, it is likely that the quantitative analysis over-predicted hearing loss impacts (i.e., TTS and PTS) in Dall's porpoises.

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

Dall's porpoises may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions, TTS, and PTS under Alternative 1 (see Figure 3.4-44 and Table 3.4-48 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-48).

As described for odontocetes above, even a few TTS or behavioral reactions in an individual animal within a given year are unlikely to have any long-term consequences for that individual. PTS could reduce an animal's ability to detect biologically important sounds; however, as discussed above, hearing loss beyond a minor TTS is unlikely and a small threshold shift due to exposure to sonar is unlikely to affect the hearing range that Dall's porpoise rely upon if it did occur. Nevertheless, PTS could have minor long-term consequences for individuals if it were to occur. This minor consequence for an individual is unlikely to have any long-term consequences for the species or stock. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of Dall's porpoises incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

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

Dall's porpoises may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions, TTS, and PTS under Alternative 1 (see Figure 3.4-44 and Table 3.4-48 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-48).

As described for odontocetes above, even a few TTS or behavioral reactions in an individual animal within a given year are unlikely to have any long-term consequences for that individual. PTS could reduce an animal's ability to detect biologically important sounds; however, as discussed above, hearing loss beyond a minor TTS is unlikely and a small threshold shift due to exposure to sonar is unlikely to affect the hearing range that Dall's porpoise rely upon if it did occur. Nevertheless, PTS could have minor long-term consequences for individuals if it were to occur. This minor consequence for an individual is unlikely to have any long-term consequences for the species or stocks. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of Dall's porpoises incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-44: Dall's Porpoise Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-48: Estimated Impacts on Individual Dall's Porpoise Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts by Effect						
Stock	Training			Testing		
	Behavioral	TTS	PTS	Behavioral	TTS	PTS
Alaska	0	0	0	179	459	0
California, Oregon, & Washington	6,911	6,368	6	6,530	13,837	25

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Dall's porpoise may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions, TTS, and PTS under Alternative 2 (see Figure 3.4-45 and Table 3.4-49 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-49).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of Dall's porpoises incidental to those activities.

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

Dall's porpoise may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions, TTS, and PTS under Alternative 2 (see Figure 3.4-45 and Table 3.4-49 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-49).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking of Dall's porpoises incidental to those activities.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-45: Dall's Porpoise Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-49: Estimated Impacts on Individual Dall's Porpoise Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
Alaska	0	0	0	204	574	0
California, Oregon, & Washington	7,088	6,419	6	7,843	18,206	31

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Harbor Porpoises

TTS and PTS thresholds for high-frequency cetaceans, including Harbor porpoise, are lower than for all other marine mammals, which leads to a higher number of estimated impacts relative to the number of animals exposed to the sound as compared to other hearing groups (e.g., mid-frequency cetaceans). Harbor porpoises are particularly sensitive to human-made noise and disturbance and will avoid sound levels between 120 and 140 dB re 1 µPa at distances up to 30 km for more intense activities (as discussed below). This means that the quantitative analysis greatly overestimates hearing loss in harbor porpoises because most animals would avoid sound levels that could cause TTS or PTS.

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

Harbor porpoises may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions, TTS, and PTS per year under Alternative 1 (see Figure 3.4-46 and Table 3.4-50 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the multiple stocks (see Table 3.4-50).

As described for odontocetes above, even a few TTS or behavioral reactions in an individual animal within a given year are unlikely to have any long-term consequences for that individual. PTS could reduce an animal's ability to detect biologically important sounds; however, as discussed above, hearing loss beyond a minor TTS is unlikely and a small threshold shift due to exposure to sonar is unlikely to affect the hearing range that harbor porpoise rely upon if it did occur. Nevertheless, PTS could have minor long-term consequences for individuals if it were to occur. This minor consequence for an individual is unlikely to have any long-term consequences for the species or stocks. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

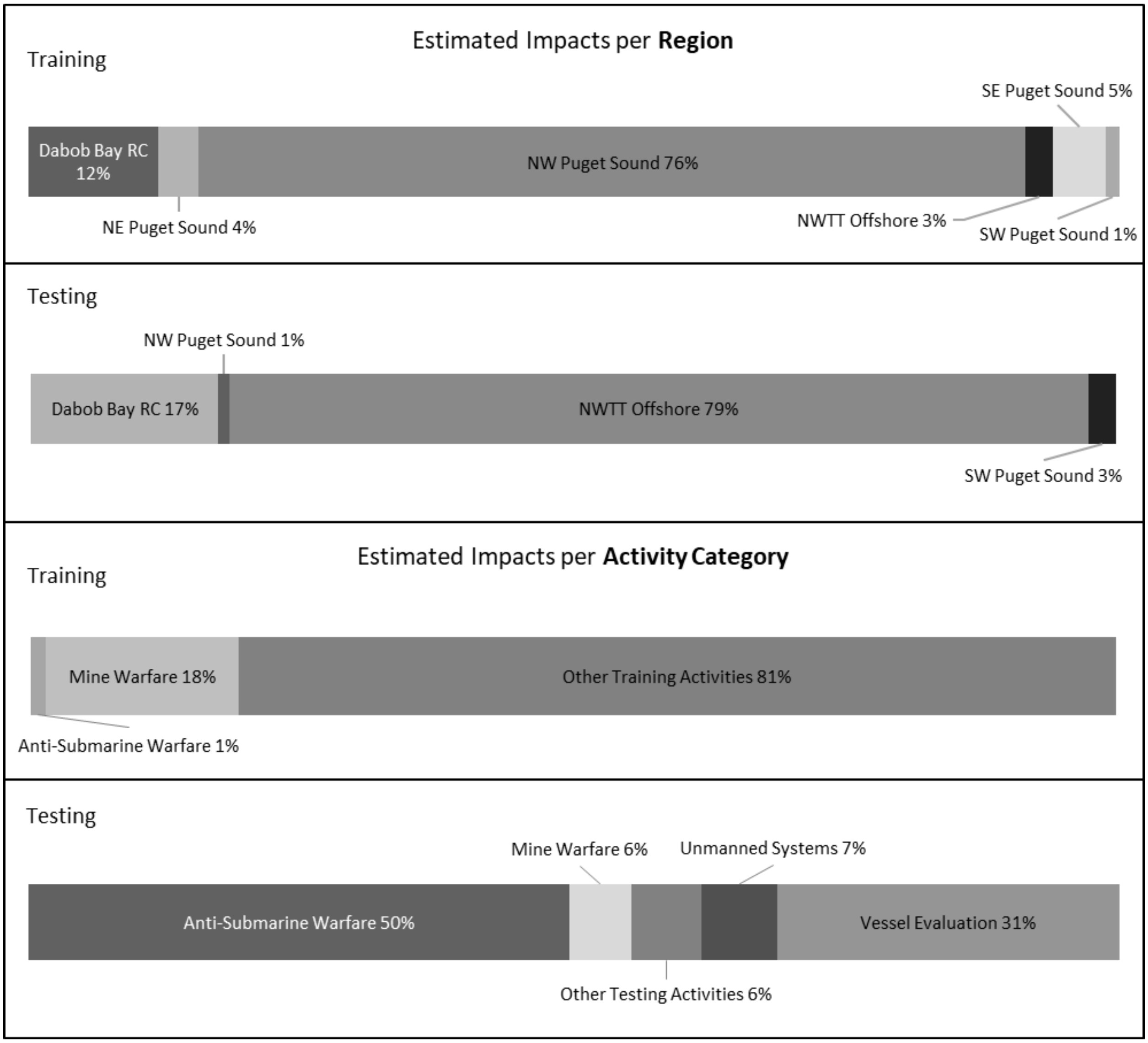
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of harbor porpoises incidental to those activities. The Navy will request authorization from NMFS as required by section 101(a)(5)(A) of the MMPA.

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

Harbor porpoises may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions, TTS, and PTS per year under Alternative 1 (see Figure 3.4-46 and Table 3.4-50 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the multiple stocks (see Table 3.4-50).

As described for odontocetes above, even a few TTS or behavioral reactions in an individual animal within a given year are unlikely to have any long-term consequences for that individual. PTS could reduce an animal's ability to detect biologically important sounds; however, as discussed above, hearing loss beyond a minor TTS is unlikely and a small threshold shift due to exposure to sonar is unlikely to affect the hearing range that harbor porpoise rely upon if it did occur. Nevertheless, PTS could have minor long-term consequences for individuals if it were to occur. This minor consequence for an individual is unlikely to have any long-term consequences for the species or stocks. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of harbor porpoises incidental to those activities. The Navy will request authorization from NMFS as required by section 101(a)(5)(A) of the MMPA.



Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-46: Harbor Porpoise Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-50: Estimated Impacts on Individual Harbor Porpoise Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
Southeast Alaska	0	0	0	92	38	0
Northern Oregon/ Washington Coast	212	87	0	39,304	24,976	34
Northern California/ Southern Oregon	21	0	0	1,579	134	0
Washington Inland Waters	8,010	4,244	16	7,353	10,284	137

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Harbor porpoises may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions, TTS, and PTS per year under Alternative 2. See Figure 3.4-47 below or Appendix E (Estimated Marine Mammal and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors under Navy Training and Testing Activities) for tabular results. Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the multiple stocks (see Table 3.4-51).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

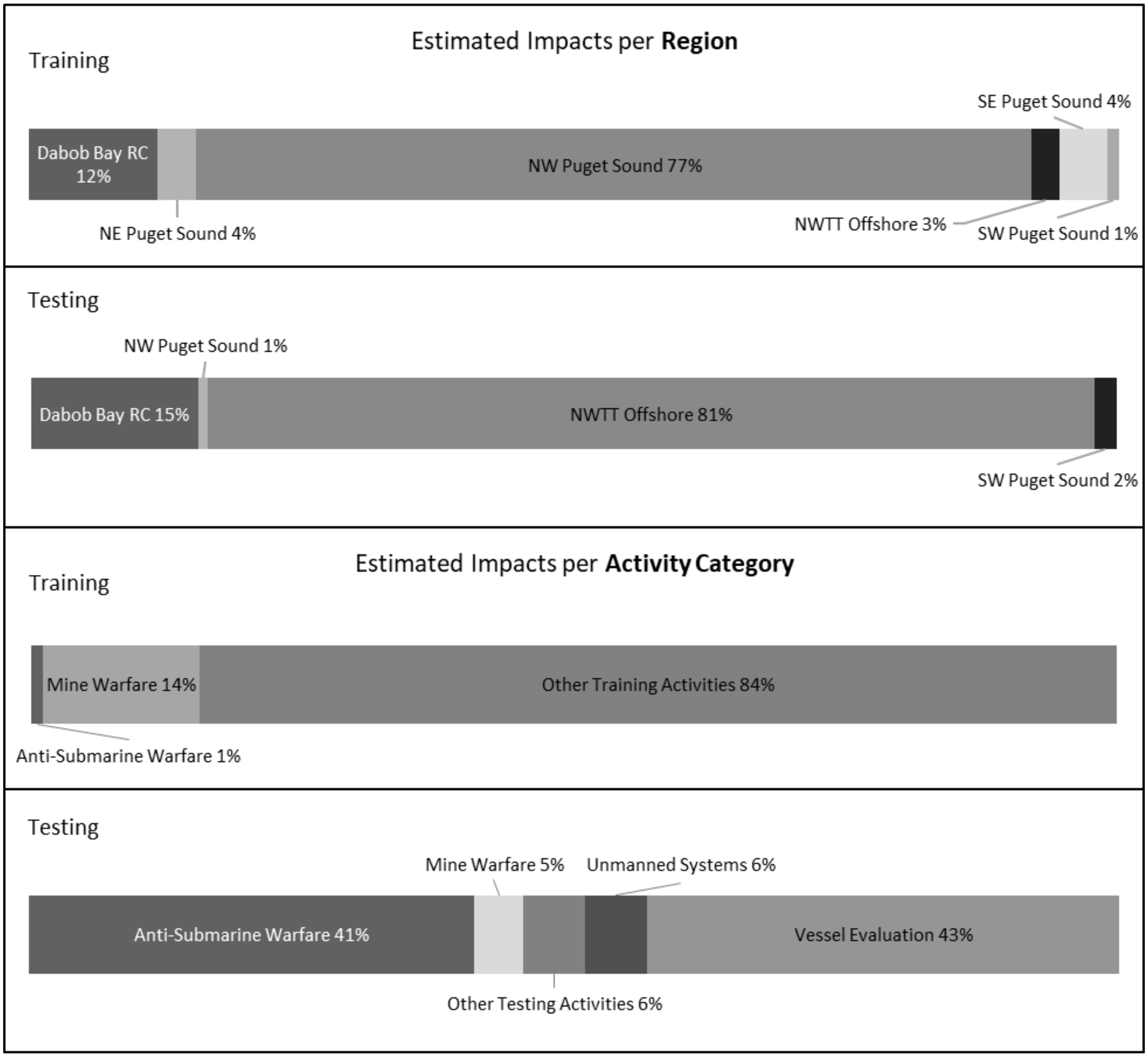
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of harbor porpoises incidental to those activities.

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

Harbor porpoises may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions, TTS, and PTS per year under Alternative 2. See Figure 3.4-47 below or Appendix E (Estimated Marine Mammal and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors under Navy Training and Testing Activities) for tabular results. Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the multiple stocks (see Table 3.4-51).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking of harbor porpoises incidental to those activities.



Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-47: Harbor Porpoise Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-51: Estimated Impacts on Individual Harbor Porpoise Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	*Training*			*Testing*		
	Behavioral	*TTS*	*PTS*	*Behavioral*	*TTS*	*PTS*
Southeast Alaska	0	0	0	102	47	0
Northern Oregon/ Washington Coast	273	99	0	49,607	33,824	48
Northern California/ Southern Oregon	21	0	0	1,582	134	0
Washington Inland Waters	9,977	5,196	19	8,428	10,890	147

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Sperm Whales (Endangered Species Act-Listed)

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

Sperm whales may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-48 and Table 3.4-52 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-52).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of sperm whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 1 may affect ESA-listed sperm whales. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

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

Sperm whales may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-48 and Table 3.4-52 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-52).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of sperm whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 1 may affect ESA-listed sperm whales. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-48: Sperm Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-52: Estimated Impacts on Individual Sperm Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California, Oregon, & Washington	510	2	0	319	3	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Sperm whales may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-49 and Table 3.4-53 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-53).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of sperm whales incidental to those activities.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 2 may affect ESA-listed sperm whales.

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

Sperm whales may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-49 and Table 3.4-53 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-53).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking of sperm whales incidental to those activities.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 2 may affect ESA-listed sperm whales.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-49: Sperm Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-53: Estimated Impacts on Individual Sperm Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California, Oregon, & Washington	519	2	0	418	4	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Beaked Whales

Beaked whales within the NWTT study area include: Baird's beaked whale, Blainville's beaked whale, Cuvier's beaked whale, Hubb's beaked whale, Ginkgo-toothed beaked whale, Perrin's beaked whale, Stejneger's beaked whale, and the Pygmy beaked whale. Impacts to Blainville's beaked whale, Hubb's beaked whale, Ginkgo-toothed beaked whale, Perrin's beaked whale, Stejneger's beaked whale and the Pygmy beaked whale are combined and represented in the beaked whale guild (*Mesoplodon spp*.).

As discussed above for odontocetes overall, the quantitative analysis overestimates hearing loss in marine mammals because behavioral response research has shown that most marine mammals are likely to avoid sound levels that could cause more than minor to moderate TTS (6–20 dB). Specifically for beaked whales, behavioral response research discussed below and in Section 3.4.2.1.1.5 (Behavioral Reactions), has demonstrated that beaked whales are sensitive to sound from sonars and usually avoid sound sources by 10 or more kilometers. These are well beyond the ranges to TTS for mid-frequency cetaceans such as beaked whales. Therefore, any TTS predicted by the quantitative analysis is unlikely to occur in beaked whales.

Research and observations (Section 3.4.2.1.1.5, Behavioral Reactions) show that if beaked whales are exposed to sonar or other transducers they may startle, break off feeding dives, and avoid the area of the sound source at levels ranging between 95 and 157 dB re 1 µPa (McCarthy et al., 2011). Furthermore, in research done at the Navy's fixed tracking range in the Bahamas and Hawaii, animals leave the immediate area of the anti-submarine warfare training exercise but return within a few days after the event ends (Henderson et al., 2015b; Henderson et al., 2016; Manzano-Roth et al., 2016; Tyack et al., 2011). Populations of beaked whales and other odontocetes on Navy fixed ranges that have been operating for decades appear to be stable, and analysis is ongoing. Significant behavioral reactions seem likely in most cases if beaked whales are exposed to anti-submarine sonar within a few tens of kilometers, especially for prolonged periods (a few hours or more) since this is one of the most sensitive marine mammal groups to human-made sound of any species or group studied to date.

Based on the best available science, the Navy believes that beaked whales that exhibit a significant behavioral reaction due to sonar and other transducers during training or testing activities would generally not have long-term consequences for individuals or populations. However, because of a lack of scientific consensus regarding the causal link between sonar and stranding events, NMFS has stated in a letter to the Navy dated October 2006 that it "cannot conclude with certainty the degree to which mitigation measures would eliminate or reduce the potential for serious injury or mortality." The Navy does not anticipate that marine mammal strandings or mortality will result from the operation of sonar during Navy exercises within the Study Area. Additionally, through the MMPA process (which allows for adaptive management), NMFS and the Navy will determine the appropriate way to proceed in the event that a causal relationship were to be found between Navy activities and a future stranding.

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

Beaked whales may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-50 through Figure 3.4-52 and Table 3.4-54 through Table 3.4-56 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts to Baird's beaked whales, Cuvier's beaked whale, and the small beaked whale guild (*Mesoplodon spp*.) apply to the California, Oregon, and Washington stocks (see Table 3.4-54, Table 3.4-55, and Table 3.4-56).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

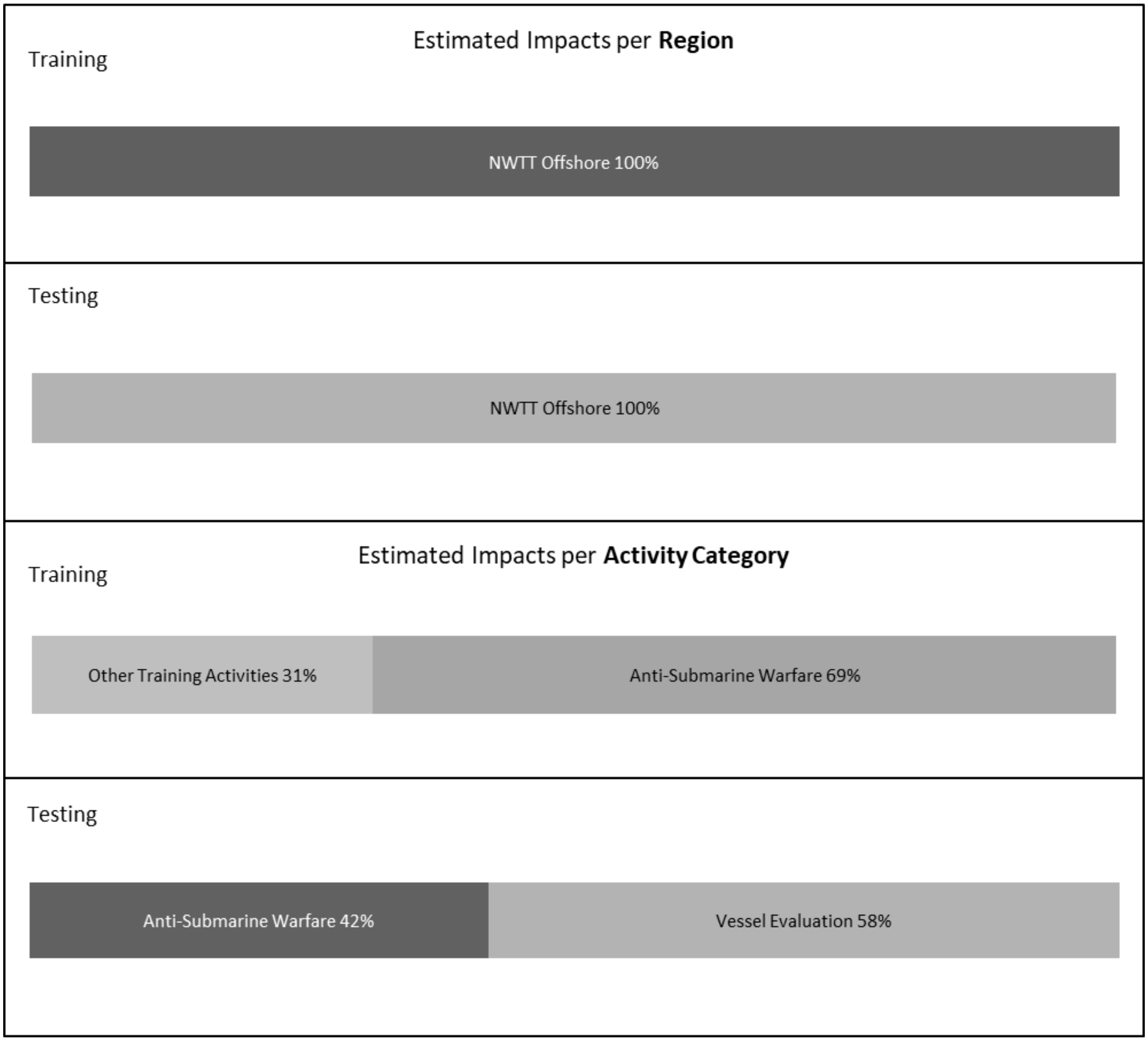
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of Baird's, Cuvier's, and Mesoplodon spp. beaked whales (species within the beaked whale guild) incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

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

Beaked whales may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-50 through Figure 3.4-52 and Table 3.4-54 through Table 3.4-56 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts to Baird's beaked whales, Cuvier's beaked whale, and the small beaked whale guild (*Mesoplodon spp*.) apply to the California, Oregon, and Washington stock (see Table 3.4-54, Table 3.4-55, and Table 3.4-56).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of Baird's, Cuvier's, and Mesoplodon spp. beaked whales (species within the beaked whale guild) incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.



Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-50: Baird's Beaked Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-54: Estimated Impacts on Individual Baird's Beaked Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California, Oregon, & Washington	556	0	0	420	0	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-51: Cuvier's Beaked Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-55: Estimated Impacts on Individual Cuvier's Beaked Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California, Oregon, & Washington	1,461	1	0	1,072	3	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-52: Mesoplodon Spp. (Small Beaked Whale Guild) Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-56: Estimated Impacts on Individual Mesoplodon Spp. (Small Beaked Whale Guild) Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California, Oregon, & Washington	651	1	0	467	2	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Beaked whales may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-53 through Figure 3.4-55 and Table 3.4-57 through Table 3.4-59 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts to Baird's beaked whales, Cuvier's beaked whale, and the small beaked whale guild (*Mesoplodon spp*.) apply to the California, Oregon, and Washington stock (see Table 3.4-57, Table 3.4-58, and Table 3.4-59).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

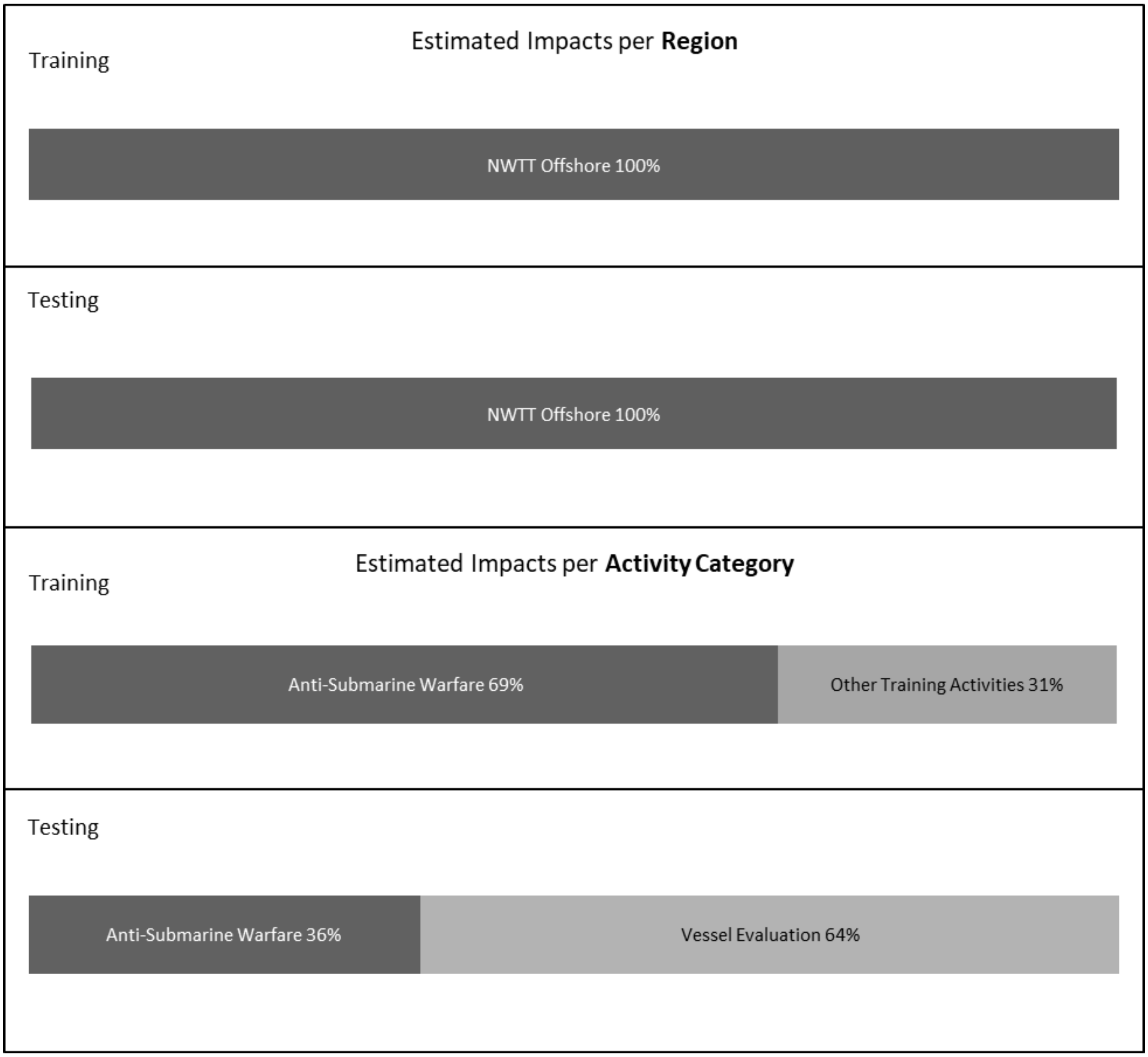
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of Baird's, Cuvier's, and Mesoplodon spp. beaked whales (species within the beaked whale guild) incidental to those activities.

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

Beaked whales may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-53 through Figure 3.4-55 and Table 3.4-57 through Table 3.4-59). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts to Baird's beaked whales, Cuvier's beaked whale, and the small beaked whale guild (*Mesoplodon spp*.) apply to the California, Oregon, and Washington stock (see Table 3.4-57, Table 3.4-58, and Table 3.4-59).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking of Baird's, Cuvier's, and Mesoplodon spp. beaked whales (species within the beaked whale guild) incidental to those activities.



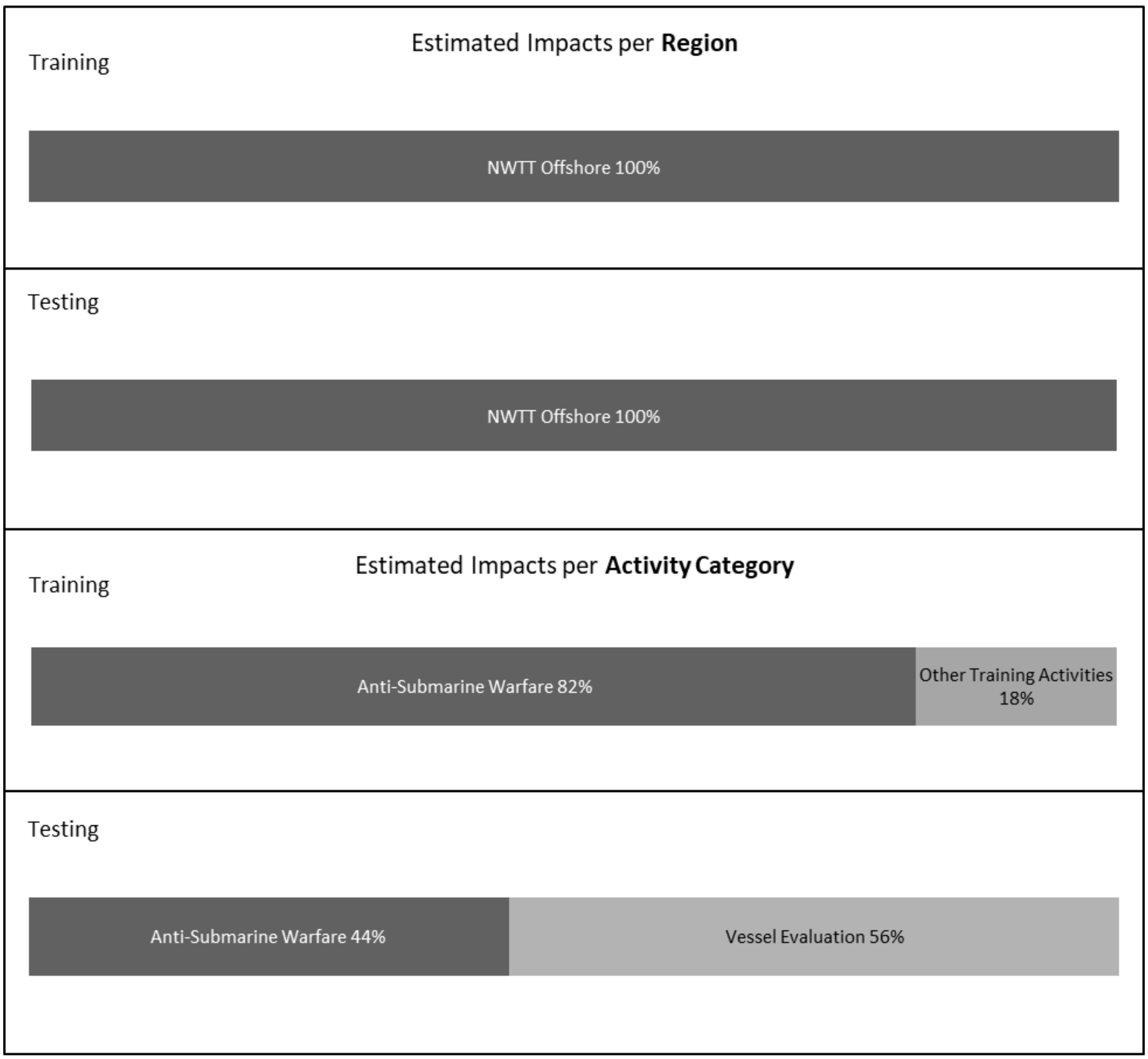
Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-53: Baird's Beaked Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-57: Estimated Impacts on Individual Baird's Beaked Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California, Oregon, & Washington	559	0	0	578	1	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.



Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-54: Cuvier's Beaked Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-58: Estimated Impacts on Individual Cuvier's Beaked Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California, Oregon, & Washington	1,497	1	0	1,391	4	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-55: Mesoplodon Spp. (Small Beaked Whale Guild) Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-59: Estimated Impacts on Individual Mesoplodon Spp. (Small Beaked Whale Guild) Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	*Training*			*Testing*		
	Behavioral	*TTS*	*PTS*	*Behavioral*	*TTS*	*PTS*
California, Oregon, & Washington	666	1	0	606	2	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Pinnipeds and Mustelids

Pinnipeds include phocid seals (true seals) and otariids (sea lions and fur seals), and mustelids include sea otters.

Pinnipeds may be exposed to sound from sonar and other transducers associated with training and testing activities throughout the year. Low- (less than 1 kHz), mid- (1–10 kHz), and high-frequency (10–100 kHz) sonars produce sounds that are likely to be within the audible range of pinnipeds (see Section 3.4.1.6, Hearing and Vocalization). Comparatively, hearing sensitivities are significantly reduced in mustelids and exposure to these sounds may have lower overall severity. If a sound is within an animal's hearing range then behavioral reactions, physiological stress, masking and hearing loss are potential impacts that must be analyzed. If a marine mammal cannot hear a sound, then behavioral reactions, physiological stress, masking, or hearing loss could not occur. Impact ranges for pinnipeds and mustelids are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers).

There is no research on the effects of sonar on sea otters. As described in Section 3.4.2.1.1.5 (Behavioral Reactions), mustelids have similar or reduced hearing capabilities compared to pinnipeds (specifically otariids). Thus, it is reasonable to assume that mustelids use their hearing similarly to that of otariids, and the types of impacts from exposure to sonar and other transducers may also be similar to those described below for pinnipeds, including behavioral reactions, physiological stress, masking, and hearing loss; however, because mustelids spend the majority of their time with their heads above or at the water's surface and live near shore, they are less likely to be exposed to or impacted by sonars and other transducers used in testing and training.

A few behavioral reactions by pinnipeds resulting from exposure to sonar could take place at distances of up to 10 km. Behavioral reactions, however, are much more likely within a kilometer or less of the sound source (see Section 3.4.2.1.1.5, Behavioral Reactions). As discussed above in *Assessing the Severity of Behavioral Responses from Sonar*, the quantitative analysis very likely overestimated the numbers of behavioral reactions due to the underlying nature of the data used to derive the behavioral response functions. Research shows that pinnipeds in the water are generally tolerant of human-made sound and activity, while mustelids have reduced underwater hearing abilities (see Section 3.4.2.1.1.5, Behavioral Reactions). If pinnipeds or mustelids are exposed to sonar or other transducers, they may react in various ways, depending on their experience with the sound source and what activity they are engaged in at the time of the acoustic exposure. Pinnipeds or mustelids may not react at all until the sound source is approaching within a few hundred meters and then may alert, ignore the stimulus, change their behaviors, or avoid the immediate area by swimming away or diving. Significant behavioral reactions would not be expected in most cases, and long-term consequences for individual pinnipeds or mustelids from a single or several impacts per year are unlikely. Behavioral research indicates that most pinnipeds probably avoid sound sources at levels that could cause higher levels of TTS (greater than 20 dB of TTS) and PTS. Recovery from TTS begins almost immediately after the noise exposure ceases and can take a few minutes to a few days to fully recover, depending on the magnitude of the initial threshold shift. Most TTS, if it does actually occur, would be more likely to be minor to moderate (i.e., less than 20 dB of TTS directly after the exposure) and would recover within a matter of minutes to hours. Threshold shifts do not necessarily affect all hearing frequencies equally, and typically manifest themselves at the exposure frequency or within an octave above the exposure frequency. During the short period that a pinniped had TTS, social calls from conspecifics could be more difficult to detect or interpret. Killer whales are a primary predator of pinnipeds. Some TTS could make killer whale calls more difficult to detect at further ranges until hearing recovers. Pinnipeds probably use sound and vibrations to find and capture prey underwater. Therefore, it could be more difficult for pinnipeds with TTS to locate food for a short period before their hearing recovers. Because TTS would likely be minor to moderate (less than 20 dB of TTS), costs would be short-term and could be recovered. A single or even a few mild to moderate TTS per year are unlikely to have any long-term consequences for that individual.

Research and observations of masking in marine mammals are discussed in Section 3.4.2.1.1.4 (Masking). Many low- (less than 1 kHz), mid- (1–10 kHz), and high-frequency (10–100 kHz) sonars produce sounds that are likely to be within the hearing range of pinnipeds and potentially mustelids. Many anti-submarine warfare (anti-submarine warfare) sonars and countermeasures use low- and mid-frequency ranges. Most low- and mid-frequency sonar signals (i.e., sounds) are limited in the temporal, frequency, and spatial domains. The duration of most individual sounds is short, lasting up to a few seconds each. Some systems operate with higher duty cycles or nearly continuously, but typically use lower power. Nevertheless, masking may be more prevalent at closer ranges to these high-duty cycle and continuous active sonar systems. Most anti-submarine warfare activities are geographically dispersed and last for only a few hours, often with intermittent sonar use even within this period. Most anti-submarine warfare sonars also have a narrow frequency band (typically less than one-third octave). These factors reduce the likelihood of sources causing significant masking in pinnipeds due to exposure to sonar used during anti-submarine warfare activities. Pinnipeds and mustelids may experience some limited masking at closer ranges from high-frequency sonars and other transducers; however, the frequency band of the sonar is narrow, limiting the likelihood of masking. Sonars that employ high frequencies are typically used for mine hunting, navigation, and object detection (avoidance). Potential costs to pinnipeds and mustelids from masking are similar to those discussed above for mild to moderate levels of TTS, with the primary difference being that the effects of masking are only present when the sound source (i.e., sonar) is actively transmitting and the effect is over the moment the sound has ceased. Nevertheless, pinnipeds that do experience some masking for a short period from sonar or other transducers may have their ability to communicate with conspecifics reduced, especially at further ranges. Sounds from mid-frequency sonar could mask killer whale vocalizations making them more difficult to detect, especially at further ranges. Pinnipeds probably use sound and vibrations to find and capture prey underwater. Therefore, it could be more difficult for pinnipeds to locate food if masking is occurring. A single or even a few short periods of masking, if it were to occur, to an individual pinniped or mustelid per year are unlikely to have any long-term consequences for that individual.

California Sea Lions

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

California sea lions may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-56 and Table 3.4-60 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the U.S. stock (see Table 3.4-60).

As described above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of California sea lions incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

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

California sea lions may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-56 and Table 3.4-60 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the U.S. stock (see Table 3.4-60).

As described above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. This minor consequence for an individual is unlikely to have any long-term consequences for the species or stock. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking California sea lions incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-56: California Sea Lion Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-60: Estimated Impacts on Individual California Sea Lion Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
U.S. Stock	3,615	9	0	23,653	337	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

California sea lions may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-57 and Table 3.4-61 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the U.S. stock (see Table 3.4-61).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of California sea lions incidental to those activities.

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

California sea lions may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-57 and Table 3.4-61 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the U.S. stock (see Table 3.4-61).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking California sea lions incidental to those activities.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-57: California Sea Lion Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-61: Estimated Impacts on Individual California Sea Lion Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
U.S. Stock	3,698	9	0	32,475	352	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Steller Sea Lions (one DPS is Endangered Species Act-Listed)

The Eastern U.S. stock of Steller sea lions is not listed under the Endangered Species Act. All impacts estimated by the quantitative analysis are on the Eastern U.S. stock. The Western U.S. stock of Steller sea lions is listed endangered under the ESA; however, Steller sea lions from the Western U.S. stock are rare in the Study Area.

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

Steller sea lions may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-58 and Table 3.4-62 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the Eastern U.S. stock (see Table 3.4-62).

As described above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of Steller sea lions incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 1 may affect ESA-listed Steller sea lions. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

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

Steller sea lions may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-58 and Table 3.4-62 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the Eastern U.S. stock (see Table 3.4-62).

As described above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. This minor consequence for an individual is unlikely to have any long-term consequences for the species or stock. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking Steller sea lions incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 1 may affect ESA-listed Steller sea lions. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-58: Steller Sea Lion Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-62: Estimated Impacts on Individual Steller Sea Lion Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
Eastern U.S.	107	1	0	3,027	6	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Steller sea lions may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-59 and Table 3.4-63 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the Eastern U.S. stock (see Table 3.4-63).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of Steller sea lions incidental to those activities.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 2 may affect ESA-listed Steller sea lions.

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

Steller sea lions may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-59 and Table 3.4-63 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the Eastern U.S. stock (see Table 3.4-63).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking Steller sea lions incidental to those activities.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 2 may affect ESA-listed Steller sea lions.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-59: Steller Sea Lion Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-63: Estimated Impacts on Individual Steller Sea Lion Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
Eastern U.S.	114	1	0	4,151	8	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Guadalupe Fur Seals (Endangered Species Act-listed)

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

Guadalupe fur seals may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-60 and Table 3.4-64 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the Mexico stock (see Table 3.4-64).

As described above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. This minor consequence for an individual is unlikely to have any long-term consequences for the species or stock. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of Guadalupe fur seals incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 1 may affect ESA-listed Guadalupe fur seals. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

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

Guadalupe fur seals may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-60 and Table 3.4-64 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the Mexico stock (see Table 3.4-64).

As described above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. This minor consequence for an individual is unlikely to have any long-term consequences for the species or stock. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of Guadalupe fur seals incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 1 may affect ESA-listed Guadalupe fur seals. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-60: Guadalupe Fur Seal Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-64: Estimated Impacts on Individual Guadalupe Fur Seal Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
Mexico	605	3	0	892	10	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Guadalupe fur seals may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-61 and Table 3.4-65 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the Mexico stock (see Table 3.4-65).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of Guadalupe fur seals incidental to those activities.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 2 may affect ESA-listed Guadalupe fur seals.

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

Guadalupe fur seals may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-61 and Table 3.4-65 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the Mexico stock (see Table 3.4-65).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking of Guadalupe fur seals incidental to those activities.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 2 may affect ESA-listed Guadalupe fur seals.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-61: Guadalupe Fur Seal Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-65: Estimated Impacts on Individual Guadalupe Fur Seal Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
Mexico	617	3	0	1,168	10	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Northern Fur Seals

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

Northern fur seals may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-62 and Table 3.4-66 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-66).

As described above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of northern fur seals incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

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

Northern fur seals may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-62 and Table 3.4-66 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-66).

As described above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. This minor consequence for an individual is unlikely to have any long-term consequences for the species or stocks. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of Northern fur seals incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-62: Northern Fur Seal Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-66: Estimated Impacts on Individual Northern Fur Seal Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
Eastern Pacific	2,130	4	0	8,424	125	0
California	43	0	0	169	1	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Northern fur seals may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-63 and Table 3.4-67 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-67).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of northern fur seals incidental to those activities.

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

Northern fur seals may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-63 and Table 3.4-67 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-67).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking of Northern fur seals incidental to those activities.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-63: Northern Fur Seal Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-67: Estimated Impacts on Individual Northern Fur Seal Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Stock	Training			Testing		
	Behavioral	*TTS*	*PTS*	*Behavioral*	*TTS*	*PTS*
Eastern Pacific	2,162	4	0	10,485	126	0
California	44	0	0	209	1	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Harbor Seals

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

Harbor seals may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions, TTS, and PTS under Alternative 1 (see Figure 3.4-64 and Table 3.4-68 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-68).

As described above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. PTS could reduce an animal's ability to detect biologically important sounds; however, as discussed above, hearing loss beyond a minor TTS is unlikely. Nevertheless, PTS could have minor long-term consequences for individuals if it were to occur. This minor consequence for an individual is unlikely to have any long-term consequences for the species or stocks. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

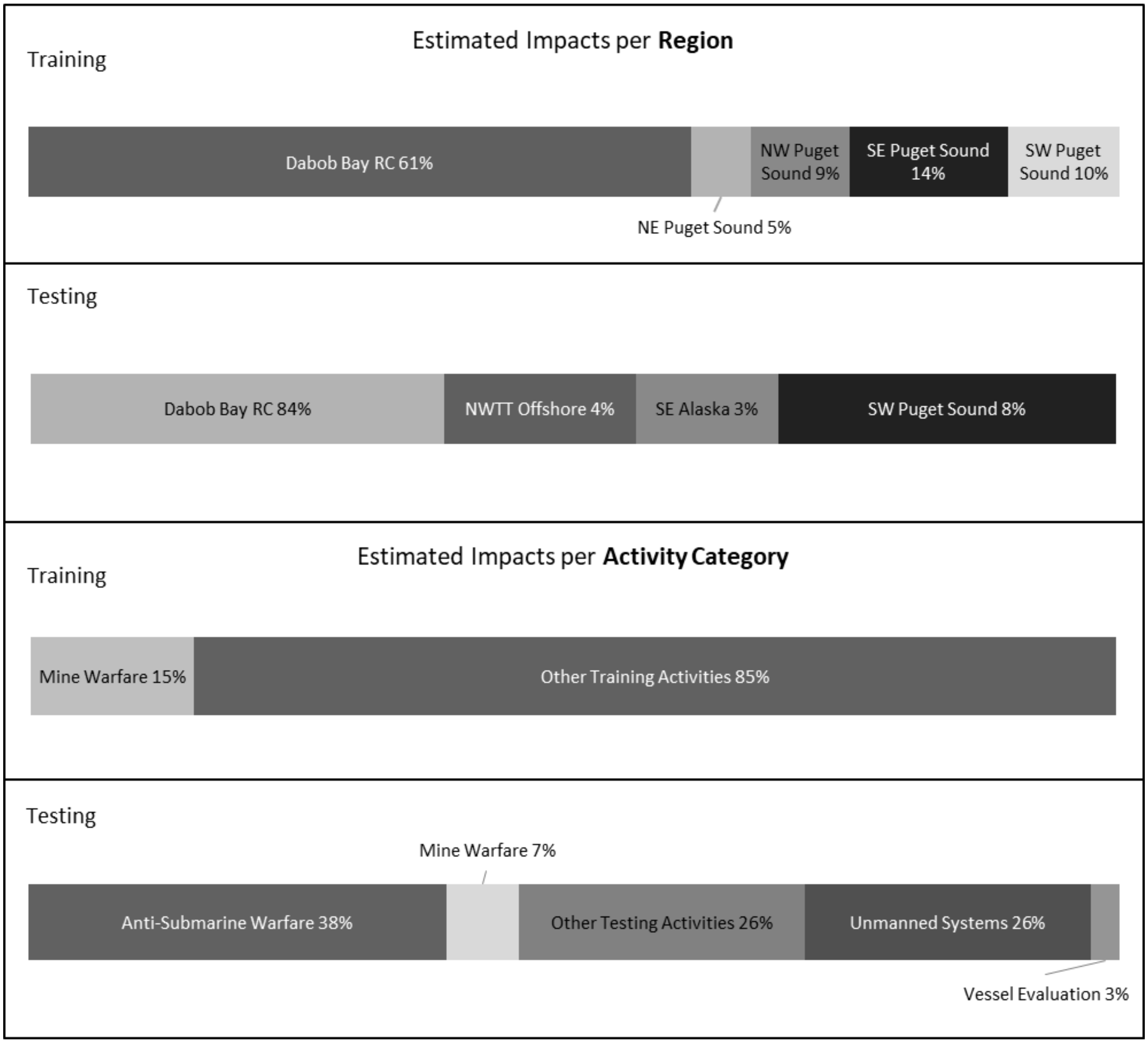
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of harbor seals incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

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

Harbor seals may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions, TTS, and PTS under Alternative 1 (see Figure 3.4-64 and Table 3.4-68 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-68).

As described above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. PTS could reduce an animal's ability to detect biologically important sounds; however, as discussed above, hearing loss beyond a minor TTS is unlikely. Nevertheless, PTS could have minor long-term consequences for individuals if it were to occur. This minor consequence for an individual is unlikely to have any long-term consequences for the species or stocks. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of harbor seals incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.



Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-64: Harbor Seal Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-68: Estimated Impacts on Individual Harbor Seal Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1.

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
Southeast Alaska - Clarence Strait	0	0	0	2,077	275	0
California	0	0	0	38	0	0
Oregon/Washington Coastal	0	0	0	1,350	1,766	0
Washington Northern Inland Waters	436	203	0	434	144	0
Hood Canal	2,334	348	0	36,927	23,667	0
Southern Puget Sound	730	360	1	2,544	3,204	3

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Harbor seals may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions, TTS, and PTS under Alternative 2 (see Figure 3.4-65 and Table 3.4-69 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-69).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

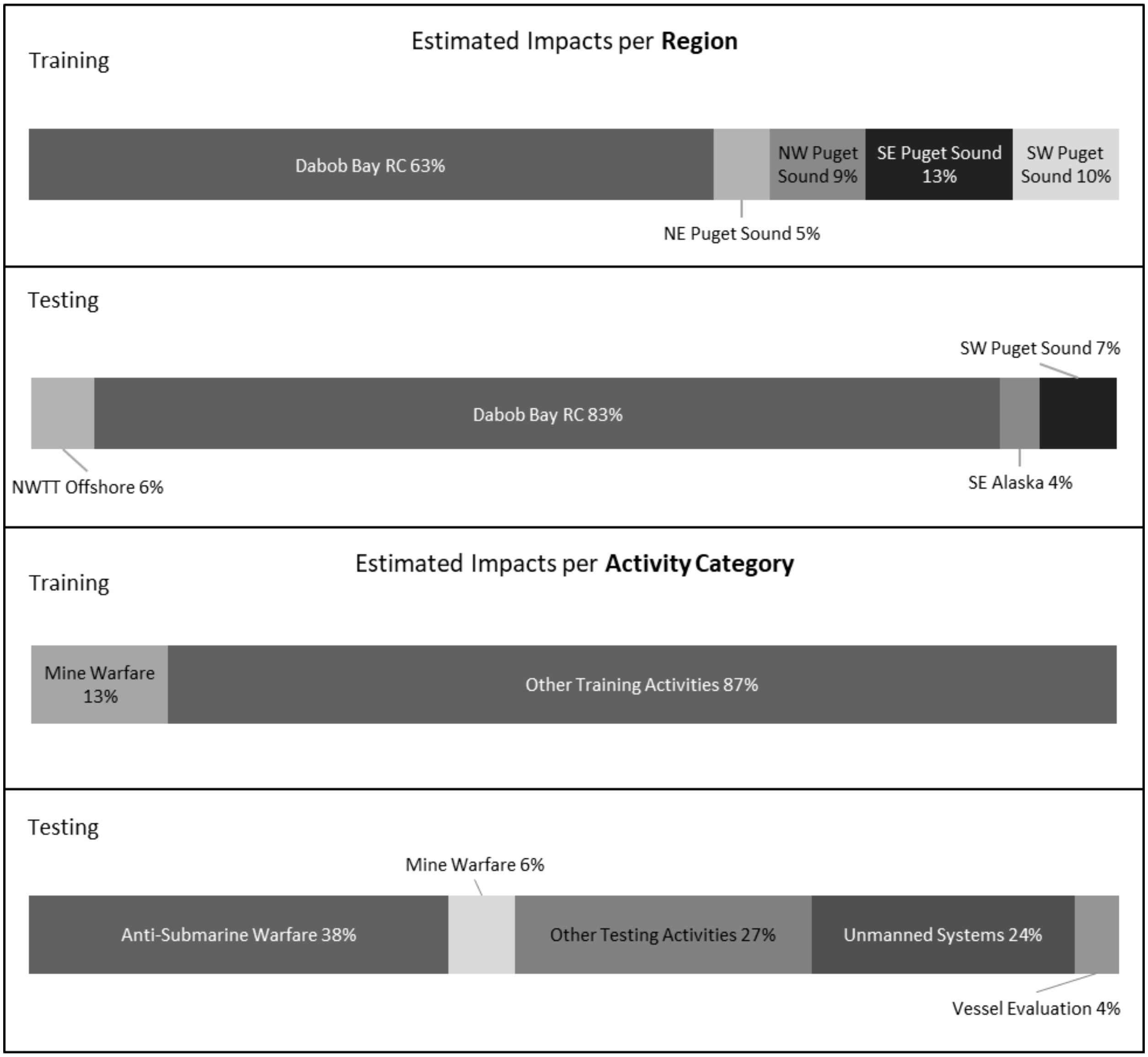
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of harbor seals incidental to those activities.

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

Harbor seals may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions, TTS, and PTS under Alternative 2 (see Figure 3.4-65 and Table 3.4-69 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.4-69).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking harbor seals incidental to those activities.



Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-65: Harbor Seal Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-69: Estimated Impacts on Individual Harbor Seal Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Stock	Estimated Impacts by Effect					
	Training			*Testing*		
	Behavioral	*TTS*	*PTS*	*Behavioral*	*TTS*	*PTS*
Southeast Alaska - Clarence Strait	0	0	0	2,513	312	0
California	0	0	0	38	0	0
Oregon/Washington Coastal	1	0	0	1,760	2,777	0
Washington Northern Inland Waters	509	227	0	434	144	0
Hood Canal	2,881	417	0	38,645	26,574	0
Southern Puget Sound	822	398	1	2,565	3,204	3

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Northern Elephant Seals

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

Northern elephant seals may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-66 and Table 3.4-70 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California stock (see Table 3.4-70).

As described above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. This minor consequence for an individual is unlikely to have any long-term consequences for the species or stock. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

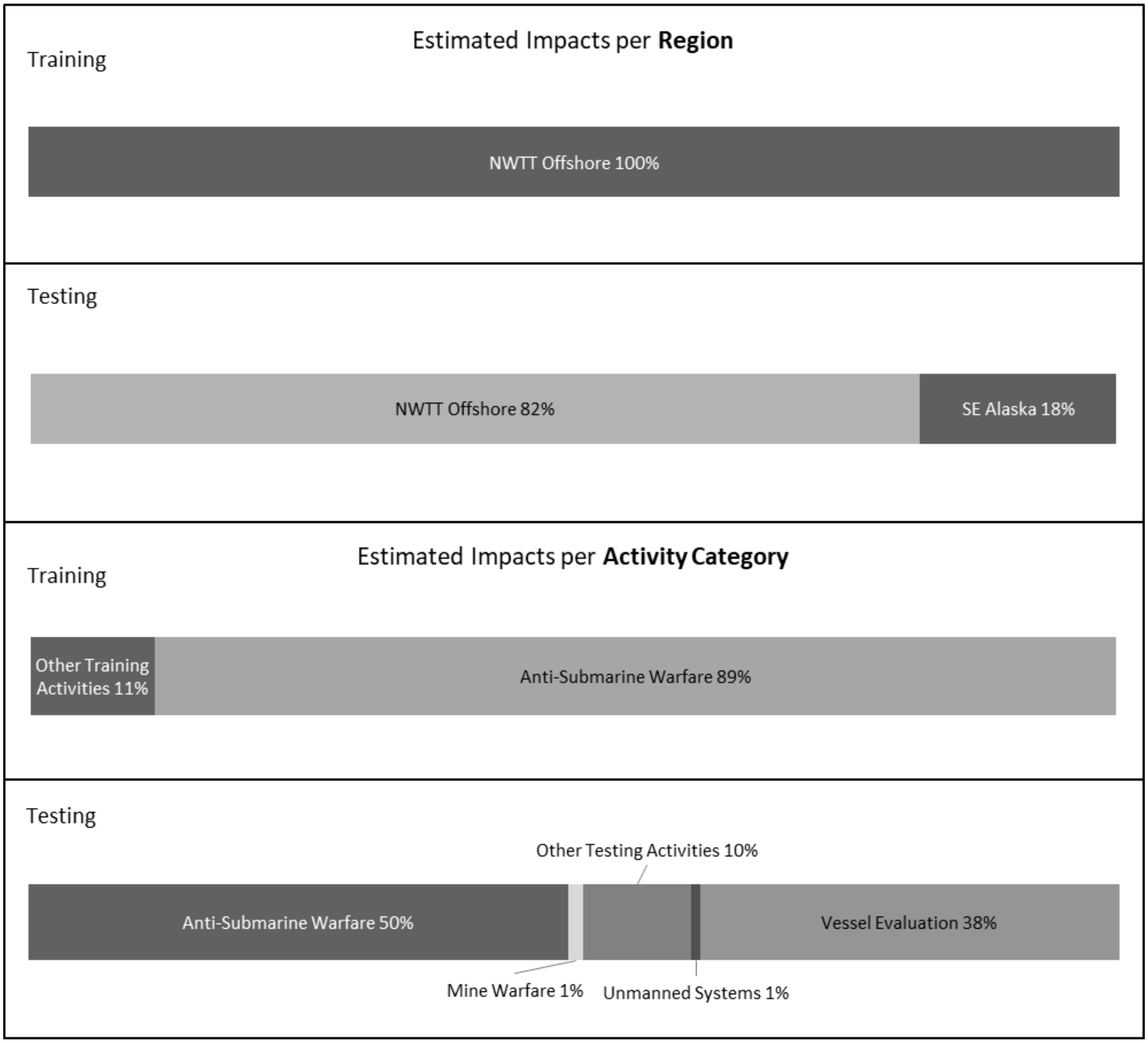
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of northern elephant seals incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

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

Northern elephant seals may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 (see Figure 3.4-66 and Table 3.4-70 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California stock (see Table 3.4-70).

As described above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. This minor consequence for an individual is unlikely to have any long-term consequences for the species or stock. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of Northern elephant seals incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.



Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-66: Northern Elephant Seal Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.4-70: Estimated Impacts on Individual Northern Elephant Seal Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California	1,698	209	0	2,437	578	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

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

Northern elephant seals may be exposed to sounds from sonar and other transducers associated with training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-67 and Table 3.4-71 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California stock (see Table 3.4-71).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of northern elephant seals incidental to those activities.

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

Northern elephant seals may be exposed to sounds from sonar and other transducers associated with testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 (see Figure 3.4-67 and Table 3.4-71 below). Impact ranges for this species are discussed in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers). Estimated impacts apply to the California stock (see Table 3.4-71).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking Northern elephant seals incidental to those activities.

Note: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent.

Figure 3.4-67: Northern Elephant Seal Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.4-71: Estimated Impacts on Individual Northern Elephant Seal Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts by Effect						
Stock	***Training***			***Testing***		
	Behavioral	***TTS***	***PTS***	***Behavioral***	***TTS***	***PTS***
California	1,735	209	0	3,137	762	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Northern Sea Otters

Sea otters that occur along the coast of Washington are the result of reintroduction efforts of the northern sea otter (from Amchitka Island, Alaska) in 1969 and 1970 (Lance et al., 2004; Sato, 2018), and are not listed as threatened or endangered under the ESA (Carretta et al., 2017c). There is a single stock in Washington waters (the northern sea otter [*Enhydra lutris kenyoni*]) and a single stock in California (the southern sea otter [*Enhydra lutris nereis*]). Only the Washington stock of sea otter is known to occur in the Study Area (Carretta et al., 2017c) and is expected to only be present in the shallow, nearshore areas of the Offshore portion of the Study Area.

Sea otters seldom range more than 2 km from shore, because they are benthic foragers and limited by their ability to dive to the seafloor, although some individuals, particularly juvenile males, may travel farther offshore (Calambokidis et al., 1987; Laidre et al., 2009; Muto et al., 2017; Riedman & Estes, 1990). Ghoul and Reichmuth (2014a) have shown that sea otters are not especially well adapted for hearing underwater, which suggests that the function of this sense has been less important in their survival and evolution than in comparison to pinnipeds. Sea otters in this region are mainly concentrated off the coast of the Olympic Peninsula and the western Strait of Juan de Fuca, with only rare sightings in Puget Sound. Sea otters do not typically occur in Inland Waters, thus activities occurring in these areas would not overlap with sea otter presence.

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

Exposures of sea otters to sonar and other transducers are unlikely because sea otters primarily inhabit shallow coastal areas outside of areas where sonars and other transducers are used in training, plus they spend the majority of their time floating at the surface with their ears above the water. Sea otters would be far outside of the distance of any possible auditory impacts from any source. Sea otters would need to be underwater to hear sonar, and sound propagation into shallow water, kelp forest habitat may be limited.

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Due to their low sensitivity to underwater sounds, their preferred habitat, their behavioral pattern of spending a majority of their time above water, and the short range to effects as described in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers), impacts to northern sea otters from Navy training activities involving sonar and other transducers are highly unlikely to occur.

Pursuant to the MMPA, the use of sonar during training activities as described under Alternative 1 would not result in the incidental taking of Northern sea otters.

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

Exposures of sea otters to sonar and other transducers are unlikely because sea otters primarily inhabit shallow coastal areas outside of areas where sonars and other transducers are used in training, plus they spend the majority of their time floating at the surface with their ears above the water. Sea otters would be far outside of the distance of any possible auditory impacts from any source. Sea otters would need to be underwater to hear sonar, and sound propagation into shallow water, kelp forest habitat may be limited.

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Due to their low sensitivity to underwater sounds, their preferred habitat, their behavioral pattern of spending a majority of their time above water, and the short range to effects as described in Section 3.4.2.1.2.2 (Impact Ranges for Sonar and Other Transducers), impacts to northern sea otters from Navy testing activities involving sonar and other transducers are highly unlikely to occur.

Pursuant to the MMPA, the use of sonar during testing activities as described under Alternative 1 would not result in the incidental taking of Northern sea otters.

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

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2.

Pursuant to the MMPA, the use of sonar during training activities as described under Alternative 2 would not result in the incidental taking of Northern sea otters.

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

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the potential for impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2.

Pursuant to the MMPA, the use of sonar during testing activities as described under Alternative 2 would not result in the incidental taking of Northern sea otters.

3.4.2.1.2.4 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 Navy 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 marine mammals, but would not measurably improve the overall distribution or abundance of marine mammals.

3.4.2.1.3 Impacts from Vessel Noise

Marine mammals 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 3.4.2.1.1 (Background) summarizes and synthesizes available information on behavioral reactions, masking, and physiological stress due to noise exposure, including vessel noise (Sections 3.4.2.1.1.2, Hearing Loss; 3.4.2.1.1.3, Physiological Stress; 3.4.2.1.1.4, Masking; and 3.4.2.1.1.5, 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, 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. The Navy will implement mitigation measures for vessel movement to avoid the potential for marine mammal vessel strikes, as discussed in Section 5.3.4.1 (Vessel Movement). The mitigation for vessel movement (i.e., maneuvering to maintain a specified distance from a marine mammal) will also help the Navy avoid or reduce potential impacts from vessel noise on marine mammals.

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 marine mammals, but would not measurably improve the overall distribution or abundance of marine mammals.

Pursuant to the MMPA, vessel noise during training and testing activities as described under Alternative 1 and Alternative 2 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, vessel noise during training and testing activities as described under Alternative 1 and Alternative 2 may affect ESA-listed marine mammals and may overlap Southern Resident Killer Whale critical habitat. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

3.4.2.1.4 Impacts from Aircraft Noise

Marine mammals may be exposed to aircraft-generated noise throughout the Study Area. Fixed- and rotary-wing aircraft are used for a variety of training and testing activities throughout the Study Area. Tilt-rotor impacts would be similar to fixed-wing or helicopter impacts depending which mode the aircraft is in. Most of these sounds would be concentrated around airbases and fixed ranges within each of the range complexes. 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 produce low-frequency sound and vibration (Pepper et al., 2003). Section 3.4.2.1.1 (Background) summarizes and synthesizes available information on behavioral reactions, masking, and physiological stress due to noise exposure, including aircraft noise (Sections 3.4.2.1.1.2, Hearing Loss; 3.4.2.1.1.3, Physiological Stress; 3.4.2.1.1.4, Masking; and 3.4.2.1.1.5, Behavioral Reactions).

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 marine mammals, but would not measurably improve the overall distribution or abundance of marine mammals.

Pursuant to the MMPA, aircraft noise during training and testing activities as described under Alternative 1 and Alternative 2 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, aircraft noise during training and testing activities as described under Alternative 1 and Alternative 2 may affect ESA-listed marine mammals, and may overlap Southern Resident killer whale critical habitat. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

3.4.2.1.5 Impacts from Weapon Noise

Marine mammals may be exposed to sounds caused by the firing of weapons, objects in flight, and inert impact of non-explosive munitions on the water's surface, which are described in Section 3.0.3.1.4 (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.

Section 3.4.2.2.1 (Background) summarizes and synthesizes available information on behavioral reactions, masking, and physiological stress due to impulsive noise exposure (Sections 3.4.2.1.1.2, Hearing Loss; 3.4.2.1.1.3, Physiological Stress; 3.4.2.1.1.4, Masking; and 3.4.2.1.1.5, 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, 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. The Navy will implement mitigation measures to avoid or reduce potential impacts from weapon noise during large-caliber gunnery activities, 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 marine mammals, but would not measurably improve the overall distribution or abundance of marine mammals.

Pursuant to the MMPA, weapon noise during training and testing activities as described under Alternative 1 and Alternative 2 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, weapon noise during training and testing activities as described under Alternative 1 and Alternative 2 may affect ESA-listed marine mammals, and training activities may overlap Southern Resident killer whale critical habitat. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

3.4.2.2 Explosive Stressors

Assessing whether an explosive detonation may disturb or injure a marine mammal involves understanding the characteristics of the explosive sources, the marine mammals that may be present near the sources, the physiological effects of a close explosive exposure, and the effects of impulsive sound on marine mammal hearing and behavior. Many other factors besides just the received level or pressure wave of an explosion such as the animal's physical condition and size, prior experience with the explosive sound, and proximity to the explosion may influence physiological effects and behavioral reactions.

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 Activities). The following Background section discusses what is currently known about explosive effects to marine mammals.

North Pacific right whales and Northern sea otters are considered extralimital or extremely rare, and are not likely to be present contemporaneous with Navy training and testing activities in the NWTT study area. Therefore, the remainder of the analysis of effects from explosives will not include North Pacific right whales or Northern sea otters.

Due to new acoustic impact criteria, marine mammal densities, and revisions to the Navy Acoustic Effects Model, the analysis provided in Section 3.4.2.2.2 (Impacts from Explosives) of this Supplemental supplants the 2015 NWTT Final EIS/OEIS for marine mammals and changes estimated impacts for some species since the 2015 NWTT Final EIS/OEIS.

3.4.2.2.1 Background

3.4.2.2.1.1 Injury

Injury refers to the direct effects on the tissues or organs of an animal due to exposure to pressure waves. Injury in marine mammals can be caused directly by exposure to explosions. Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities) provides additional information on injury and the framework used to analyze this potential impact.

Injury due to Explosives

Explosive injury to marine mammals would consist of primary blast injury, which refers to those injuries that result from the compression of a body exposed to a blast wave and 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 near instantaneous high magnitude pressure change near an explosion can injure an animal where tissue material properties significantly differ from the surrounding environment, such as around air-filled cavities such as in the lungs or gastrointestinal tract. Large pressure changes at tissue-air interfaces in the lungs and gastrointestinal tract may cause tissue rupture, resulting in a range of injuries depending on degree of exposure. 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, such as tissue lacerations, major hemorrhage, organ rupture, or air in the chest cavity (pneumothorax), 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.

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. Susceptibility would increase with depth, until normal lung collapse (due to increasing hydrostatic pressure) and increasing ambient pressures again reduce susceptibility. See Appendix D (Acoustic and Explosives Concepts) for an overview of explosive propagation and an explanation of explosive effects on gas cavities.

The only known occurrence of mortality or injury to a marine mammal due to a Navy training or testing event involving explosives occurred in March 2011 in nearshore waters off San Diego, California, at the Silver Strand Training Complex. This area had been used for underwater demolitions training for at least three decades without prior known incident. On this occasion, however, a group of approximately 100–150 long-beaked common dolphins entered the mitigation zone surrounding an area where a time-delayed firing device had been initiated on an explosive with a net explosive weight of 8.76 pounds (lb.) (3.97 kilograms [kg]) placed at a depth of 48 ft. (14.6 m). Approximately one minute after detonation, three animals were observed dead at the surface. The Navy recovered those animals and transferred them to the local stranding network for necropsy. A fourth animal was discovered stranded and dead 42 NM to the north of the detonation three days later. It is unknown exactly how close those four animals were to the detonation. Upon necropsy, all four animals were found to have sustained typical mammalian primary blast injuries (Danil & St Leger, 2011). In the Pacific Northwest, there is no known occurrence of mortality or injury to marine mammals due to Navy training or testing events involving explosives.

Relatively little is known about auditory system trauma in marine mammals resulting from explosive exposure, although it is assumed that auditory structures would be vulnerable to blast injuries. Auditory trauma was found in two humpback whales that died following the detonation of a 5,000 kg explosive used off Newfoundland during demolition of an offshore oil rig platform (Ketten et al., 1993), but the proximity of the whales to the detonation was unknown. Eardrum rupture was examined in submerged terrestrial mammals exposed to underwater explosions (Richmond et al., 1973; Yelverton et al., 1973); however, results may not be applicable to the anatomical adaptations for underwater hearing in marine mammals. In this discussion, primary blast injury to auditory tissues is considered gross structural tissue damage distinct from threshold shift or other auditory effects (see Section 3.4.2.2.1.2, Hearing Loss).

Controlled tests with a variety of lab animals (mice, rats, dogs, pigs, sheep and other species) are the best data sources on actual injury to mammals 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 at Kirtland Air Force Base, New Mexico, 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; this is consistent with earlier studies of mammal exposures to underwater explosions in which lungs were consistently the first areas to show damage, with less consistent damage observed in the gastrointestinal tract (Clark & Ward, 1943; Greaves et al., 1943). Results from all of these tests suggest two explosive metrics are predictive of explosive injury: peak pressure and impulse.

Impulse as a Predictor of Explosive Injury

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 lungs of most marine mammals are similar in proportion to overall body size as those of terrestrial mammals, so the magnitude of lung damage in the tests may approximate the magnitude of injury to marine mammals when scaled for body size. Within the marine mammals, mysticetes and deeper divers (e.g., Kogiidae, Physeteridae, Ziphiidae) tend to have lung to body size ratios that are smaller and more similar to terrestrial animal ratios than the shallow diving odontocetes (e.g., Phocoenidae, Delphinidae) and pinnipeds (Fahlman et al., 2014a; Piscitelli et al., 2010). 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 kg) to underwater detonations, Richmond et al. (1973) reported that no blast injuries were observed when exposures were less than 6 pounds per square inch per millisecond (psi-ms) (40 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 marine mammals may be several orders of magnitude 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 marine mammal size and depth in a bubble oscillation model of the lung. 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 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.

Because gas-containing organs are more vulnerable to primary blast injury, adaptations for diving that allow for collapse of lung tissues with depth may make animals less vulnerable to lung injury with depth.

Adaptations for diving include a flexible thoracic cavity, distensible veins that can fill space as air compresses, elastic lung tissue, and resilient tracheas with interlocking cartilaginous rings that provide strength and flexibility (Ridgway, 1972). Older literature suggested complete lung collapse depths at approximately 70 m for dolphins (Ridgway & Howard, 1979) and 20–50 m for phocid seals (Falke et al., 1985; Kooyman et al., 1972). Follow-on work by Kooyman and Sinnett (1982), in which pulmonary shunting was studied in harbor seals and sea lions, suggested that complete lung collapse for these species would be about 170 m and about 180 m, respectively. More recently, evidence in sea lions suggests that complete collapse might not occur until depths as great as 225 m; although the depth of collapse and depth of the dive are related, sea lions can affect the depth of lung collapse by varying the amount of air inhaled on a dive (McDonald & Ponganis, 2012). This is an important consideration for all divers who can modulate lung volume and gas exchange prior to diving via the degree of inhalation and during diving via exhalation (Fahlman et al., 2009); indeed, there are noted differences in pre-dive respiratory behavior, with some marine mammals exhibiting pre-dive exhalation to reduce the lung volume (e.g., phocid seals (Kooyman et al., 1973)).

Peak Pressure as a Predictor of Explosive Injury

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 psi (237 dB re 1 µPa peak) to feel like 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.

3.4.2.2.1.2 Hearing Loss

Exposure to intense sound may result in noise-induced hearing loss that persists after cessation of the noise exposure. Hearing loss may be temporary or permanent, depending on factors such as the exposure frequency, received SPL, temporal pattern, and duration. The frequencies affected by hearing loss may vary depending on the exposure frequency, with frequencies at and above the exposure frequency most strongly affected. The amount of hearing loss may range from slight to profound, depending on the ability of the individual to hear at the affected frequencies. Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities) provides additional information on hearing loss and the framework used to analyze this potential impact.

Hearing loss has only been studied in a few species of marine mammals, although hearing studies with terrestrial mammals are also informative. There are no direct measurements of hearing loss in marine mammals due to exposure to explosive sources. The sound resulting from an explosive detonation is considered an impulsive sound and shares important qualities (i.e., short duration and fast rise time) with other impulsive sounds such as those produced by air guns. General research findings regarding TTS and PTS in marine mammals as well as findings specific to exposure to other impulsive sound sources are discussed in Section 3.4.2.1.1.2 (Hearing Loss) and Section 3.4.2.1.1.1 (Injury) under Acoustic Stressors above.

3.4.2.2.1.3 Physiological Stress

Marine mammals naturally experience stress within their environment and as part of their life histories. The stress response is a suite of physiological changes that are meant to help an organism mitigate the impact of a stressor. However, if the magnitude and duration of the stress response is too great or too long, then it can have negative consequences to the organism (e.g., decreased immune function, decreased reproduction). Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities) provides additional information on physiological stress and the framework used to analyze this potential impact.

There are no direct measurements of physiological stress in marine mammals due to exposure to explosive sources. General research findings regarding physiological stress in marine mammals due to exposure to sound and other stressors are discussed in detail in Section 3.4.2.1.1.3 (Physiological Stress) under Acoustic Stressors above. Because there are many unknowns regarding the occurrence of acoustically induced stress responses in marine mammals, it is assumed that any physiological response (e.g., hearing loss or injury) or significant behavioral response is also associated with a stress response.

3.4.2.2.1.4 Masking

Masking occurs when one sound, distinguished as the “noise,” interferes with the detection, discrimination, or recognition of another sound. The quantitative definition of masking is the amount in decibels an auditory detection, discrimination, or recognition threshold is raised in the presence of a masker (Erbe et al., 2016). As discussed in Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities), masking can effectively limit the distance over which a marine mammal can communicate, detect biologically relevant sounds, and echolocate (odontocetes). Masking only occurs in the presence of the masking noise and does not persist after the cessation of the noise. Masking can lead to vocal changes (e.g., Lombard effect, increasing amplitude, or changing frequency) and behavior changes (e.g., cessation of foraging, leaving an area) to both signalers and receivers, in an attempt to compensate for noise levels (Erbe et al., 2016).

There are no direct observations of masking in marine mammals due to exposure to explosive sources. General research findings regarding masking in marine mammals due to exposure to sound and other stressors are discussed in detail in Section 3.4.2.1.1.4 (Masking) under Acoustic Stressors above. Potential masking from explosive sounds is likely to be similar to masking studied for other impulsive sounds such as air guns.

3.4.2.2.1.5 Behavioral Reactions

As discussed in Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities), any stimuli in the environment can cause a behavioral response in marine mammals, including noise from explosions. There are few direct observations of behavioral reactions from marine mammals due to exposure to explosive sounds. Lammers et al. (2017) recorded dolphin detections near naval mine neutralization exercises and found that although the immediate response (within 30 seconds of the explosion) was an increase in whistles relative to the 30 seconds before the explosion, there was a reduction in daytime acoustic activity during the day of and the day after the exercise within 6 km. However, the nighttime activity did not seem to be different than that prior to the exercise, and 2 days after there appeared to be an increase in daytime acoustic activity, indicating a rapid return to the area by the dolphins (Lammers et al. 2017). Vallejo et al. (2017) report on boat-based line-transect surveys which were run over 10 years in an area where an offshore wind farm was built; these surveys included the periods of preconstruction, construction, and postconstruction. Harbor porpoise were observed throughout the area during all three phases, but were not detected within the footprint of the windfarm during the construction phase, and were overall less frequent throughout the study area. However, they returned after the construction was completed at a slightly higher level than in the preconstruction phase. Furthermore, there was no large-scale displacement of harbor porpoises during construction, and in fact their avoidance behavior only occurred out to about 18 km, in contrast to the approximately 25 km avoidance distance found in other windfarm construction and pile driving monitoring efforts.

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. However, at long distances the rise time increases as the signal duration lengthens (similar to a "ringing" sound), making the impulsive signal more similar to a non-impulsive signal. Behavioral reactions from explosive sounds are likely to be similar to reactions studied for other impulsive sounds, such as those produced by air guns and impact pile driving. Data on behavioral responses to impulsive sound sources are limited across all marine mammal groups, with only a few studies available for mysticetes, odontocetes, and pinnipeds. No data currently exist for sea otters. Most data have come from seismic surveys that occur over long durations (e.g., on the order of days to weeks), and typically utilize large multi-air gun arrays that fire repeatedly. While seismic data provide the best available science for assessing behavioral responses to impulsive sounds by marine mammals, it is likely that these responses represent a worst-case scenario as compared to responses to explosives used in Navy activities, which would typically consist of single impulses or a cluster of impulses, rather than long-duration, repeated impulses.

Mysticetes

Baleen whales have shown a variety of responses to impulsive sound sources, including avoidance, attraction to the source, reduced surface intervals, altered swimming behavior, and changes in vocalization rates (Gordon et al., 2003; McCauley et al., 2000; Richardson et al., 1985; Southall et al., 2007). Studies have been conducted on many baleen whale species, including gray, humpback, blue, fin and bowhead whales; it is assumed that these responses are representative of all baleen whale species. The behavioral state of the whale seems to be an integral part of whether or not the animal responds and how they respond, as does the location and movement of the sound source, more than the received level of the sound.

Migratory behavior seems to lead to a higher likelihood of response, with some species demonstrating more sensitivity than others do. For example, migrating gray whales showed avoidance responses to seismic vessels at received levels between 164 and 190 dB re 1 µPa (Malme et al., 1986, 1988). Similarly, migrating humpback whales showed avoidance behavior at ranges of 5–8 km from a seismic array during observational studies and controlled exposure experiments in one Australian study (McCauley et al., 1998), and in another Australian study decreased their dive times and reduced their swimming speeds (Dunlop et al., 2015). However, when comparing received levels and behavioral responses when using ramp-up versus a constant noise level of air guns, humpback whales did not change their dive behavior but did deviate from their predicted heading and decreased their swim speeds (Dunlop et al., 2016). In addition, the whales demonstrated more course deviation during the constant source trials but reduced travel speeds more in the ramp-up trials; in either case there was no dose-response relationship with the received level of the air gun noise, and similar responses were observed in control trials with vessel movement but no air guns so some of the response was likely due to the presence of the vessel and not the received level of the air guns. When looking at the relationships between proximity, received level, and behavioral response, Dunlop et al. (2017) used responses to two different air guns and found responses occurred more towards the smaller, closer source than to the larger source at the same received level, demonstrating the importance of proximity. Responses were found to be more likely when the source was within 3 km or above 140 dB re 1 µPa, although responses were variable and some animals did not respond at those values while others responded below them. In addition, responses were generally small, with course deviations of only around 500 m, and short-term (Dunlop et al., 2017). McDonald et al. (1995) tracked a blue whale with seafloor seismometers and reported that it stopped vocalizing and changed its travel direction at a range of 10 km from the seismic vessel (estimated received level 143 dB re 1 µPa peak-to-peak). Bowhead whales seem to be the most sensitive species, perhaps due to a higher overlap between bowhead whale distribution and seismic surveys in Arctic and sub-Arctic waters, as well as a recent history of being hunted. While most bowhead whales did not show active avoidance until within 8 km of seismic vessels (Richardson et al., 1995b), some whales avoided vessels by more than 20 km at received levels as low as 120 dB re 1 µPa. Additionally, Malme et al. (1988) observed clear changes in diving and breathing patterns in bowheads at ranges up to 73 km from seismic vessels, with received levels as low as 125 dB re 1 µPa. Bowhead whales may also avoid the area around seismic surveys, from 6–8 km (Koski and Johnson 1987, as cited in Gordon et al., 2003) out to 20 or 30 km (Richardson et al., 1999). However, work by Robertson (2014) supports the idea that behavioral responses are contextually dependent, and that during seismic operations bowhead whales may be less "available" for counting due to alterations in dive behavior but that they may not have left the area after all.

In contrast, noise from seismic surveys was not found to impact feeding behavior or exhalation rates in western gray whales while resting or diving off the coast of Russia (Gailey et al., 2007; Yazvenko et al., 2007); however, the increase in vessel traffic associated with the surveys and the proximity of the vessels to the whales did affect the orientation of the whales relative to the vessels and shortened their dive-surface intervals (Gailey et al., 2016). Todd et al. (1996) found no clear short-term behavioral responses by foraging humpbacks to explosions associated with construction operations in Newfoundland but did see a trend of increased rates of net entanglement closer to the noise source, possibly indicating a reduction in net detection associated with the noise through masking or TTS. Distributions of fin and minke whales were modeled with a suite of environmental variables along with the occurrence or absence of seismic surveys, and no evidence of a decrease in sighting rates relative to seismic activity was found for either species (Vilela et al., 2016). Their distributions were driven entirely by environmental variables, particularly those linked to prey including warmer sea surface temperatures, higher chlorophyll-a values, and higher photosynthetically available radiation (a measure of primary productivity).

Vocal responses to seismic surveys have been observed in a number of baleen whale species, including a cessation of calling, a shift in frequency, increases in amplitude or call rate, or a combination of these strategies. Blue whale feeding/social calls were found to increase when seismic exploration was underway, with seismic pulses at average received SELs of 131 dB re 1 $\mu Pa^2 s$ (Di Lorio & Clark, 2010), a potentially compensatory response to increased noise level. Responses by fin whales to a 10-day seismic survey in the Mediterranean Sea included possible decreased 20-Hz call production and movement of animals from the area based on lower received levels and changes in bearings (Castellote et al., 2012). However, similarly distant seismic surveys elicited no apparent vocal response from fin whales in the mid-Atlantic Ocean; instead, Nieukirk et al. (2012) hypothesized that 20-Hz calls may have been masked from the receiver by distant seismic noise. Models of humpback whale song off Angola showed significant seasonal and diel variation, but also showed a decrease in the number of singers with increasing received levels of air gun pulses (Cerchio et al., 2014). Bowhead whale calling rates decreased significantly at sites near seismic surveys (41–45 km) where median received levels were between 116–129 dB re 1 µPa, and did not decrease at sites further from the seismic surveys (greater than 104 km) where median received levels were 99–108 dB re 1 µPa (Blackwell et al., 2013). In fact, bowhead whale calling rates increased at the lower received levels, began decreasing at around 127 dB re 1 $\mu Pa^2 s$ cumulative SEL, and ceased altogether at received levels over 170 dB re 1 $\mu Pa^2 s$ cumulative SEL (Blackwell et al., 2015). Similar patterns were observed for bowhead vocalizations in the presence of tonal sounds associated with drilling activities, and were amplified when the presence of both the tonal sounds and air gun pulses (Blackwell et al., 2017).

Mysticetes seem to be the most sensitive taxonomic group of marine mammals to impulsive sound sources, with possible avoidance responses occurring out to 30 km and vocal changes occurring in response to sounds over 100 km away. However, responses appear to be behaviorally mediated, with most avoidance responses occurring during migration behavior and little observed response during feeding behavior. These response patterns are likely to hold true for Navy impulsive sources; however, Navy impulsive sources would largely be stationary (e.g., explosives fired at a fixed target), and short-term (on the order of hours rather than days or weeks) than were found in these studies and so responses would likely occur in closer proximity or not at all.

Odontocetes

Few data are available on odontocete responses to impulsive sound sources, with only a few studies on responses to seismic surveys, pile driving and construction activity available. However, odontocetes appear to be less sensitive to impulsive sound than mysticetes, with responses occurring at much closer distances. This may be due to the predominance of low-frequency sound associated with these sources that propagates long distances and overlaps with the range of best hearing for mysticetes but is below that range for odontocetes. The exception to this is the harbor porpoise, which has been shown to be highly sensitive to most sound sources, avoiding both stationary (e.g., pile driving) and moving (e.g., seismic survey vessels) impulsive sound sources out to approximately 20 km (e.g., Haelters et al., 2014; Pirotta et al., 2014). However, even this response is short-term, with porpoises returning to the area within hours after the cessation of the noise.

Madsen et al. (2006) and Miller et al. (2009) tagged and monitored eight sperm whales in the Gulf of Mexico exposed to seismic air gun surveys. Sound sources were from approximately 2 to 7 NM away from the whales, and received levels were as high as 162 dB SPL re 1 µPa (Madsen et al., 2006). The whales showed no horizontal avoidance, however one whale rested at the water’s surface for an extended period of time until air guns ceased firing (Miller et al., 2009). While the remaining whales continued to execute foraging dives throughout exposure, tag data suggested there may have been subtle effects of noise on foraging behavior (Miller et al., 2009). Similarly, Weir (2008) observed that seismic air gun surveys along the Angolan coast did not significantly reduce the encounter rate of sperm whales during the 10-month survey period, nor were avoidance behaviors to air gun impulsive sounds observed. In contrast, Atlantic spotted dolphins did show a significant, short-term avoidance response to air gun impulses within approximately 1 km of the source (Weir, 2008). The dolphins were observed at greater distances from the vessel when the air gun was in use, and when the air gun was not in use they readily approached the vessel to bow ride.

Captive bottlenose dolphins sometimes vocalized or were reluctant to return to the test station after exposure to single impulses from a seismic water gun (Finneran et al., 2002). When exposed to multiple impulses from a seismic air gun, some dolphins turned their heads away from the sound source just before the impulse, showing that they could anticipate the timing of the impulses and perhaps reduce the received level (Finneran et al., 2015). During construction (including the blasting of old bastions) of a bridge over a waterway commonly used by the Tampa Bay, FL stock of bottlenose dolphins, the use of the area by females decreased while males displayed high site fidelity and continued using the area, perhaps indicating differential habitat uses between the sexes (Weaver, 2015).

A study was conducted on the response of harbor porpoises to a seismic survey using aerial surveys and C-PODs (an autonomous recording device that counts odontocete clicks); the animals appeared to have left the area of the survey, and decreased their foraging activity within 5–10 km, as evidenced by both a decrease in vocalizations near the survey and an increase in vocalizations at a distance (Pirotta et al., 2014; Thompson et al., 2013). However, the animals returned within a day after the air gun operation ceased, and the decrease in occurrence over the survey period was small relative to the observed natural seasonal decrease compared to the previous year. A number of studies (Brandt et al., 2011; Dähne et al., 2014; Haelters et al., 2014; Thompson et al., 2010; Tougaard et al., 2005; Tougaard et al., 2009) also found strong avoidance responses by harbor porpoises out to 20 km during pile driving; however, all studies found that the animals returned to the area after the cessation of pile driving. When bubble curtains were deployed around pile driving, the avoidance distance appeared to be reduced to half that distance (12 km), and the response only lasted about five hours rather than a day before the animals returned to the area (Dähne et al., 2017). Kastelein et al. (2013b) exposed a captive harbor porpoise to impact pile driving sounds, and found that above 136 dB re 1 µPa (zero-to-peak) the animal's respiration rates increased, and at higher levels it jumped more frequently. Bergstrom et al. (2014) found that although there was a high likelihood of acoustic disturbance during wind farm construction (including pile driving), the impact was short-term. Graham et al. (2017) assessed the occurrence of bottlenose dolphins and harbor porpoises over different area and time scales with and without impact and vibratory pile driving. While there were fewer hours with bottlenose dolphin detections and reduced detection durations within the pile driving area and increased detection durations outside the area, the effects sizes were small, and the reduced harbor porpoise encounter duration was attributed to seasonal changes outside the influence of the pile driving. However, received levels in this area were lower due to propagation effects than in the other areas described above, which may have led to the lack of or reduced response.

Odontocete behavioral responses to impulsive sound sources are likely species- and context-dependent, with most species demonstrating little to no apparent response. Responses might be expected within close proximity to a noise source, under specific behavioral conditions such as females with offspring, or for sensitive species such as harbor porpoises.

Pinnipeds

A review of behavioral reactions by pinnipeds to impulsive noise can be found in Richardson et al. (1995b) and Southall et al. (2007). Blackwell et al. (2004) observed that ringed seals exhibited little or no reaction to pipe-driving noise with mean underwater levels of 157 dB re 1 µPa and in-air levels of 112 dB re 20 µPa, suggesting that the seals had habituated to the noise. In contrast, captive California sea lions avoided sounds from an underwater impulsive source at levels of 165–170 dB re 1 µPa (Finneran et al., 2003b). Harbor and grey seals were also observed to avoid a seismic air gun by rapidly swimming away, and ceased foraging during exposure, but returned to normal behavior afterwards (Thompson et al. 1998, cited in Gordon et al., 2003). In another study, few responses were observed by New Zealand fur seals to a towed air gun array operating at full power; rather, when responses were observed it seemed to be to the physical presence of the vessel and tow apparatus, and these only occurred when the vessel was within 200 m and sometimes as close as 5 m (Lalas & McConnell, 2016). Captive Steller sea lions were exposed to a variety of tonal, sweep, impulsive and broadband sounds to determine what might work as a deterrent from fishing nets. The impulsive sound had a source level of 120 dB re 1 µPa at 1 m, and caused the animals to haul out and refuse to eat fish presented in a net (Akamatsu et al., 1996). Steller sea lions exposed to in-air explosive blasts increased their activity levels and often re-entered the water when hauled out (Demarchi et al., 2012). However, these responses were short-lived and within minutes, the animals had hauled out again, and there were no lasting behavioral impacts in the days following the blasts.

Experimentally, Götz & Janik (2011) tested underwater startle responses to a startling sound (sound with a rapid rise time and a 93 dB sensation level [the level above the animal's hearing threshold at that frequency]) and a nonstartling sound (sound with the same level, but with a slower rise time) in wild-captured gray seals. The animals exposed to the startling treatment avoided a known food source, whereas animals exposed to the nonstartling treatment did not react or habituated during the exposure period. The results of this study highlight the importance of the characteristics of the acoustic signal in an animal’s response of habituation.

Pinnipeds may be the least sensitive taxonomic group to most noise sources, although some species may be more sensitive than others, and are likely to only respond to loud impulsive sound sources at close ranges by startling, jumping into the water when hauled out, or even cease foraging, but only for brief periods before returning to their previous behavior (e.g., (Southall et al., 2007)). Pinnipeds may even experience TTS (see Section 3.4.2.2.1.2, Hearing Loss) before exhibiting a behavioral response (Southall et al., 2007).

Sea Otters

There are few available studies on responses of sea otters to impulsive sounds. A playback study of multiple and single air guns had no impact on sea otters in California; foraging and dive behaviors remained undisturbed, as did the density and distribution of sea otters in the area (Reidman, 1983). Sea otters spend approximately 80 percent of their time on the surface of the water (Curland, 1997) with their heads above the surface, which reduces their exposure to underwater sounds. If reactions were to occur, they may be similar to those of pinnipeds, which show temporary avoidance responses or cessation of foraging behavior (Thompson et al. 1998, cited in Gordon et al., 2003). However, underwater hearing sensitivities are significantly reduced in sea otters when compared to pinnipeds (Ghoul & Reichmuth, 2014a, 2014b), so reactions may not be as strong, if they occur at all.

3.4.2.2.1.6 Stranding

When a marine mammal (alive or dead) swims or floats onto shore and becomes beached or incapable of returning to sea, the event is termed a “stranding” (Geraci et al., 1999; Geraci & Lounsbury, 2005; Perrin & Geraci, 2002). Specifically, under U.S. law, a stranding is an event in the wild where: “(A) a marine mammal is dead and is (i) on a beach or shore of the United States; or (ii) in waters under the jurisdiction of the United States (including any navigable waters); or (B) a marine mammal is alive and is (i) on a beach or shore of the United States and is unable to return to the water; (ii) on a beach or shore of the United States and, although able to return to the water, is in need of medical attention; or (iii) in the waters under the jurisdiction of the United States (including any navigable waters), but is unable to return to its natural habitat under its own power or without assistance" (16 U.S.C. section 1421h).

Impulsive sources (e.g., explosions) also have the potential to contribute to strandings, but such occurrences are even less common than those that have been related to certain sonar activities. During a Navy training event on March 4, 2011, at the Silver Strand Training Complex in San Diego, California, three long-beaked common dolphins were killed by an underwater detonation. Further details are provided above. Discussions of mitigation measures associated with these and other training and testing events are presented in Chapter 5 (Mitigation).

3.4.2.2.1.7 Long-Term Consequences

Long-term consequences to a population are determined by examining changes in the population growth rate. For additional information on the determination of long-term consequences, see Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities). Physical effects from explosive sources 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 or chronic masking, which could impact navigation, foraging, predator avoidance, or communication. The long-term consequences due to individual behavioral reactions, masking and short-term instances of physiological stress are especially difficult to predict because individual experience over time can create complex contingencies, especially for long-lived animals like marine mammals. For example, a lost reproductive opportunity could be a measurable cost to the individual; however, short-term costs may be recouped during the life of an otherwise healthy individual. These factors are taken into consideration when assessing risk of long-term consequences.

3.4.2.2.2 Impacts from Explosives

Marine mammals could be exposed to energy, sound, and fragments from explosions in the water and near the water surface associated with the proposed activities. Energy from an explosion is 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 or PTS may limit an animal's ability to find food, communicate with other animals, or interpret the surrounding environment. Impairment of these abilities can decrease an individual's chance of survival or impact its ability to successfully reproduce. TTS can also impair an animal's abilities, but the individual is likely to recover quickly with little significant effect.

Explosions in the ocean or near the water surface can introduce loud, impulsive, broadband sounds into the marine environment. These sounds, which are within the audible range of most marine mammals, could cause behavioral reactions, masking and elevated physiological stress. Behavioral responses can include shorter surfacings, shorter dives, fewer blows (breaths) per surfacing, longer intervals between blows, ceasing or increasing vocalizations, shortening or lengthening vocalizations, and changing frequency or intensity of vocalizations (National Research Council 2005). Sounds from explosives could also mask biologically important sounds; however, the duration of individual sounds is very short, reducing the likelihood of substantial auditory masking.

3.4.2.2.2.1 Methods for Analyzing Impacts from Explosives

The Navy performed a quantitative analysis to estimate the number of times that marine mammals could be impacted by explosions used during Navy training and testing activities. The Navy's quantitative analysis to determine impacts on marine mammals uses the Navy Acoustic Effects Model to produce initial estimates of the number of instances that animals may experience these effects; these estimates are further refined by considering animal avoidance of sound-producing activities and implementation of procedural mitigation measures. The steps of this quantitative analysis are described in Section 3.0.1.2 (Navy's Quantitative Analysis to Determine Impacts to Sea Turtles and Marine Mammals), which takes into account:

- criteria and thresholds used to predict impacts from explosives (see below)
- the density and spatial distribution of marine mammals
- 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 detailed explanation of this analysis is provided in the technical report *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2018b).

Criteria and Thresholds used to Estimate Impacts on Marine Mammals from Explosives

Mortality and Injury from Explosives

As discussed above in Section 3.4.2.1.1.1 (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).

Because data on explosive injury do not indicate a set threshold for injury, rather a range of risk for explosive exposures, two sets of criteria 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 3.4-72). The thresholds for the farthest range to effect are based on the received level at which 1 percent risk is predicted and are useful for assessing potential effects to marine mammals and the level of potential impacts covered by the mitigation zones. 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, marine mammal populations are assumed to be 70 percent adult and 30 percent calf/pup. Sub-adult masses are used to determine onset of effect, in order to estimate the farthest range at which an effect may first be observable. 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 3.4-72: Criteria to Quantitatively Assess Non-Auditory Injury Due to Underwater Explosions

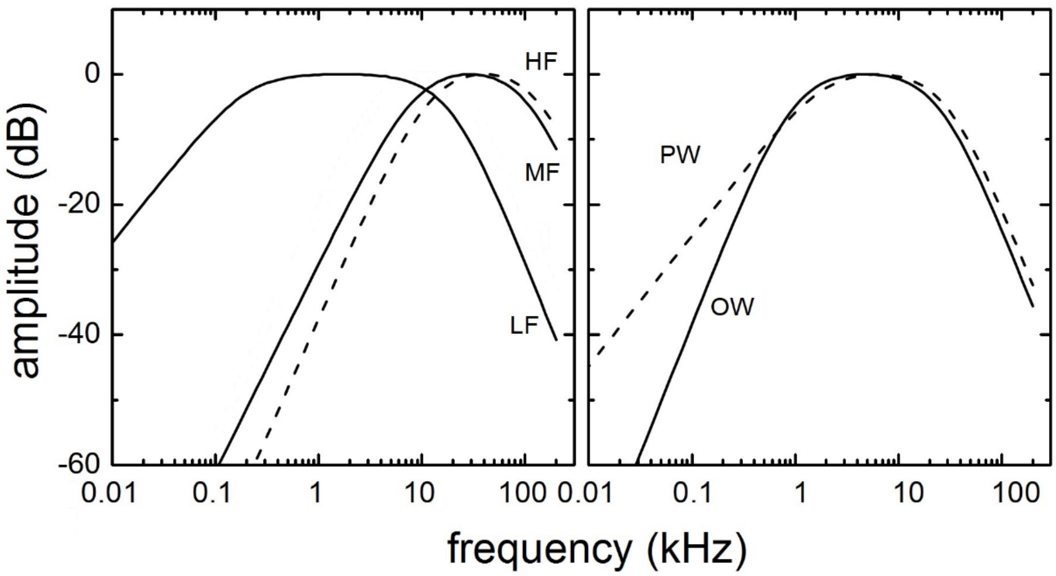
Impact Category	*Exposure Threshold*	*Threshold for Farthest Range to Effect*[2]
Mortality[1]	$144M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/6}$ Pa-s	$103M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/6}$ Pa-s
Injury[1]	$65.8\mathrm{M}^{1/3}\left(1+\frac{\mathrm{D}}{10.1}\right)^{1/6}$ Pa-s	$47.5\mathrm{M}^{1/3}\left(1+\frac{\mathrm{D}}{10.1}\right)^{1/6}$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

[1] Impulse delivered over 20% of the estimated lung resonance period. See U.S. Department of the Navy (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 ordnance (e.g., bomb or missile) detonates, fragments of the weapon are thrown at high-velocity from the detonation point, which can injure or kill marine mammals if they are struck. Risk of fragment injury reduces exponentially with distance as the fragment density is reduced. Fragments underwater tend to be larger than fragments produced by in-air explosions (Swisdak & Montanaro, 1992). Underwater, the friction of the water would quickly slow these fragments to a point where they no longer pose a threat. On the other hand, the blast wave from an explosive detonation moves efficiently through the seawater. Because the ranges to mortality and injury due to exposure to the blast wave are likely to far exceed the zone where fragments could injure or kill an animal, the above thresholds are assumed to encompass risk due to fragmentation.

Auditory Weighting Functions

Animals are not equally sensitive to noise at all frequencies. To capture the frequency-dependent nature of the effects of noise, auditory weighting functions are used (Figure 3.4-68). Auditory weighting functions are mathematical functions based on a generic band-pass filter and incorporate species-specific hearing abilities to calculate a weighted received sound level in units SPL or SEL. Due to the band pass nature of auditory weighting functions, they resemble an inverted "U" shape with amplitude plotted as a function of frequency. The flatter portion of the plotted function, where the amplitude is closest to zero, is the emphasized frequency range (i.e., the pass-band), while the frequencies below and above this range (where amplitude declines) are de-emphasized.



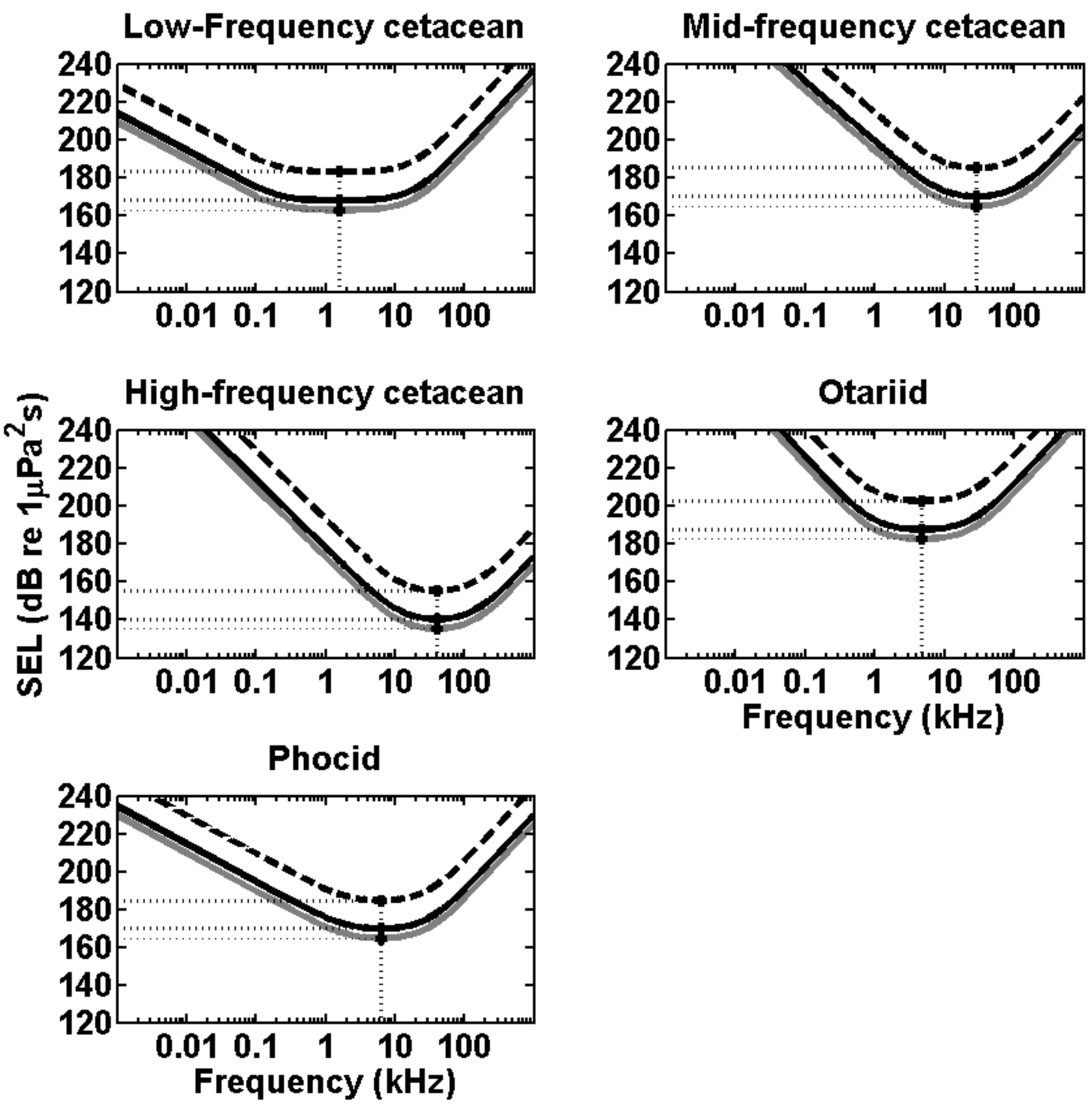
Source: See Finneran (2015) for parameters used to generate the functions and more information on weighting function derivation.

Notes: MF = mid-frequency cetacean, HF = high-frequency cetacean, LF = low-frequency cetacean, PW = phocid (in-water), and OW = otariid (in-water)

Figure 3.4-68: Navy Phase III Weighting Functions for All Species Groups

Hearing Loss from Explosives

Criteria used to define threshold shifts from explosions are derived from the two known studies designed to induce TTS in marine mammals from impulsive sources. Finneran et al. (2002) reported behaviorally measured TTS of 6 and 7 dB in a beluga exposed to single impulses from a seismic water gun and Lucke et al. (2009) reported auditory evoked potential-measured TTS of 7 to 20 dB in a harbor porpoise exposed to single impulses from a seismic air gun. Since marine mammal PTS data from impulsive noise exposures do not exist, onset-PTS levels for all groups were estimated by adding 15 dB to the threshold for non-impulsive sources. This relationship was derived by Southall et al. (2007) from impulsive noise TTS growth rates in chinchillas. These frequency dependent thresholds are depicted by the exposure functions for each group's range of best hearing (see Figure 3.4-69). Weighted sound exposure thresholds for underwater explosive sounds used in the analysis are shown in Table 3.4-73).



Notes: The dark dashed curve is the exposure function for PTS onset, the solid black curve is the exposure function for TTS onset, and the light grey curve is the exposure function for behavioral response. Small dashed lines indicate the SEL threshold for behavioral response, TTS, and PTS onset at each group's most sensitive frequency (i.e., the weighted SEL threshold).

Figure 3.4-69: Navy Phase III Behavioral, TTS and PTS Exposure Functions for Explosives

Table 3.4-73: Navy Phase III Weighted Sound Exposure Thresholds for Underwater Explosive Sounds

Hearing Group	***Explosive Sound Source***				
	Behavior (SEL) weighted (dB)	***TTS (SEL) weighted (dB)***	***TTS (Peak SPL) unweighted (dB)***	***PTS (SEL) weighted (dB)***	***PTS (Peak SPL) unweighted (dB)***
Low-frequency Cetacean (LF)	163	168	213	183	219
Mid-frequency Cetacean (MF)	165	170	224	185	230
High-frequency Cetacean (HF)	135	140	196	155	202
Otariids in water (OW)	183	188	226	203	232
Phocid seal in water (PW)	165	170	212	185	218

Notes: dB = decibels, PTS = permanent threshold shift, SEL = sound exposure level, SPL = sound pressure level, and TTS = temporary threshold shift.

Behavioral Responses from Explosives

If more than one explosive event occurs within any given 24-hour period within a training or testing activity, criteria are applied to predict the number of animals that may have a behavioral reaction. For exercises with multiple explosions, the behavioral threshold used in this analysis is 5 dB less than the TTS onset threshold (in SEL). This value is derived from observed onsets of behavioral response by test subjects (bottlenose dolphins) during non-impulsive TTS testing (Schlundt et al., 2000).

Some multiple explosive exercises, such as certain naval gunnery exercises, may be treated as a single event because a few explosions occur closely spaced within a very short time (a few seconds). For single explosions at received sound levels below hearing loss thresholds, the most likely behavioral response is a brief alerting or orienting response. Since no further sounds follow the initial brief impulses, significant behavioral reactions would not be expected to occur. This reasoning was applied to previous shock trials (63 FR 230; 66 FR 87; 73 FR 143) and is extended to the criteria used in this analysis.

Accounting for Mitigation

The Navy will implement mitigation measures to avoid or reduce potential impacts from explosives on marine mammals, 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 marine mammal is observed in a mitigation zone. The mitigation zones for explosives extend beyond the respective average ranges to mortality. Therefore, the impact analysis quantifies the potential for procedural 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., an explosive activity) 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, 2018b).

In the quantitative analysis, consideration of mitigation measures means that, for activities that implement mitigation, model-estimated mortality is considered mitigated to the level of injury. The impact analysis does not analyze the potential for mitigation to reduce non-auditory injury, PTS, TTS, or behavioral effects, even though mitigation would 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 ranges to mortality was estimated for each training or testing event. The ability of Navy Lookouts to detect marine mammals within a mitigation zone is dependent on the animal's presence at the surface and the characteristics of the animal that influence its sightability (such as group size or surface active behavior). The behaviors and characteristics of some species may make them easier to detect. Certain behaviors, such as leaping and breaching, are visible from a great distance and likely increase sighting distances and detections of those species. Environmental conditions under which the training or testing activity could take place are also considered, such as sea surface conditions, weather (e.g., fog or rain), and day versus night.

The Navy will also implement mitigation measures for certain explosive activities within mitigation areas, as described in Appendix K (Geographic Mitigation Assessment). The benefits of mitigation areas are discussed qualitatively and have not been factored into the quantitative analysis process or reductions in take for the MMPA and ESA impact estimates. Mitigation areas are designed to help avoid or reduce impacts during biologically important life processes within particularly important habitat areas. Therefore, mitigation area benefits are discussed in terms of the context of impact avoidance or reduction.

3.4.2.2.2.2 Impact Ranges for 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 3.4.2.2.2.1, Methods for Analyzing Impacts from Explosives). The range to effects are shown for a range of explosive bins, from E1 (up to 0.25 lb. net explosive weight) to E11 (greater than 500 lb. to 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 behavioral response, TTS, PTS, and non-auditory injury. 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 likely be mitigated within applicable mitigation zones.

Table 3.4-74 shows the minimum, average, and maximum ranges due to varying propagation conditions to non-auditory injury as a function of animal mass and explosive bin. Ranges to gastrointestinal tract injury typically exceed ranges to slight lung injury; therefore, the maximum range to effect is not mass-dependent. 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 3.4-75.

The following tables (Table 3.4-76 through Table 3.4-85) show the minimum, average, and maximum ranges to onset of auditory and behavioral effects based on the thresholds described in Section 3.4.2.2.2.1 (Methods for Analyzing Impacts from Explosives) 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, 2018b).

Table 3.4-74: Ranges to Non-Auditory Injury (in meters) for All Marine Mammal Hearing Groups

Bin	*Range to Non-Auditory Injury (meters)* [1]
E1	12 (11–13)
E2	16 (15–16)
E3	25 (25–45)
E4	31 (23–50)
E5	40 (40–40)
E7	104 (80–190)
E8	149 (130–210)
E10	153 (100–400)
E11	419 (350–725)

[1] Average distance is shown with the minimum and maximum distances due to varying propagation environments in parentheses.
Notes: Modeled ranges based on peak pressure for a single explosion generally exceed the modeled ranges based on impulse (related to animal mass and depth).

Table 3.4-75: Ranges to Mortality (in meters) for All Marine Mammal Hearing Groups as a Function of Animal Mass

Bin	*Range to Mortality (meters) for Various Animal Mass Intervals (kg)*[1]					
	10 kg	***250 kg***	***1,000 kg***	***5,000 kg***	***25,000 kg***	***72,000 kg***
E1	3 (2–3)	1 (0–3)	0 (0 –0)	0 (0 –0)	0 (0–0)	0 (0–0)
E2	4 (3–5)	2 (1–3)	1 (0–1)	0 (0–0)	0 (0–0)	0 (0–0)
E3	10 (9–20)	5 (3–20)	2 (1–5)	0 (0–3)	0 (0–1)	0 (0–1)
E4	13 (11–19)	7 (4–13)	3 (2–4)	2 (1–3)	1 (1–1)	1 (0–1)
E5	13 (11–15)	7 (4–11)	3 (3–4)	2 (1–3)	1 (1–1)	1 (0–1)
E7	49 (40–80)	27 (15–60)	13 (10–20)	9 (5–12)	4 (4–6)	3 (2–4)
E8	65 (60–75)	34 (22–55)	17 (14–20)	11 (9–13)	6 (5–6)	5 (4–5)
E10	43 (40–50)	25 (16–40)	13 (11–16)	9 (7–11)	5 (4–6)	4 (3–4)
E11	185 (90–230)	90 (30–170)	40 (30–50)	28 (23–30)	15 (13–16)	11 (9–13)

[1]Average distance to mortality (meters) is depicted above the minimum and maximum distances, which are in parentheses for each animal mass interval.
Notes: kg = kilogram

Table 3.4-76: SEL-Based Ranges to Onset PTS, Onset TTS, and Behavioral Reaction (in meters) for High-Frequency Cetaceans

Range to Effects for Explosives: High-Frequency Cetaceans[1]					
Bin	***Source Depth (meters)***	***Cluster Size***	***Range to PTS (meters)***	***Range to TTS (meters)***	***Range to Behavioral (meters)***
E1	0.1	1	361 (350–370)	1,108 (1,000–1,275)	1,515 (1,025–2,025)
		18	1,002 (925–1,025)	2,404 (1,275–4,025)	3,053 (1,275–5,025)
E2	0.1	1	439 (420–450)	1,280 (1,025–1,775)	1,729 (1,025–2,525)
		5	826 (775–875)	1,953 (1,275–3,025)	2,560 (1,275–4,275)

Table 3.4-76: SEL-Based Ranges to Onset PTS, Onset TTS, and Behavioral Reaction (in meters) for High-Frequency Cetaceans (continued)

Range to Effects for Explosives: High-Frequency Cetaceans[1]					
Bin	***Source Depth (meters)***	***Cluster Size***	***Range to PTS (meters)***	***Range to TTS (meters)***	***Range to Behavioral (meters)***
E3	10	1	1,647 (160–3,525)	2,942 (160–10,275)	3,232 (160–12,275)
		12	3,140 (160–9,525)	3,804 (160–17,525)	3,944 (160–21,775)
	18.25	1	684 (550–1,000)	2,583 (1,025–5,025)	4,217 (1,525–7,525)
		12	1,774 (1,025–3,775)	5,643 (1,775–10,025)	7,220 (2,025–13,275)
E4	10	2	1,390 (950–3,025)	5,250 (2,275–8,275)	7,004 (2,775–11,275)
	30	2	1,437 (925–2,775)	4,481 (1,525–7,775)	5,872 (2,775–10,525)
	70	2	1,304 (925–2,275)	3,845 (2,525–7,775)	5,272 (3,525–9,525)
	90	2	1,534 (900–2,525)	5,115 (2,525–7,525)	6,840 (3,275–10,275)
E5	0.1	1	940 (850–1,025)	2,159 (1,275–3,275)	2,762 (1,275–4,275)
		20	1,930 (1,275–2,775)	4,281 (1,775–6,525)	5,176 (2,025–7,775)
E7	10	1	2,536 (1,275–3,775)	6,817 (2,775–11,025)	8,963 (3,525–14,275)
	30	1	1,916 (1,025–4,275)	5,784 (2,775–10,525)	7,346 (2,775–12,025)
E8	45.75	1	1,938 (1,275–4,025)	4,919 (1,775–11,275)	5,965 (2,025–15,525)
E10	0.1	1	1,829 (1,025–2,775)	4,166 (1,775–6,025)	5,023 (2,025–7,525)
E11	91.4	1	3,245 (2,025–6,775)	6,459 (2,525–15,275)	7,632 (2,775–19,025)
	200	1	3,745 (3,025–5,025)	7,116 (4,275–11,275)	8,727 (5,025–15,025)

[1] Average distance (meters) to PTS, TTS, and behavioral thresholds are depicted above the minimum and maximum distances (due to varying propagation environments), which are in parentheses.
Notes: PTS = permanent threshold shift, SEL = sound exposure level, TTS = temporary threshold shift

Table 3.4-77: Peak Pressure Based Ranges to Onset PTS and Onset TTS (in meters) for High-Frequency Cetaceans

Range to Effects for Explosives: High-Frequency Cetaceans[1]			
Bin	***Source Depth (meters)***	***Range to PTS (meters)***	***Range to TTS (meters)***
E1	0.1	713 (625–800)	1,018 (775–1,275)
E2	0.1	833 (700–1,000)	1,151 (850–1,525)
E3	10	2,229 (160–6,025)	2,994 (160–9,775)
	18.25	2,030 (1,275–5,775)	2,982 (1,275–6,775)
E4	10	2,990 (1,275–5,775)	5,338 (2,275–10,025)
	30	2,321 (1,525–4,025)	4,064 (2,275–7,525)
	70	3,100 (1,775–4,525)	4,731 (3,525–6,525)
	90	3,046 (2,025–4,525)	4,850 (2,775–8,275)
E5	0.1	1,508 (1,000–2,275)	2,078 (1,025–3,525)
E7	10	6,747 (3,275–12,025)	10,248 (4,275–20,525)
	30	6,159 (3,025–9,275)	10,175 (4,775–17,275)
E8	45.75	4,661 (1,775–18,775)	10,961 (1,775–47,025)
E10	0.1	2,880 (1,275–4,775)	3,807 (1,775–12,775)
E11	91.4	16,639 (2,525–49,275)	39,992 (6,525–97,775)
	200	13,555 (4,275–42,775)	45,123 (39,525–88,775)

[1] Average distance (meters) is shown with the minimum and maximum distances due to varying propagation environments in parentheses.

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

Table 3.4-78: SEL-Based Ranges to Onset PTS, Onset TTS, and Behavioral Reaction (in meters) for Low-Frequency Cetaceans

Range to Effects for Explosives: Low-Frequency Cetaceans[1]					
Bin	***Source Depth (meters)***	***Cluster Size***	***Range to PTS (meters)***	***Range to TTS (meters)***	***Range to Behavioral (meters)***
E1	0.1	1	52 (50–55)	221 (120–250)	354 (160–420)
		18	177 (110–200)	656 (230–875)	836 (280–1,025)
E2	0.1	1	66 (55–70)	276 (140–320)	432 (180–525)
		5	128 (90–140)	512 (200–650)	735 (250–975)
E3	10	1	330 (160–550)	1,583 (160–4,025)	2,085 (160–7,525)
		12	1,177 (160–2,775)	2,546 (160–11,775)	2,954 (160–17,025)
	18.25	1	198 (180–220)	1,019 (490–2,275)	1,715 (625–4,025)
		12	646 (390–1,025)	3,723 (800–9,025)	6,399 (1,025–46,525)
E4	10	2	462 (400–600)	3,743 (2,025–7,025)	6,292 (2,525–13,275)
	30	2	527 (330–950)	3,253 (1,775–4,775)	5,540 (2,275–8,275)
	70	2	490 (380–775)	3,026 (1,525–4,775)	5,274 (2,275–7,775)
	90	2	401 (360–500)	3,041 (1,275–4,525)	5,399 (1,775–9,275)
E5	0.1	1	174 (100–260)	633 (220–850)	865 (270–1,275)
		20	550 (200–700)	1,352 (420–2,275)	2,036 (700–4,275)
E7	10	1	1,375 (875–2,525)	7,724 (3,025–15,025)	11,787 (4,525–25,275)
	30	1	1,334 (675–2,025)	7,258 (2,775–11,025)	11,644 (4,525–24,275)
E8	45.75	1	1,227 (575–2,525)	3,921 (1,025–17,275)	7,961 (1,275–48,525)
E10	0.1	1	546 (200–700)	1,522 (440–5,275)	3,234 (850–30,525)
E11	91.4	1	2,537 (950–5,525)	11,249 (1,775–50,775)	37,926 (6,025–94,775)
	200	1	2,541 (1,525–4,775)	7,407 (2,275–43,275)	42,916 (6,275–51,275)

[1] Average distance (meters) is shown with the minimum and maximum distances due to varying propagation environments in parentheses. Values depict the range produced by SEL hearing threshold criteria levels.
Notes: PTS = permanent threshold shift, SEL = sound exposure level, TTS = temporary threshold shift

Table 3.4-79: Peak Pressure Based Ranges to Onset PTS and Onset TTS (in meters) for Low-Frequency Cetaceans

Range to Effects for Explosives: Low-Frequency Cetaceans[1]			
Bin	***Source Depth (meters)***	***Range to PTS (meters)***	***Range to TTS (meters)***
E1	0.1	133 (90–150)	234 (110–270)
E2	0.1	165 (100–180)	288 (120–340)
E3	10	450 (160–1,000)	907 (160–3,275)
	18.25	355 (260–825)	664 (390–1,775)
E4	10	402 (370–430)	833 (650–1,275)
	30	582 (300–975)	938 (470–2,025)
	70	571 (370–1,275)	891 (550–1,775)
	90	437 (370–750)	933 (650–1,525)
E5	0.1	410 (150–500)	683 (210–900)
E7	10	1,121 (750–2,025)	2,248 (1,025–4,775)
	30	1,307 (525–2,275)	1,829 (775–3,775)
E8	45.75	1,486 (575–3,525)	2,130 (800–5,775)
E10	0.1	925 (280–1,275)	1,243 (350–1,775)
E11	91.4	2,845 (950–7,525)	3,662 (1,025–9,025)
	200	3,284 (1,525–6,025)	4,586 (1,775–8,275)

[1] Average distance (meters) is shown with the minimum and maximum distances due to varying propagation environments in parentheses.

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

Table 3.4-80: SEL-Based Ranges to Onset PTS, Onset TTS, and Behavioral Reaction (in meters) for Mid-Frequency Cetaceans

Range to Effects for Explosives: Mid-Frequency Cetaceans[1]					
Bin	***Source Depth (meters)***	***Cluster Size***	***Range to PTS (meters)***	***Range to TTS (meters)***	***Range to Behavioral (meters)***
E1	0.1	1	25 (25–25)	118 (110–120)	203 (190–210)
		18	96 (90–100)	430 (410–440)	676 (600–700)
E2	0.1	1	30 (30–30)	146 (140–150)	246 (230–250)
		5	64 (60–65)	298 (290–300)	493 (470–500)
E3	10	1	61 (50–100)	512 (160–750)	928 (160–2,025)
		12	300 (160–625)	1,604 (160–3,525)	2,085 (160–5,525)
	18.25	1	40 (35–40)	199 (180–280)	368 (310–800)
		12	127 (120–130)	709 (575–1,000)	1,122 (875–2,525)
E4	10	2	73 (70–75)	445 (400–575)	765 (600–1,275)
	30	2	71 (65–90)	554 (320–1,025)	850 (525–1,775)
	70	2	63 (60–85)	382 (320–675)	815 (525–1,275)
	90	2	59 (55–85)	411 (310–900)	870 (525–1,275)
E5	0.1	1	79 (75–80)	360 (350–370)	575 (525–600)
		20	295 (280–300)	979 (800–1,275)	1,442 (925–1,775)
E7	10	1	121 (110–130)	742 (575–1,275)	1,272 (875–2,275)
	30	1	111 (100–130)	826 (500–1,775)	1,327 (925–2,275)
E8	45.75	1	133 (120–170)	817 (575–1,525)	1,298 (925–2,525)
E10	0.1	1	273 (260–280)	956 (775–1,025)	1,370 (900–1,775)
E11	91.4	1	242 (220–310)	1,547 (1,025–3,025)	2,387 (1,275–4,025)
	200	1	209 (200–300)	1,424 (1,025–2,025)	2,354 (1,525–3,775)

[1] Average distance (meters) is shown with the minimum and maximum distances due to varying propagation environments in parentheses.
Note: PTS = permanent threshold shift, SEL = sound exposure level, TTS = temporary threshold shift

Table 3.4-81: Peak Pressure Based Ranges to Onset PTS and Onset TTS (in meters) for Mid-Frequency Cetaceans

Range to Effects for Explosives: Mid-Frequency Cetaceans[1]			
Bin	***Source Depth (meters)***	***Range to PTS (meters)***	***Range to TTS (meters)***
E1	0.1	44 (40–45)	86 (80–90)
E2	0.1	59 (55–60)	106 (100–110)
E3	10	122 (100–230)	245 (160–410)
	18.25	100 (100–100)	190 (180–280)
E4	10	120 (120–120)	247 (240–260)
	30	136 (120–220)	365 (230–750)
	70	129 (120–200)	257 (230–440)
	90	126 (120–190)	247 (230–380)
E5	0.1	160 (150–170)	295 (280–300)
E7	10	309 (300–370)	592 (525–825)
	30	483 (290–850)	840 (525–1,775)
E8	45.75	561 (350–1,025)	1,056 (625–2,275)
E10	0.1	557 (490–600)	878 (625–1,025)
E11	91.4	1,187 (650–2,525)	2,272 (1,025–4,275)
	200	683 (650–950)	1,972 (1,025–4,025)

[1] Average distance (meters) is shown with the minimum and maximum distances due to varying propagation environments in parentheses.

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

Table 3.4-82: SEL Based Ranges to Onset PTS, Onset TTS, and Behavioral Reaction (in meters) for Otariids and Mustelids

Range to Effects for Explosives: Otariids and Mustelids[1]					
Bin	*Source Depth (meters)*	*Cluster Size*	Range to *PTS* *(meters)*	Range to *TTS* *(meters)*	Range to *Behavioral* *(meters)*
E1	0.1	1	7 (7–8)	34 (30–35)	58 (55–60)
		18	25 (25–25)	124 (120–130)	208 (200–210)
E2	0.1	1	9 (9–10)	43 (40–45)	72 (70–75)
		5	19 (19–20)	88 (85–90)	145 (140–150)
E3	10	1	21 (18–25)	135 (120–210)	250 (160–370)
		12	82 (75–100)	551 (160–875)	954 (160–2,025)
	18.25	1	15 (15–15)	91 (85–95)	155 (150–160)
		12	53 (50–55)	293 (260–430)	528 (420–825)
E4	10	2	30 (30–30)	175 (170–180)	312 (300–350)
	30	2	25 (25–25)	176 (160–250)	400 (290–750)
	70	2	26 (25–35)	148 (140–200)	291 (250–400)
	90	2	26 (25–35)	139 (130–190)	271 (250–360)
E5	0.1	1	25 (24–25)	111 (110–120)	188 (180–190)
		20	93 (90–95)	421 (390–440)	629 (550–725)
E7	10	1	60 (60–60)	318 (300–360)	575 (500–775)
	30	1	53 (50–65)	376 (290–700)	742 (500–1,025)
E8	45.75	1	55 (55–55)	387 (310–750)	763 (525–1,275)
E10	0.1	1	87 (85–90)	397 (370–410)	599 (525–675)
E11	91.4	1	100 (100–100)	775 (550–1,275)	1,531 (900–3,025)
	200	1	94 (90–100)	554 (525–700)	1,146 (900–1,525)

[1] Average distance (meters) is shown with the minimum and maximum distances due to varying propagation environments in parentheses.

Notes: PTS = permanent threshold shift, SEL = sound exposure level, TTS = temporary threshold shift

Table 3.4-83: Peak Pressure Based Ranges to Onset PTS and Onset TTS (in meters) for Otariids and Mustelids

Range to Effects for Explosives: Otariids and Mustelids[1]			
Bin	***Source Depth (meters)***	***Range to PTS (meters)***	***Range to TTS (meters)***
E1	0.1	37 (35–40)	69 (65–70)
E2	0.1	48 (45–50)	88 (80–90)
E3	10	99 (85–170)	197 (150–370)
	18.25	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)	913 (525–2,025)
E10	0.1	476 (450–490)	739 (600–875)
E11	91.4	934 (525–1,775)	1,912 (1,000–3,775)
	200	553 (525–800)	1,516 (1,000–3,525)

[1] Average distance (meters) is shown with the minimum and maximum distances due to varying propagation environments in parentheses.
Notes: PTS = permanent threshold shift, TTS = temporary threshold shift

Table 3.4-84: SEL-Based Ranges to Onset PTS, Onset TTS, and Behavioral Reaction (in meters) for Phocids

Range to Effects for Explosives: Phocids[1]					
Bin	*Source Depth (meters)*	*Cluster Size*	*Range to PTS (meters)*	*Range to TTS (meters)*	*Range to Behavioral (meters)*
E1	0.1	1	47 (45–50)	219 (210–230)	366 (350–370)
		18	171 (160–180)	764 (725–800)	1,088 (1,025–1,275)
E2	0.1	1	59 (55–60)	273 (260–280)	454 (440–460)
		5	118 (110–120)	547 (525–550)	881 (825–925)
E3	10	1	185 (160–260)	1,144 (160–2,775)	1,655 (160–4,525)
		12	760 (160–1,525)	2,262 (160–8,025)	2,708 (160–12,025)
	18.25	1	112 (110–120)	628 (500–950)	1,138 (875–2,525)
		12	389 (330–625)	2,248 (1,275–4,275)	4,630 (1,275–8,525)
E4	10	2	226 (220–240)	1,622 (950–3,275)	3,087 (1,775–5,775)
	30	2	276 (200–600)	1,451 (1,025–2,275)	2,611 (1,775–4,275)
	70	2	201 (180–280)	1,331 (1,025–1,775)	2,403 (1,525–3,525)
	90	2	188 (170–270)	1,389 (975–2,025)	2,617 (1,775–3,775)
E5	0.1	1	151 (140–160)	685 (650–700)	1,002 (950–1,025)
		20	563 (550–575)	1,838 (1,275–2,275)	2,588 (1,525–3,525)
E7	10	1	405 (370–490)	3,185 (1,775–6,025)	5,314 (2,275–11,025)
	30	1	517 (370–875)	2,740 (1,775–4,275)	4,685 (3,025–7,275)
E8	45.75	1	523 (390–1,025)	2,502 (1,525–6,025)	3,879 (2,025–10,275)
E10	0.1	1	522 (500–525)	1,800 (1,275–2,275)	2,470 (1,525–3,275)
E11	91.4	1	1,063 (675–2,275)	5,043 (2,775–10,525)	7,371 (3,275–18,025)
	200	1	734 (675–850)	5,266 (3,525–9,025)	7,344 (5,025–12,775)

[1] Average distance (meters) is shown with the minimum and maximum distances due to varying propagation environments in parentheses.

Notes: PTS = permanent threshold shift, SEL = sound exposure level, TTS = temporary threshold shift

Table 3.4-85: Peak Pressure Based Ranges to Onset PTS and Onset TTS (in meters) for Phocids

Range to Effects for Explosives: Phocids[1]			
Bin	***Source Depth (meters)***	***Range to PTS (meters)***	***Range to TTS (meters)***
E1	0.1	156 (140–160)	291 (270–300)
E2	0.1	198 (190–200)	366 (350–370)
E3	10	582 (160–1,775)	975 (160–2,525)
	18.25	398 (330–700)	795 (600–1,775)
E4	10	456 (430–490)	940 (750–1,775)
	30	700 (430–1,025)	1,111 (825–2,025)
	70	645 (420–1,275)	1,085 (750–1,775)
	90	557 (420–875)	1,082 (750–1,775)
E5	0.1	538 (525–550)	936 (850–1,000)
E7	10	1,241 (875–2,025)	2,571 (1,275–5,775)
	30	1,495 (900–2,275)	2,185 (1,275–3,775)
E8	45.75	1,919 (1,025–4,025)	3,206 (1,775–7,275)
E10	0.1	1,469 (1,025–1,775)	2,244 (1,275–3,025)
E11	91.4	4,277 (2,525–9,275)	6,965 (3,025–13,775)
	200	4,388 (2,775–7,025)	6,853 (4,275–12,775)

[1] Average distance (meters) is shown with the minimum and maximum distances due to varying propagation environments in parentheses.

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

3.4.2.2.2.3 Impacts from Explosives Under the Action Alternatives

The following provides a brief description of training and testing as it pertains to underwater and near-surface explosions under the action alternatives:

As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.5-1, and Section 3.0.3.2 (Explosive Stressors), training activities under Alternative 1 would use underwater detonations and explosive ordnance. Within Alternative 1, most training activities that use explosives reoccur on an annual basis, with some variability year-to-year. Training activities involving explosives would be concentrated in the NWTT Offshore Area. Detonations would generally occur greater than 50 NM from shore, with the exception of a very small amount of mine neutralization training activities that would occur in existing mine warfare areas in Inland Waters (i.e., Crescent Harbor and Hood Canal Explosive Ordnance Disposal Training Ranges).

As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.5-2 and Table 2.5-3, and Section 3.0.3.2 (Explosive Stressors), testing activities under Alternative 1 would use underwater detonations and explosive ordnance. Within Alternative 1, most testing activities that use explosives reoccur on an annual basis. All testing involving explosives will occur in the Offshore Area, and with the exception of mine countermeasure and neutralization testing (new testing activities in Phase III), will 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 in the Offshore Area. Although this activity would occur closer to shore, it would typically occur in water depths greater than 100 feet.

As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.5-1, and Section 3.0.3.2 (Explosive Stressors), training activities under Alternative 2 would use underwater detonations and explosive ordnance. Within Alternative 2, most training activities that use explosives reoccur on an annual basis, with the same number of exercises planned each year. Training activities involving explosives would be concentrated in the NWTT Offshore Area. Detonations would generally occur greater than 50 NM from shore, with the exception of a very small amount of mine neutralization training activities that would occur in existing mine warfare areas in Inland Waters (i.e., Crescent Harbor and Hood Canal Explosive Ordnance Disposal Training Ranges).

As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.5-2 and Table 2.5-3, and Section 3.0.3.2 (Explosive Stressors), testing activities with explosives is identical under Alternative 1 and Alternative 2; therefore, the locations, types, and severity of predicted impacts would be the same.

Presentation of Estimated Impacts from the Quantitative Analysis

The results of the analysis of potential impacts on marine mammals from explosives (see above Section 3.4.2.2.2.1, Methods for Analyzing Impacts from Explosives) are discussed below. The numbers of potential impacts estimated for individual species of marine mammals from exposure to explosive energy and sound for training activities under Alternative 1 and 2 are shown in Appendix E (Estimated Marine Mammal and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities). Additionally, estimated numbers of potential impacts from the quantitative analysis for each species are presented below (e.g., Figure 3.4-70). The most likely regions and activity categories from which the impacts could occur are displayed in the impact graphics for each species. There is a potential for impacts to occur anywhere within the Study Area where sound and energy from explosives and the species overlap, although only regions or activity categories where 0.5 percent of the impacts, or greater, are estimated to occur are graphically represented on the impact graphics below. All (i.e., grand total) estimated impacts are also included, regardless of region or category.

Regions within the NWTT Study Area include (see Study Area maps in Chapter 2, Description of Proposed Action and Alternatives) Offshore Area, Inland Waters, and Western Behm Canal, Alaska.

The numbers of activities planned under Alternative 1 can vary slightly from year-to-year. Alternative 1 results are presented for a maximum explosive use year; however, during most years, explosive use would be less resulting in fewer potential impacts. The numbers of activities planned under Alternative 2 are consistent from year-to-year. The numbers of explosives used under each alternative are described in Section 3.0.3.2 (Explosive Stressors).

Mysticetes

Mysticetes may be exposed to sound and energy from explosions associated with training and testing activities throughout the year. Explosions produce sounds that are within the hearing range of mysticetes (see Section 3.4.1.6, Hearing and Vocalization). Potential impacts from explosive energy and sound include non-auditory injury, behavioral reactions, physiological stress, masking, and hearing loss. The quantitative analysis estimates TTS and PTS in mysticetes. Impact ranges for mysticetes exposed to explosive sound and energy are discussed under low-frequency cetaceans in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Mysticetes that do experience threshold shift from explosive sounds may have reduced ability to detect biologically important sounds (e.g., social vocalizations) until their hearing recovers. Recovery from threshold shift begins almost immediately after the noise exposure ceases and can take a few minutes to a few days, depending on the severity of the initial shift, to recover. TTS would recover fully and PTS would leave some residual hearing loss. Threshold shifts do not necessarily affect all hearing frequencies equally, and typically manifest themselves at the exposure frequency or within an octave above the exposure frequency. Noise from explosions is broadband with most energy below a few hundred Hertz; therefore, any hearing loss from exposure to explosive sounds is likely to be broadband with effects predominantly at lower frequencies. During the short period that a mysticete had TTS, or permanently for PTS, social calls from conspecifics could be more difficult to detect or interpret, the ability to detect predators may be reduced, and the ability to detect and avoid sounds from approaching vessels or other stressors might be reduced. It is unclear how or if mysticetes use sound for finding prey or feeding; therefore, it is unknown whether a TTS would affect a mysticete's ability to locate prey or rate of feeding.

Research and observations of auditory masking in marine mammals due to impulsive sounds are discussed in Section 3.4.2.2.1.4 (Masking). Explosions introduce low-frequency, broadband sounds into the environment, which could mask hearing thresholds in mysticetes that are nearby, although sounds from explosions last for only a few seconds at most. Masking due to time-isolated detonations would not be significant. Activities that have multiple detonations such as some naval gunfire exercises could create some masking for mysticetes in the area over the short duration of the event. Potential costs to mysticetes from masking are similar to those discussed above for TTS, with the primary difference being that the effects of masking are only present when the sound from the explosion is present within the water and the effect is over the moment the sound has ceased.

Research and observations (see Behavioral Responses from Explosives) show that if mysticetes are exposed to impulsive sounds such as those from explosives, they may react in a variety of ways, which may include alerting, startling, breaking off feeding dives and surfacing, diving or swimming away, changing vocalization, or showing no response at all. Overall, mysticetes have been observed to be more reactive to acoustic disturbance when a noise sources is located directly on their migration route. Mysticetes disturbed while migrating could pause their migration or route around the disturbance. Animals disturbed while engaged in other activities such as feeding or reproductive behaviors may be more likely to ignore or tolerate the disturbance and continue their natural behavior patterns. Because noise from most activities using explosives is short-term and intermittent, and because detonations usually occur within a small area, behavioral reactions from mysticetes are likely to be short-term and low to moderate severity, although there are no estimated behavioral impacts to mysticetes.

Physiological stress could be caused by injury or hearing loss and could accompany any behavioral reaction as well. Research and observations of physiological stress in marine mammals are discussed in

Section 3.4.2.2.1.3 (Physiological Stress). Due to the short-term and intermittent use of explosives, physiological stress is also likely to be short-term and intermittent. Long-term consequences from physiological stress due to the sound of explosives would not be expected.

North Pacific Right Whales (Endangered Species Act-Listed)

North Pacific right whales are extremely rare in the Study Area. Data on right whale presence is insufficient to develop density estimates for use in the Navy Acoustic Effects Model for estimating the number of animals that may be exposed to explosives. Based on the highly unlikely presence of North Pacific right whales in the offshore portion of the Study Area and no records of occurrence in the inland waters or Behm Canal portions of the Study Area, in addition to the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), exposure of any North Pacific right whales to explosives associated with training activities is highly unlikely.

Impacts from Explosives Under Alternative 1 for Training Activities

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of North Pacific right whales.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 1 may affect ESA-listed North Pacific right whales. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

Impacts from Explosives Under Alternative 1 for Testing Activities

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 would not result in the incidental taking of North Pacific right whales.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 1 may affect ESA-listed North Pacific right whales. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

Impacts from Explosives Under Alternative 2 for Training Activities

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 would not result in the incidental taking of North Pacific right whales.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 2 may affect ESA-listed North Pacific right whales.

Impacts from Explosives Under Alternative 2 for Testing Activities

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 would not result in the incidental taking of North Pacific right whales.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 2 may affect ESA-listed North Pacific right whales.

Blue Whales (Endangered Species Act-Listed)

Impacts from Explosives Under Alternative 1 for Training Activities

Blue whales may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosives per year under

Alternative 1, estimates no impacts for training activities. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of blue whales.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 1 may affect ESA-listed blue whales. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

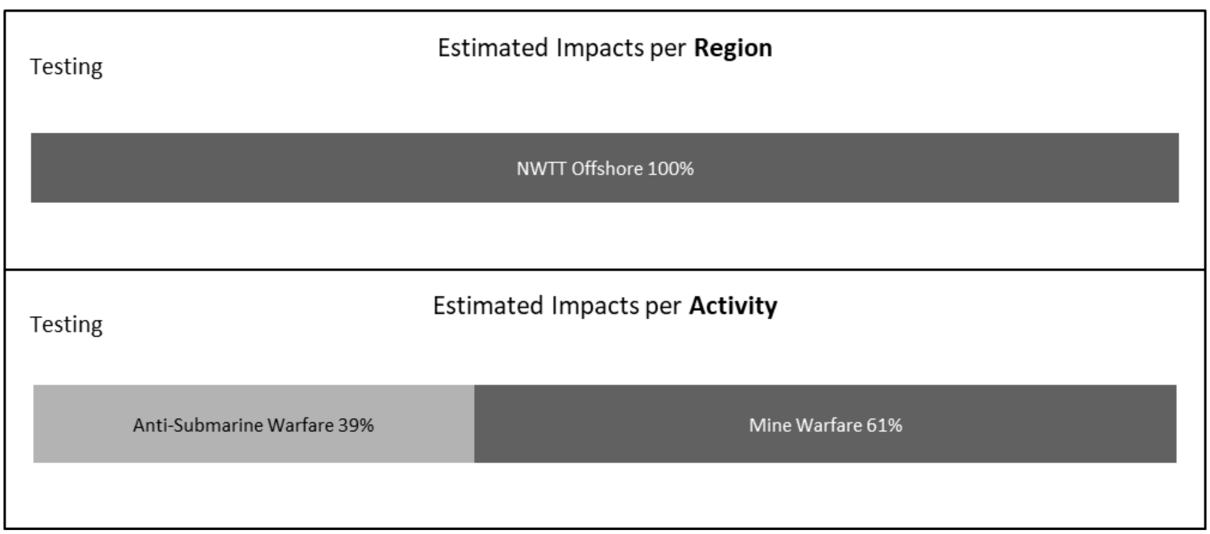
Impacts from Explosives Under Alternative 1 for Testing Activities

Blue whales may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosives per year under Alternative 1, estimates behavioral reactions (see Figure 3.4-70 and Table 3.4-86). Impact ranges for this species are discussed in Section 3.4.2.2.2.2, Impact Ranges for Explosives. Estimated impacts apply to the Eastern North Pacific stock (see Table 3.4-86).

As described for mysticetes above, even a few minor to moderate behavioral impacts to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 will result in the unintentional taking of blue whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 1 may affect ESA-listed blue whales. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.



Notes: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent. Estimated impacts most years would be less based on fewer explosions.

Figure 3.4-70: Blue Whale Impacts Estimated per Year from the Maximum Number of Explosions During Testing Under Alternative 1 and Alternative 2

Table 3.4-86: Estimated Impacts on Individual Blue Whale Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1 and Alternative 2

Estimated Impacts by Effect								
Stock	***Training***				***Testing***			
	Behavioral	***TTS***	***PTS***	***Injury***	***Behavioral***	***TTS***	***PTS***	***Injury***
Eastern North Pacific	0	0	0	0	1	0	0	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1 and Alternative 2.

Impacts from Explosives Under Alternative 2 for Training Activities

Potential annual impacts under Alternative 2 from training with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Training Activities. The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 would not result in the incidental taking of blue whales.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 2 may affect ESA-listed blue whales.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities (see Table 3.4-86).

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of blue whales incidental to those activities.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 2 may affect ESA-listed blue whales.

Fin Whales (Endangered Species Act-Listed)

Impacts from Explosives Under Alternative 1 for Training Activities

Fin whales may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for training activities. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of fin whales.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 1 may affect ESA-listed fin whales. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

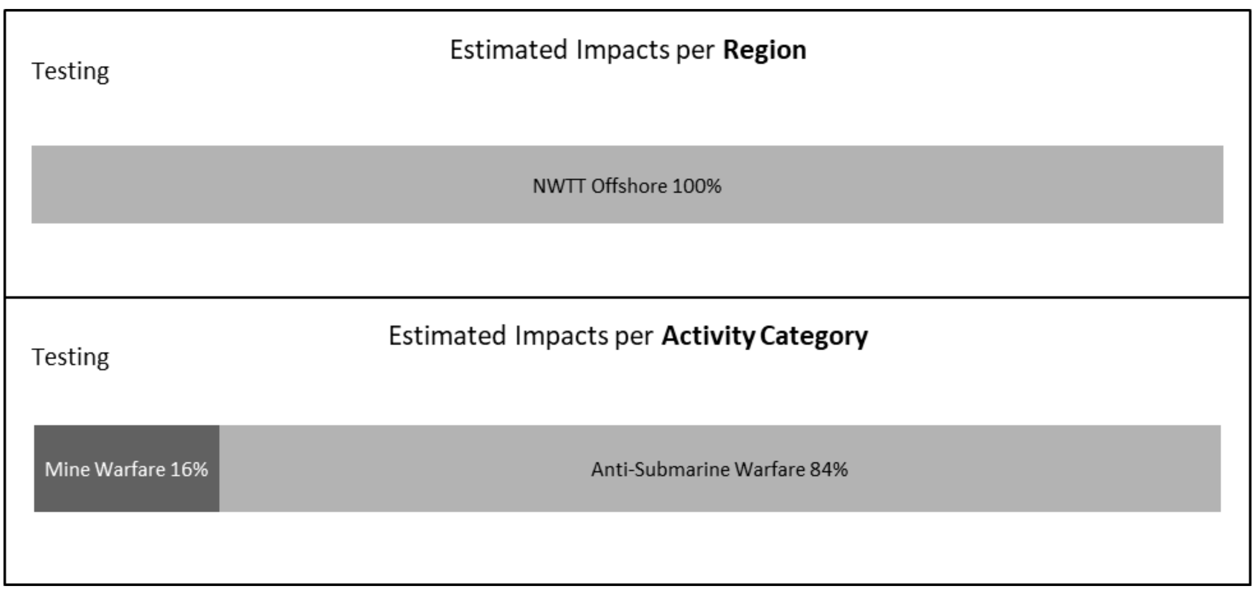
Impacts from Explosives Under Alternative 1 for Testing Activities

Fin whales may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates behavioral reactions and TTS (see Figure 3.4-71 and Table 3.4-87). Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives). Estimated impacts apply to California, Oregon, and Washington stock (see Table 3.4-87).

As described for mysticetes above, even a few minor to moderate behavioral responses or TTS to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 will result in the unintentional taking of fin whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 1 may affect ESA-listed fin whales. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.



Notes: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent. Estimated impacts most years would be less based on fewer explosions.

Figure 3.4-71: Fin Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing Under Alternative 1 and Alternative 2

Table 3.4-87: Estimated Impacts on Individual Fin Whale Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1 and Alternative 2

Estimated Impacts by Effect								
Stock	***Training***				***Testing***			
	Behavioral	***TTS***	***PTS***	***Injury***	***Behavioral***	***TTS***	***PTS***	***Injury***
California, Oregon, & Washington	0	0	0	0	6	2	0	0
Northeast Pacific	0	0	0	0	0	0	0	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1 and Alternative 2.

Impacts from Explosives Under Alternative 2 for Training Activities

Potential annual impacts under Alternative 2 from training with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Training Activities. The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 would not result in the incidental taking of fin whales.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 2 may affect ESA-listed fin whales.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities (see Figure 3.4-71 and Table 3.4-87).

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of fin whales incidental to those activities.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 2 may affect ESA-listed fin whales.

Sei Whales (Endangered Species Act-Listed)

Impacts from Explosives Under Alternative 1 for Training Activities

Sei whales may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for training. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of sei whales.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 1 may affect ESA-listed sei whales. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

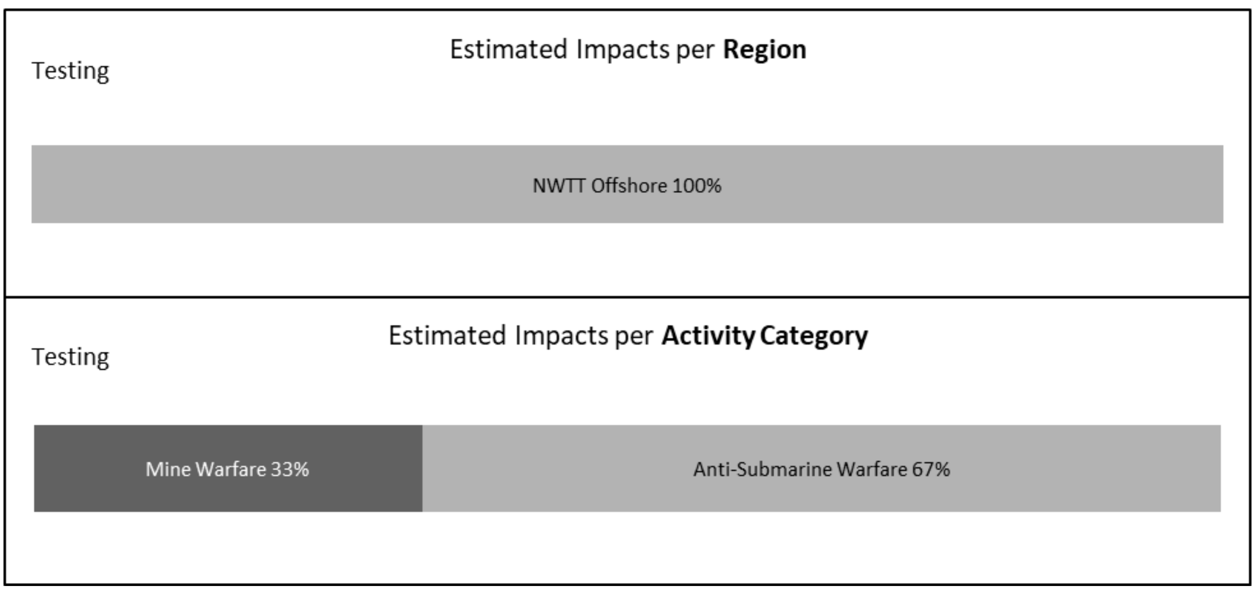
Impacts from Explosives Under Alternative 1 for Testing Activities

Sei whales may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates behavioral reactions and TTS (see Figure 3.4-72 and Table 3.4-88)). Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives). Estimated impacts apply to the Eastern North Pacific stock (see Table 3.4-88).

As described for mysticetes above, even a few minor to moderate behavioral responses or TTS to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 will result in the unintentional taking of sei whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 1 may affect ESA-listed sei whales. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.



Notes: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent. Estimated impacts most years would be less based on fewer explosions.

Figure 3.4-72: Sei Whale Impacts Estimated per Year from the Maximum Number of Explosions During Testing Under Alternative 1 and Alternative 2

Table 3.4-88: Estimated Impacts on Individual Sei Whale Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1 and Alternative 2

Estimated Impacts by Effect								
Stock	***Training***				***Testing***			
	Behavioral	***TTS***	***PTS***	***Injury***	***Behavioral***	***TTS***	***PTS***	***Injury***
Eastern North Pacific	0	0	0	0	1	1	0	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1 and Alternative 2.

Impacts from Explosives Under Alternative 2 for Training Activities

Potential annual impacts under Alternative 2 from training with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Training Activities. The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 would not result in the incidental taking of sei whales.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 2 may affect ESA-listed sei whales.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities (see Figure 3.4-72 and Table 3.4-88).

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of sei whales incidental to those activities.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 2 may affect ESA-listed sei whales.

Minke Whales

Impacts from Explosives Under Alternative 1 for Training Activities

Minke whales may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for training activities. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

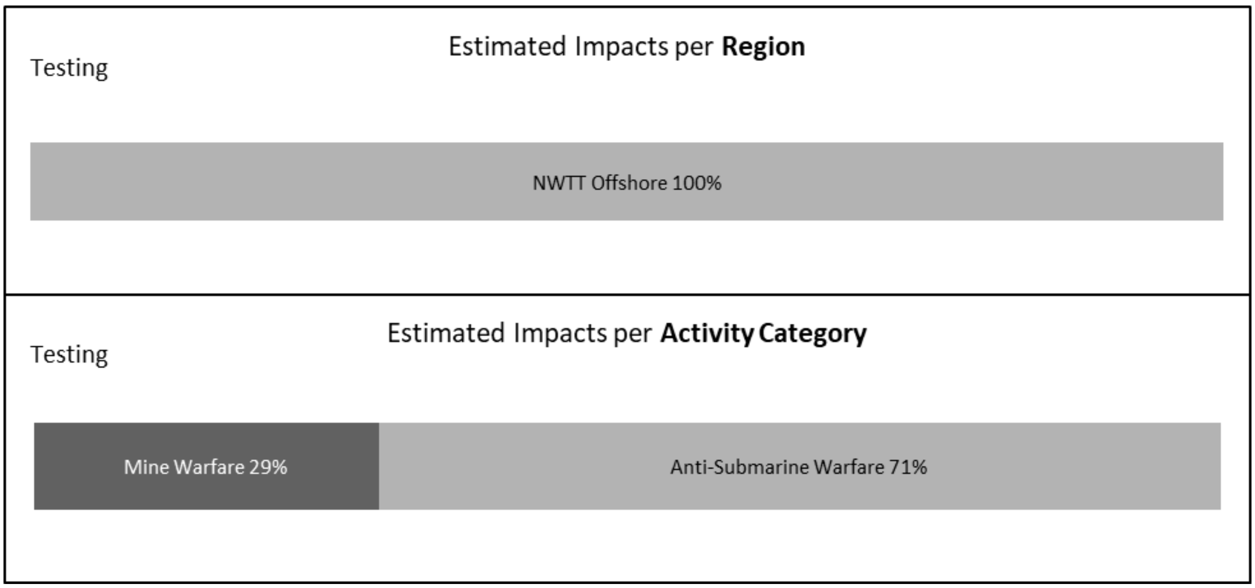
Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of minke whales.

Impacts from Explosives Under Alternative 1 for Testing Activities

Minke whales may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates behavioral reactions and TTS (see Figure 3.4-73 and Table 3.4-89). Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-89).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 will result in the unintentional taking of minke whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.



Notes: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent. Estimated impacts most years would be less based on fewer explosions.

Figure 3.4-73: Minke Whale Impacts Estimated per Year from the Maximum Number of Explosions During Testing Under Alternative 1 and Alternative 2

Table 3.4-89: Estimated Impacts on Individual Minke Whale Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1 and Alternative 2

Estimated Impacts by Effect								
Stock	***Training***				***Testing***			
	Behavioral	***TTS***	***PTS***	***Injury***	***Behavioral***	***TTS***	***PTS***	***Injury***
Alaska	0	0	0	0	0	0	0	0
California, Oregon, & Washington	0	0	0	0	4	2	0	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1 and Alternative 2.

Impacts from Explosives Under Alternative 2 for Training Activities

Potential annual impacts under Alternative 2 from training with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Training Activities. The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 would not result in the incidental taking of minke whales.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities (see Figure 3.4-73 and Table 3.4-89).

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of minke whales incidental to those activities.

Humpback Whales (some DPSs are Endangered Species Act-Listed)

Impacts have been modeled for the Hawaii (Central North Pacific stock) population of humpback whales, which are not ESA-Listed, and for the Mexico (California, Oregon, and Washington stock), and Central America (California, Oregon, and Washington stock populations of humpback whales, which are ESA listed. Western North Pacific DPS/stock humpback whales are not likely to be present in the NWTT Study Area during or in proximity to any of the proposed training or testing activities.

Impacts from Explosives Under Alternative 1 for Training Activities

Humpback whales may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for training activities. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of humpback whales.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 1 may affect ESA-listed humpback whales. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

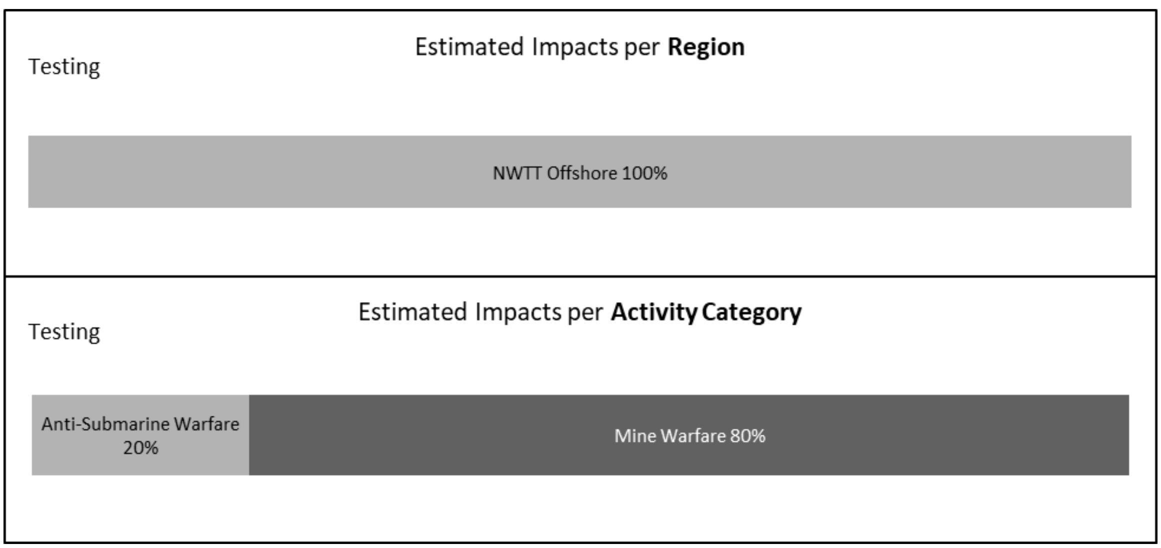
Impacts from Explosives Under Alternative 1 for Testing Activities

Humpback whales may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates behavioral reactions and TTS (see Figure 3.4-74 and Table 3.4-90). Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-90).

As described for mysticetes above, even a few minor to moderate behavioral impacts or TTS to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 will result in the unintentional taking of humpback whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 1 may affect ESA-listed humpback whales. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.



Notes: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent. Estimated impacts most years would be less based on fewer explosions.

Figure 3.4-74: Humpback Whale Impacts Estimated per Year from the Maximum Number of Explosions During Testing Under Alternative 1 and Alternative 2

Table 3.4-90: Estimated Impacts on Individual Humpback Whale Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1 and Alternative 2

Estimated Impacts by Effect								
Stock	***Training***				***Testing***			
	Behavioral	***TTS***	***PTS***	***Injury***	***Behavioral***	***TTS***	***PTS***	***Injury***
California, Oregon, & Washington	0	0	0	0	1	2	0	0
Central North Pacific	0	0	0	0	0	0	0	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1 and Alternative 2.

Impacts from Explosives Under Alternative 2 for Training Activities

Potential annual impacts under Alternative 2 from training with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Training Activities. The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 would not result in the incidental taking of humpback whales.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 2 may affect ESA-listed humpback whales.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities (see Table 3.4-90).

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of humpback whales incidental to those activities.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 2 may affect ESA-listed humpback whales.

Gray Whales (one DPS is Endangered Species Act-Listed)

The vast majority of gray whales in the study are from the non-endangered Eastern North Pacific stock, and all of the modeled impacts are attributed to this stock. On rare occasions Western North Pacific gray whales, which are Endangered Species Act-Listed, occur in the Study Area but are not included in this analysis.

Impacts from Explosives Under Alternative 1 for Training Activities

Gray whales may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for training activities. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of gray whales.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 1 would not affect ESA-listed gray whales.

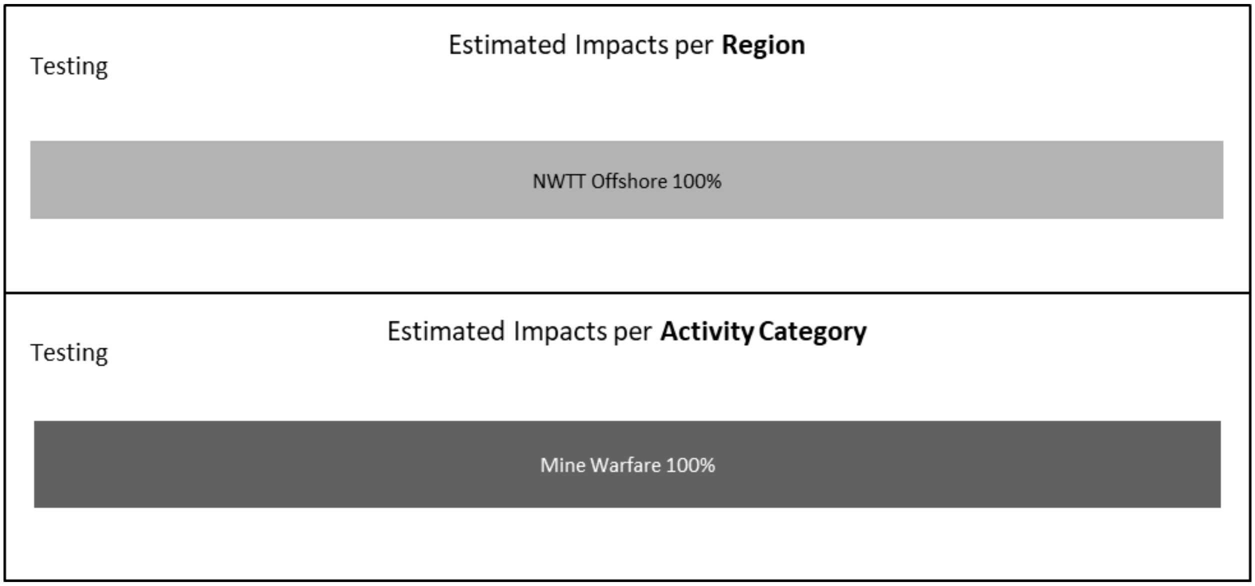
Impacts from Explosives Under Alternative 1 for Testing Activities

Gray whales may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates behavioral reactions and TTS (see Figure 3.4-75 and Table 3.4-91). Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives). Estimated impacts apply to the Eastern North Pacific stock (see Table 3.4-91).

As described for mysticetes above, even a few minor to moderate behavioral impacts or TTS to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 will result in the unintentional taking of gray whales incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 1 would not affect ESA-listed gray whales.



Notes: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent. Estimated impacts most years would be less based on fewer explosions.

Figure 3.4-75: Gray Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing Under Alternative 1 and Alternative 2

Table 3.4-91: Estimated Impacts on Individual Gray Whale Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1 and Alternative 2

Estimated Impacts by Effect								
Stock	***Training***				***Testing***			
	Behavioral	***TTS***	***PTS***	***Injury***	***Behavioral***	***TTS***	***PTS***	***Injury***
Eastern North Pacific	0	0	0	0	1	2	0	0
Western North Pacific	0	0	0	0	0	0	0	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1 and Alternative 2.

Impacts from Explosives Under Alternative 2 for Training Activities

Potential annual impacts under Alternative 2 from training with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Training Activities. The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 would not result in the incidental taking of gray whales.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 2 would not affect ESA-listed gray whales.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities (see Table 3.4-91).

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the incidental taking of gray whales.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 2 would not affect ESA-listed gray whales.

Odontocetes

Odontocetes may be exposed to sound and energy from explosives associated with training and testing activities throughout the year. Explosions produce sounds that are within the hearing range of odontocetes (see Section 3.4.1.6, Hearing and Vocalization). Potential impacts from explosive energy and sound include non-auditory injury, behavioral reactions, physiological stress, masking and hearing loss. Impact ranges for odontocetes exposed to explosive sound and energy are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives) under mid-frequency cetaceans for most species, and under high-frequency cetaceans for Kogia whales and Dall's porpoises.

Non-auditory injuries to odontocetes, if they did occur, could include anything from mild injuries that are recoverable and are unlikely to have long-term consequences, to more serious injuries, including mortality. It is possible for marine mammals to be injured or killed by an explosion in isolated instances. Animals that did sustain injury could have long-term consequences for that individual. Considering that dolphin species for which these impacts are predicted have populations with tens to hundreds of thousands of animals, removing several animals from the population would be unlikely to have measurable long-term consequences for the species or stocks. As discussed in Section 5.3.3 (Explosive Stressors), the Navy will implement procedural mitigation measures to delay or cease detonations when a marine mammal is sighted in a mitigation zone to avoid or reduce potential explosive impacts.

Odontocetes that do experience a hearing threshold shift from explosive sounds may have reduced ability to detect biologically important sounds (e.g., social vocalizations) until their hearing recovers. Recovery from a hearing threshold shift begins almost immediately after the noise exposure ceases. A threshold shift can take a few minutes to a few days, depending on the severity of the initial shift, to recover. TTS would recover fully and PTS would leave some residual hearing loss. Threshold shifts do not necessarily affect all hearing frequencies equally, and typically manifest themselves at the exposure frequency or within an octave above the exposure frequency. Noise from explosions is broadband with most energy below a few hundred Hertz; therefore, any hearing loss from exposure to explosive sounds is likely to be broadband with effects predominantly at lower frequencies. During the period that an odontocete had hearing loss, social calls from conspecifics and sounds from predators such as killer whale vocalizations could be more difficult to detect or interpret, although many of these sounds may be above the frequencies of the threshold shift. Odontocetes use echolocation clicks to find and capture prey. These echolocation clicks and vocalizations are at frequencies above a few kHz, which are less likely to be affected by threshold shift at lower frequencies, and should not affect odontocete's ability to locate prey or rate of feeding.

Research and observations of masking in marine mammals due to impulsive sounds are discussed in Section 3.4.2.2.1.4 (Masking). Explosions introduce low-frequency, broadband sounds into the environment, which could mask hearing thresholds in odontocetes that are nearby, although sounds from explosions last for only a few seconds at most. Also, odontocetes typically communicate, vocalize, and echolocate at higher frequencies that would be less affected by masking noise at lower frequencies such as those produced by an explosion. Masking due to time-isolated detonations would not be significant. Activities that have multiple detonations such as some naval gunfire exercises could create some masking for odontocetes in the area over the short duration of the event. Potential costs to odontocetes from masking are similar to those discussed above for TTS, with the primary difference being that the effects of masking are only present when the sound from the explosion is present within the water and the effect is over the moment the sound has ceased.

Research and observations (see Section 3.4.2.2.1.5, Behavioral Reactions) show that odontocetes do not typically show strong behavioral reactions to impulsive sounds such as explosions. Reactions, if they did occur, would likely be limited to short ranges, within a few kilometers of multiple explosions. Reactions could include alerting, startling, breaking off feeding dives and surfacing, diving or swimming away, change in vocalization, or showing no response at all. Animals disturbed while engaged in other activities such as feeding or reproductive behaviors may be more likely to ignore or tolerate the disturbance and continue their natural behavior patterns. Because noise from most activities using explosives is short-term and intermittent, and because detonations usually occur within a small area, behavioral reactions from odontocetes are likely to be short-term and low to moderate severity.

Physiological stress could be caused by injury or hearing loss and could accompany any behavioral reaction as well. Research and observations of physiological stress in marine mammals are discussed in Section 3.4.2.2.1.3 (Physiological Stress). Due to the short-term and intermittent use of explosives, physiological stress is also likely to be short-term and intermittent. Long-term consequences from physiological stress due to the sound of explosives would not be expected.

Common Bottlenose Dolphins

Impacts from Explosives Under Alternative 1 for Training Activities

Common bottlenose dolphins may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for training activities. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of common bottlenose dolphins.

Impacts from Explosives Under Alternative 1 for Testing Activities

Common bottlenose dolphins may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for testing activities. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 would not result in the incidental taking of common bottlenose dolphins.

Impacts from Explosives Under Alternative 2 for Training Activities

Potential annual impacts under Alternative 2 from training with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Training Activities. The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 would not result in the incidental taking of common bottlenose dolphins.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 would not result in the incidental taking of common bottlenose dolphins.

Killer Whales (one DPS is Endangered Species Act-Listed)

For the populations of killer whales present in the Study Area, only the Southern Resident population is listed as endangered under the ESA and has designated critical habitat located in the Inland Waters of the Study Area.

Impacts from Explosives Under Alternative 1 for Training Activities

Killer whales may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for training. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of killer whales.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 1 may affect ESA-listed killer whales, and may overlap Southern Resident killer whale critical habitat. The Navy will consult with NMFS as required by section 7(a)(2).

Impacts from Explosives Under Alternative 1 for Testing Activities

Killer whales may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for testing activities. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

All testing involving explosives will occur in the Offshore Area, and with the exception of mine countermeasure and neutralization testing (new testing activities in Phase III), will typically occur at distances greater than 50 NM from shore. There are no testing activities that involve the use of explosives in Inland Waters. Therefore, there would be no explosives use within or near critical habitat.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 would not result in the incidental taking of killer whales.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 1 would have no effect on Southern Resident killer whale critical habitat, but may affect ESA-listed killer whales. The Navy will consult with NMFS as required by section 7(a)(2).

Impacts from Explosives Under Alternative 2 for Training Activities

Potential annual impacts under Alternative 2 from training with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Training Activities. The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 would not result in the incidental taking of killer whales.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 2 may affect ESA-listed killer whales, but would have no effect on Southern Resident killer whale critical habitat.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 would not result in the incidental taking of killer whales.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 2 would have no effect on Southern Resident killer whale critical habitat, but may affect ESA-listed killer whales.

Northern Right Whale Dolphins

<u>Impacts from Explosives Under Alternative 1 for Training Activities</u>

Northern right whale dolphins may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for training. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

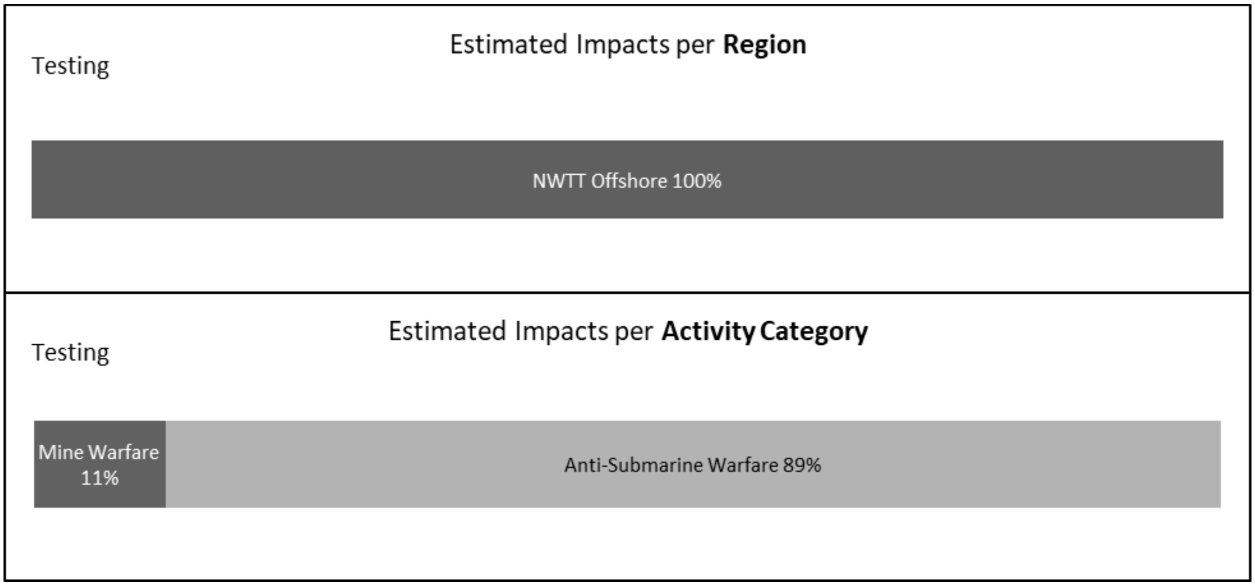
Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of Northern right whale dolphins.

<u>Impacts from Explosives Under Alternative 1 for Testing Activities</u>

Northern right whale dolphins may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates behavioral reactions and TTS (see Figure 3.4-76 and Table 3.4-92). Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-92).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 will result in the unintentional taking of Northern right whale dolphins incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.



Notes: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent. Estimated impacts most years would be less based on fewer explosions.

Figure 3.4-76: Northern Right Whale Dolphin Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing Under Alternative 1

Table 3.4-92: Estimated Impacts on Individual Northern Right Whale Dolphin Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts by Effect								
Stock	***Training***				***Testing***			
	Behavioral	***TTS***	***PTS***	***Injury***	***Behavioral***	***TTS***	***PTS***	***Injury***
California, Oregon, & Washington	0	0	0	0	1	1	0	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

Impacts from Explosives Under Alternative 2 for Training Activities

The quantitative analysis, using the maximum number of explosions per year under Alternative 2, estimates TTS (see Figure 3.4-77 and Table 3.4-93). Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-93). The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

As described for odontocetes above, even a few minor to moderate TTS to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual.

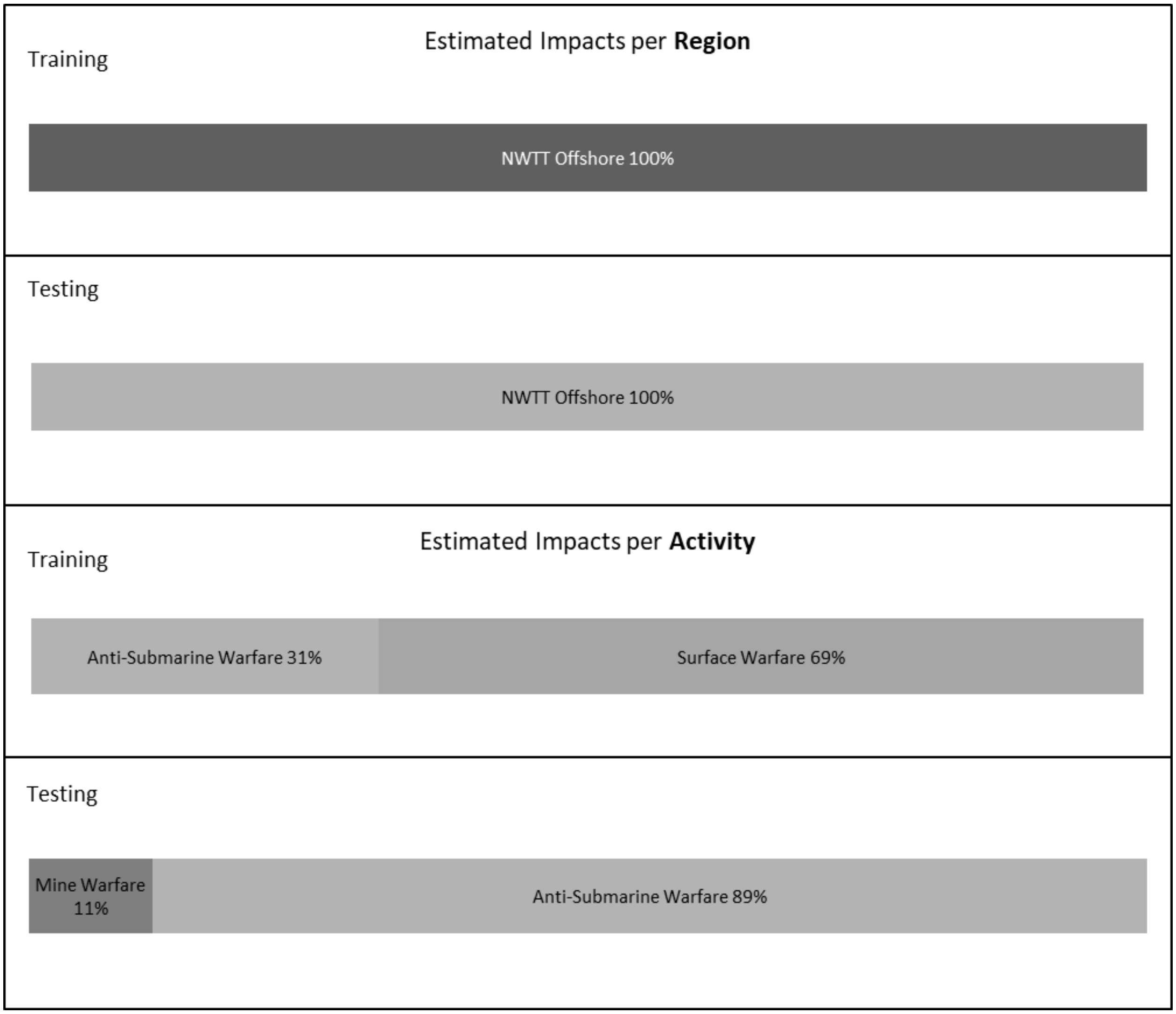
Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of Northern right whale dolphins incidental to those activities.

Impacts from Explosives Under Alternative 2 for Testing Activities

Potential annual impacts on this species under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities (see Figure 3.4-77 and Table 3.4-93). Therefore, over a multi-year period, the number of impacts for this species from testing under Alternative 2 would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of northern right whale dolphins incidental to those activities.



Notes: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent. Estimated impacts most years would be less based on fewer explosions.

Figure 3.4-77: Northern Right Whale Dolphin Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing Under Alternative 2

Table 3.4-93: Estimated Impacts on Individual Northern Right Whale Dolphin Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 2

Estimated Impacts by Effect								
Stock	***Training***				***Testing***			
	Behavioral	***TTS***	***PTS***	***Injury***	***Behavioral***	***TTS***	***PTS***	***Injury***
California, Oregon, & Washington	0	1	0	0	1	1	0	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Pacific White-Sided Dolphins

Impacts from Explosives Under Alternative 1 for Training Activities

Pacific white-sided dolphins may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts from training. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

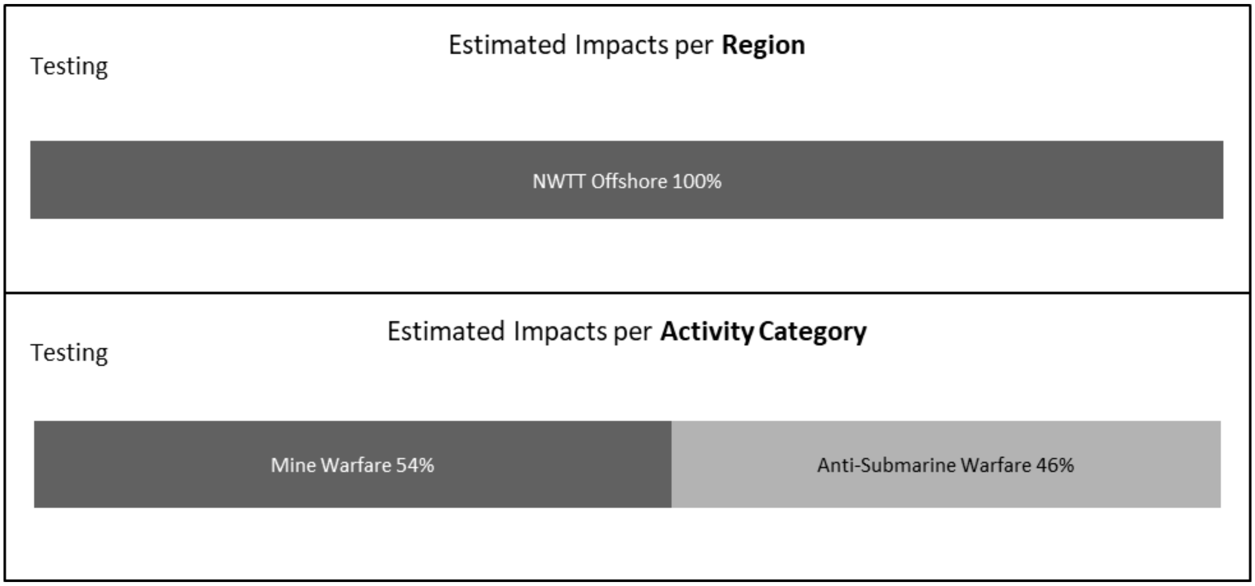
Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of Pacific white-sided dolphins.

Impacts from Explosives Under Alternative 1 for Testing Activities

Pacific white-sided dolphins may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates behavioral reactions and TTS (see Figure 3.4-78 and Table 3.4-94). Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-94).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 will result in the unintentional taking of Pacific white-sided dolphins incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.



Notes: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent. Estimated impacts most years would be less based on fewer explosions.

Figure 3.4-78: Pacific White-Sided Dolphin Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing Under Alternative 1

Table 3.4-94: Estimated Impacts to Individual Pacific White-Sided Dolphin Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts by Effect								
Stock	***Training***				***Testing***			
	Behavioral	***TTS***	***PTS***	***Injury***	***Behavioral***	***TTS***	***PTS***	***Injury***
California, Oregon, & Washington	0	0	0	0	1	1	0	0
North Pacific	0	0	0	0	0	0	0	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

Impacts from Explosives Under Alternative 2 for Training Activities

The quantitative analysis, using the maximum number of explosions per year under Alternative 2, estimates TTS (see Figure 3.4-79 and Table 3.4-95). Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-95). The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

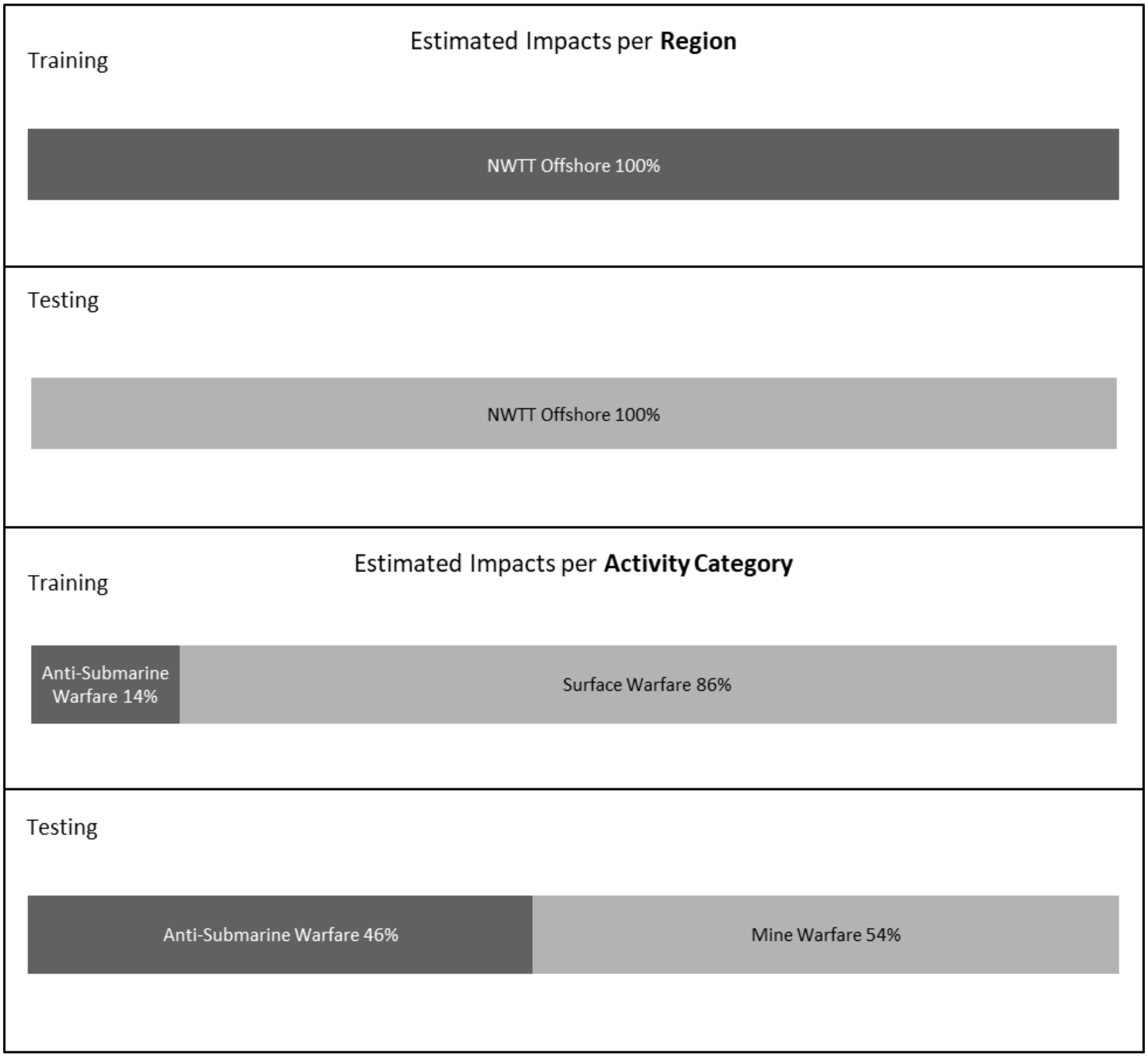
As described for odontocetes above, even a few minor to moderate TTS to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of Pacific white-sided dolphins incidental to those activities.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities (see Figure 3.4-79 and Table 3.4-95).

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of Pacific white-sided dolphins incidental to those activities.



Notes: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent. Estimated impacts most years would be less based on fewer explosions.

Figure 3.4-79: Pacific White-Sided Dolphin Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing Under Alternative 2

Table 3.4-95: Estimated Impacts to Individual Pacific White-Sided Dolphin Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 2

Estimated Impacts by Effect								
Stock	***Training***				***Testing***			
	Behavioral	***TTS***	***PTS***	***Injury***	***Behavioral***	***TTS***	***PTS***	***Injury***
California, Oregon, & Washington	0	1	0	0	1	1	0	0
North Pacific	0	0	0	0	0	0	0	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Risso's Dolphins

Impacts from Explosives Under Alternative 1 for Training Activities

Risso's dolphins may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for training activities. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of Risso's dolphins.

Impacts from Explosives Under Alternative 1 for Testing Activities

Risso's dolphins may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for testing activities. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 would not result in the incidental taking of Risso's dolphins.

Impacts from Explosives Under Alternative 2 for Training Activities

Potential annual impacts under Alternative 2 from training with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Training Activities. The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 would not result in the incidental taking of Risso's dolphins.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 would not result in the incidental taking of Risso's dolphins.

Short-Beaked Common Dolphin

Impacts from Explosives Under Alternative 1 for Training Activities

Short-beaked common dolphins may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for training activities. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of short-beaked common dolphins.

Impacts from Explosives Under Alternative 1 for Testing Activities

Short-beaked common dolphins may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for testing. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 would not result in the incidental taking of short-beaked common dolphins.

Impacts from Explosives Under Alternative 2 for Training Activities

Potential annual impacts under Alternative 2 from training with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Training Activities. The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 would not result in the incidental taking of short-beaked common.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 would not result in the incidental taking of short-beaked common dolphins.

Short-Finned Pilot Whales

Impacts from Explosives Under Alternative 1 for Training Activities

Short-finned pilot whales may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for training activities. Impact ranges for these species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of short-finned pilot whales.

Impacts from Explosives Under Alternative 1 for Testing Activities

Short-finned pilot whales may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for testing. Impact ranges for these species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 would not result in the incidental taking of short-finned pilot whales.

Impacts from Explosives Under Alternative 2 for Training Activities

Potential annual impacts under Alternative 2 from training with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Training Activities. The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 would not result in the incidental taking of short-finned pilot whales.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 would not result in the incidental taking of short-finned pilot whales.

Striped Dolphins

Impacts from Explosives Under Alternative 1 for Training Activities

Striped dolphins may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for training activities. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of striped dolphins.

Impacts from Explosives Under Alternative 1 for Testing Activities

Striped dolphins may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for testing activities. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 would not result in the incidental taking of striped dolphins.

Impacts from Explosives Under Alternative 2 for Training Activities

Potential annual impacts under Alternative 2 from training with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Training Activities. The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 would not result in the incidental taking of striped dolphins.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 would not result in the incidental taking of striped dolphins.

Kogia Whales

Kogia whales include two species that are often difficult to distinguish from one another: dwarf sperm whales and pygmy sperm whales.

TTS and PTS thresholds for high-frequency cetaceans, such as Kogia whales are lower than for all other marine mammals, which leads to a higher number of estimated hearing loss impacts relative to the number of animals exposed to the sound as compared to other hearing groups (e.g., mid-frequency cetaceans).

Impacts from Explosives Under Alternative 1 for Training Activities

Kogia whales may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for training activities. Impact ranges for these species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

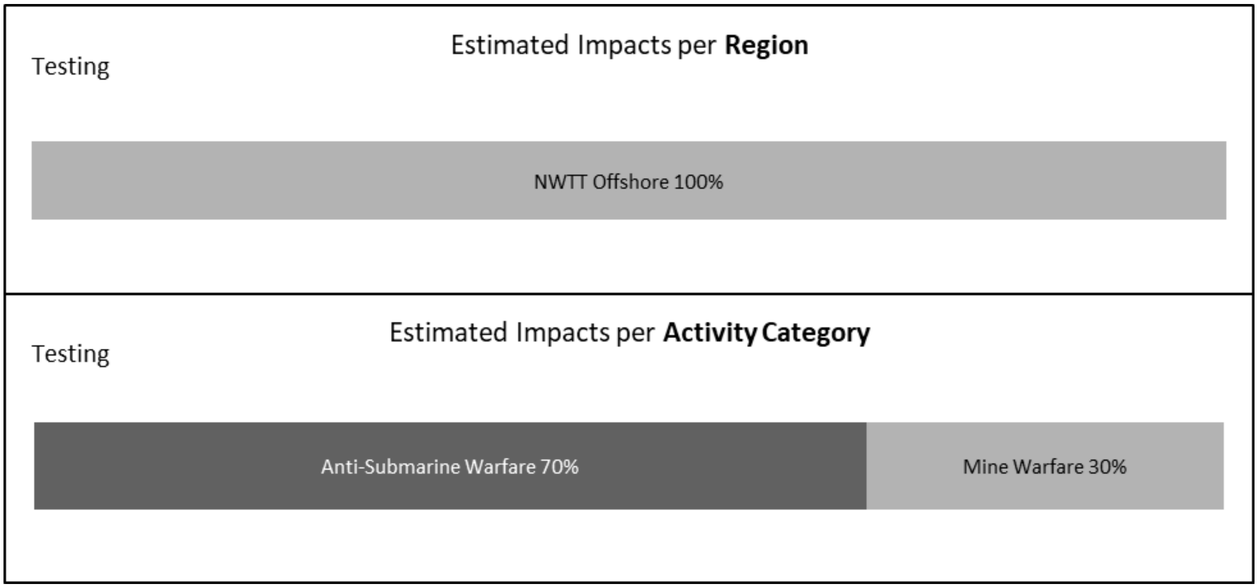
Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of Kogia whales (dwarf and pygmy sperm whales).

Impacts from Explosives Under Alternative 1 for Testing Activities

Kogia whales may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts on dwarf sperm whales for training activities. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates behavioral reactions, TTS, and PTS for pygmy sperm whales (see Figure 3.4-80, Table 3.4-96, and tabular results in Appendix E, Estimated Marine Mammal and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors under Navy Training and Testing Activities). Impact ranges for these species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives). Estimated impacts to Kogia whales apply only to the California, Oregon, and Washington stocks.

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. PTS in an individual could have no to minor long-term consequences for individuals although a single minor long-term consequence for an individual is unlikely to lead to long-term consequences for a population. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 would result in the unintentional taking of Kogia whales (dwarf and pygmy sperm whales) incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.



Notes: Region and Activity bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent. Estimated impacts most years would be less based on fewer explosions.

Figure 3.4-80: Pygmy Sperm Whales Impacts Estimated per Year from the Maximum Number of Explosions During Testing Under Alternative 1

Table 3.4-96: Estimated Impacts on Individual Pygmy Sperm Whale Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Stock	Estimated Impacts by Effect							
	Training				Testing			
	Behavioral	TTS	PTS	Injury	Behavioral	TTS	PTS	Injury
California, Oregon, & Washington	0	0	0	0	1	3	1	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

<u>Impacts from Explosives Under Alternative 2 for Training Activities</u>

The quantitative analysis, using the maximum number of explosions per year under Alternative 2 for training activities, estimates no impacts on dwarf sperm whales and TTS for pygmy sperm whales (see Figure 3.4-81, Table 3.4-97, and tabular results in Appendix E, Estimated Marine Mammal and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors under Navy Training and Testing Activities). Estimated impacts most years would be less based on fewer explosions. Impact ranges for these species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives). Estimated impacts to Kogia whales apply only to the California, Oregon, and Washington stocks. The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

As described for odontocetes above, even a few minor to moderate TTS to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. PTS in an individual could have no to minor long-term consequences for individuals although a single minor long-term consequence for an individual is unlikely to lead to long-term consequences for a population. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of Kogia whales (dwarf and pygmy sperm whales) incidental to those activities.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities (see Figure 3.4-81 and Table 3.4-97).

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of Kogia whales (dwarf and pygmy sperm whales) incidental to those activities.

Notes: Region and Activity bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent. Estimated impacts most years would be less based on fewer explosions.

Figure 3.4-81: Pygmy Sperm Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing Under Alternative 2

Table 3.4-97: Estimated Impacts on Individual Pygmy Sperm Whale Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 2

Estimated Impacts by Effect								
Stock	*Training*				*Testing*			
	Behavioral	*TTS*	*PTS*	*Injury*	*Behavioral*	*TTS*	*PTS*	*Injury*
California, Oregon, & Washington	0	1	0	0	1	3	1	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Dall's Porpoises

TTS and PTS thresholds for high-frequency cetaceans, such as Dall's porpoises, are lower than for all other marine mammals, which leads to a higher number of estimated hearing loss impacts relative to the number of animals exposed to the sound as compared to other hearing groups (e.g., mid-frequency cetaceans).

Impacts from Explosives Under Alternative 1 for Training Activities

Dall's porpoises may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates behavioral reactions, TTS, and PTS (see Figure 3.4-82 and Table 3.4-98). Estimated impacts most years would be less based on fewer explosions. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives). Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-98).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. PTS in an individual could have no to minor long-term consequences for individuals although a single minor long-term consequence for an individual is unlikely to lead to long-term consequences for a population. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will result in the unintentional taking of Dall's porpoises incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Impacts from Explosives Under Alternative 1 for Testing Activities

Dall's porpoises may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates behavioral reactions, TTS, and PTS (see Figure 3.4-82 and Table 3.4-98). Impact ranges for this species are discussed in Section 3.4.2.2.2.2, Impact Ranges for Explosives. Estimated impacts apply to the California, Oregon, and Washington stock (see Table 3.4-98).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. PTS in an individual could have no to minor long-term consequences for individuals although a single minor long-term consequence for an individual is unlikely to lead to long-term consequences for a population. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 will result in the unintentional taking of Dall's porpoises incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Notes: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent. Estimated impacts most years would be less based on fewer explosions.

Figure 3.4-82: Dall's Porpoise Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing Under Alternative 1

Table 3.4-98: Estimated Impacts on Individual Dall's Porpoise Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts by Effect								
Stock	***Training***				***Testing***			
	Behavioral	***TTS***	***PTS***	***Injury***	***Behavioral***	***TTS***	***PTS***	***Injury***
Alaska	0	0	0	0	0	0	0	0
California, Oregon, & Washington	4	16	2	0	52	175	66	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

Impacts from Explosives Under Alternative 2 for Training Activities

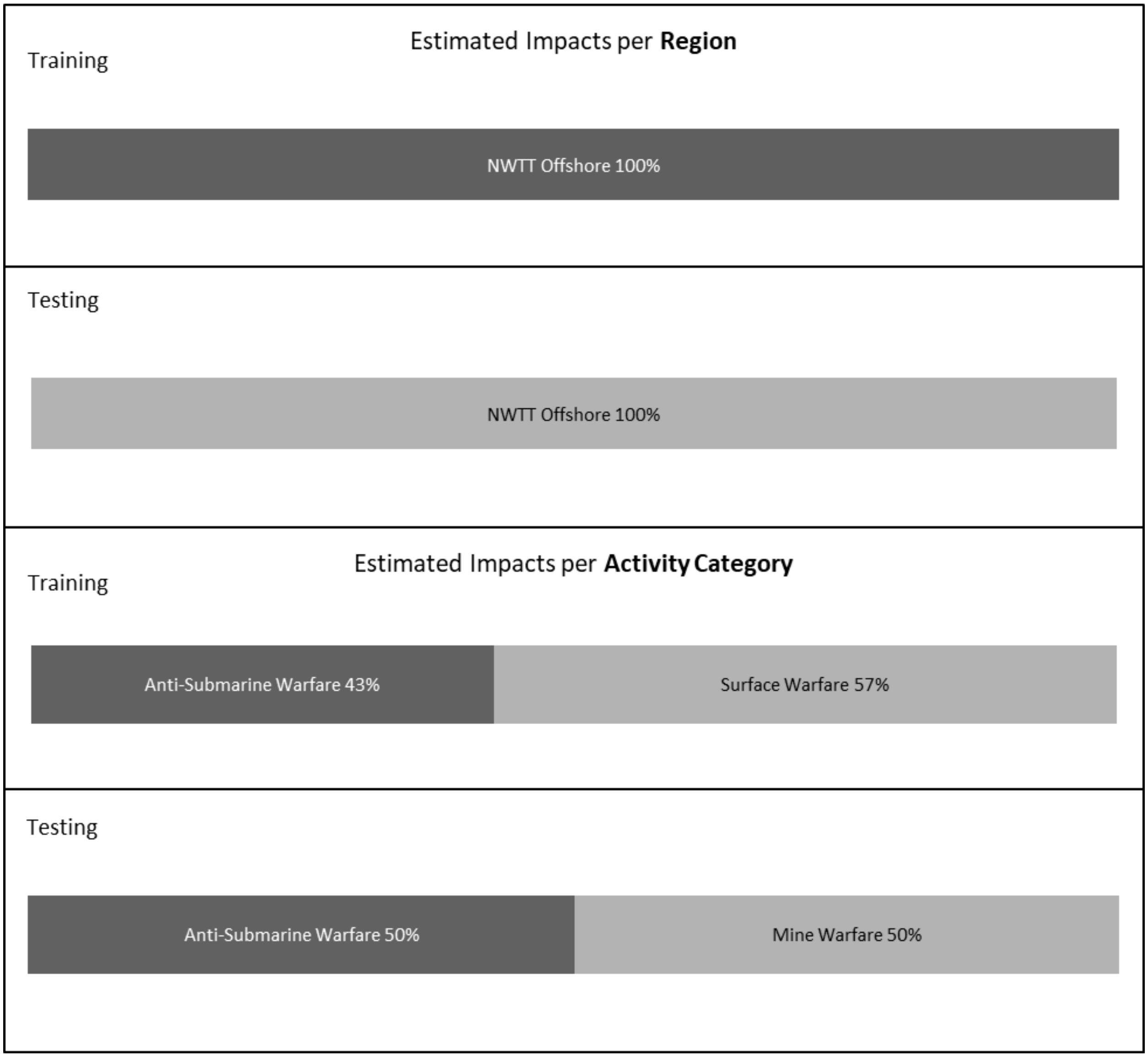
Potential annual impacts under Alternative 2 from training with explosives would be similar to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Training Activities (see Figure 3.4-83 and Table 3.4-99). The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of Dall's porpoises incidental to those activities.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities (see Figure 3.4-83 and Table 3.4-99).

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of Dall's porpoises incidental to those activities.



Notes: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent. Estimated impacts most years would be less based on fewer explosions.

Figure 3.4-83: Dall's Porpoise Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing Under Alternative 2

Table 3.4-99: Estimated Impacts on Individual Dall's Porpoise Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 2

Estimated Impacts by Effect								
Stock	***Training***				***Testing***			
	Behavioral	***TTS***	***PTS***	***Injury***	***Behavioral***	***TTS***	***PTS***	***Injury***
Alaska	0	0	0	0	0	0	0	0
California, Oregon, & Washington	4	39	6	0	52	175	66	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Harbor Porpoises

TTS and PTS thresholds for high-frequency cetaceans, such as harbor porpoises, are lower than for all other marine mammals, which leads to a higher number of estimated hearing loss impacts relative to the number of animals exposed to the sound as compared to other hearing groups (e.g., mid-frequency cetaceans).

Impacts from Explosives Under Alternative 1 for Training Activities

Harbor porpoises may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates TTS and PTS (see Figure 3.4-84 and Table 3.4-100). Estimated impacts most years would be less based on fewer explosions. Impact ranges for this species are discussed in Section 3.4.2.2.2.2, Impact Ranges for Explosives. Estimated impacts apply to the Washington Inland Waters stock (see Table 3.4-100).

As described for odontocetes above, even a few minor to moderate TTS to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. PTS in an individual could have no to minor long-term consequences for individuals although a single minor long-term consequence for an individual is unlikely to lead to long-term consequences for a population. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

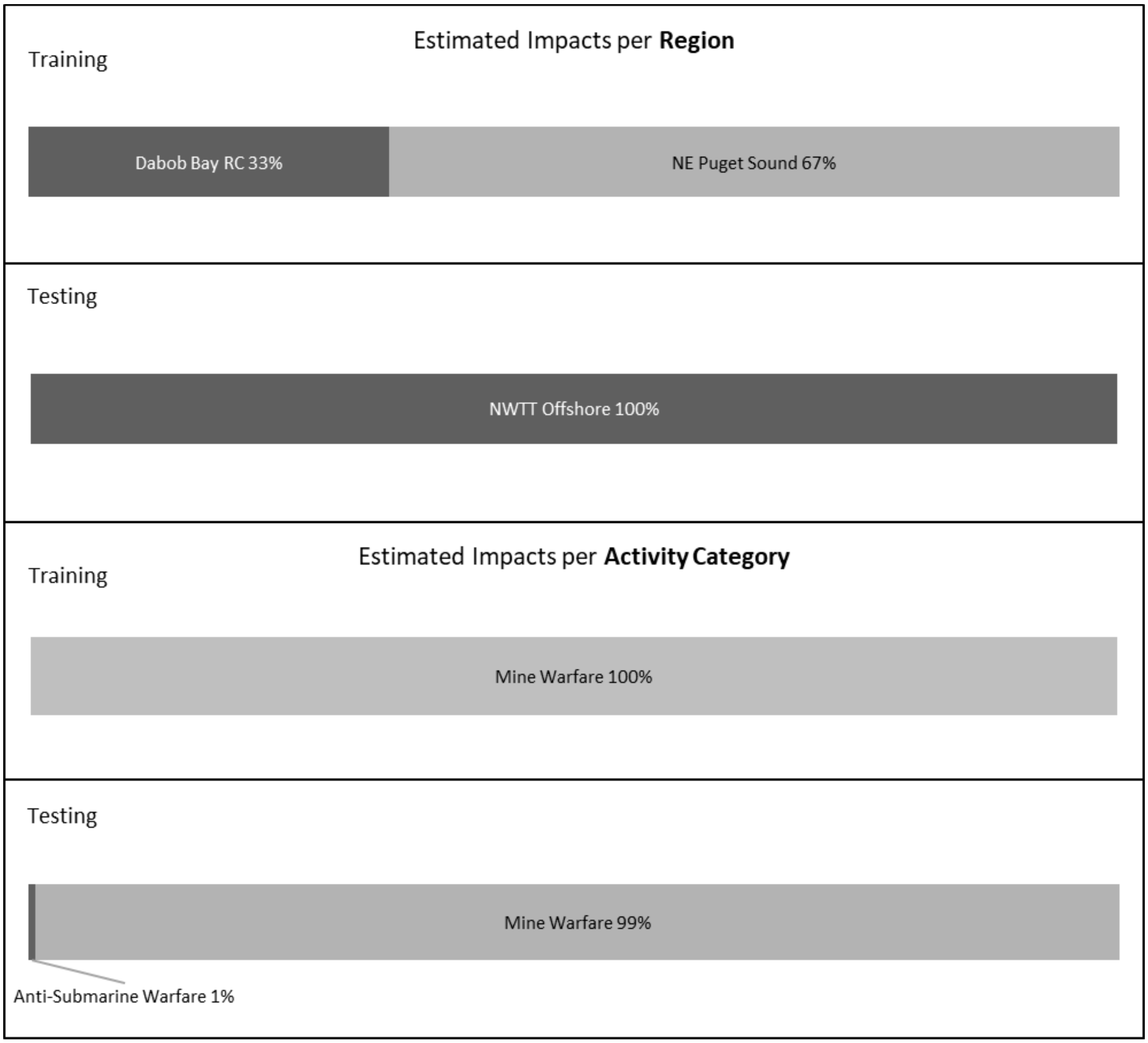
Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will result in the unintentional taking of harbor porpoises incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Impacts from Explosives Under Alternative 1 for Testing Activities

Harbor porpoises may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates behavioral reactions, TTS, and PTS (see Figure 3.4-84 and Table 3.4-100). Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives). Estimated impacts apply to multiple stocks (see Table 3.4-100).

As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. PTS in an individual could have no to minor long-term consequences for individuals although a single minor long-term consequence for an individual is unlikely to lead to long-term consequences for a population. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 will result in the unintentional taking of harbor porpoises incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.



Notes: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent. Estimated impacts most years would be less based on fewer explosions.

Figure 3.4-84: Harbor Porpoise Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing Under Alternative 1 and Alternative 2

Table 3.4-100: Estimated Impacts on Individual Harbor Porpoise Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Stock	Training				Testing			
	Behavioral	*TTS*	*PTS*	*Injury*	*Behavioral*	*TTS*	*PTS*	*Injury*
Southeast Alaska	0	0	0	0	0	0	0	0
Northern Oregon/ Washington Coast	0	0	0	0	52	178	79	0
Northern California/ Southern Oregon	0	0	0	0	91	214	86	0
Washington Inland Waters	0	61	27	0	0	0	0	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

Impacts from Explosives Under Alternative 2 for Training Activities

Potential annual impacts under Alternative 2 from training with explosives would be similar to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Training Activities (see Table 3.4-101). The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of harbor porpoises incidental to those activities.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities (see Table 3.4-101).

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of harbor porpoises incidental to those activities.

Table 3.4-101: Estimated Impacts on Individual Harbor Porpoise Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 2

Estimated Impacts by Effect								
Stock	***Training***				***Testing***			
	Behavioral	***TTS***	***PTS***	***Injury***	***Behavioral***	***TTS***	***PTS***	***Injury***
Southeast Alaska	0	0	0	0	0	0	0	0
Northern Oregon/ Washington Coast	0	0	0	0	52	178	79	0
Northern California/ Southern Oregon	0	0	0	0	91	214	86	0
Washington Inland Waters	0	102	45	0	0	0	0	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Sperm Whales (Endangered Species Act-Listed)

<u>Impacts from Explosives Under Alternative 1 for Training Activities</u>

Sperm whales may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for training activities (see Table E-5 and tabular results in Appendix E, Estimated Marine Mammal and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors under Navy Training and Testing Activities). Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of sperm whales.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 1 may affect ESA-listed sperm whales. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

<u>Impacts from Explosives Under Alternative 1 for Testing Activities</u>

Sperm whales may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for testing activities. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 would not result in the incidental taking of sperm whales.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 1 may affect ESA-listed sperm whales. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

Impacts from Explosives Under Alternative 2 for Training Activities

Potential annual impacts under Alternative 2 from training with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Training Activities. The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 would not result in the incidental taking of sperm whales.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 2 may affect ESA-listed sperm whales.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 would not result in the incidental taking of sperm whales.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 2 may affect ESA-listed sperm whales.

Beaked Whales

Beaked whales within the NWTT study area include: Baird's beaked whale, Blainville's beaked whale, Cuvier's beaked whale, Hubb's beaked whale, ginkgo-toothed beaked whale, Perrin's beaked whale, Stejneger's beaked whale, and the pygmy beaked whale. Impacts to Blainville's beaked whale, Hubb's beaked whale, ginkgo-toothed beaked whale, Perrin's beaked whale, Stejneger's beaked whale and the pygmy beaked whale are combined and represented in the beaked whale guild (*Mesoplodon spp*.).

Research and observations (see *Behavioral Responses from Explosives*) show that beaked whales are sensitive to human disturbance including noise from sonars, although no research on specific reactions to impulsive sounds or noise from explosions is available. Odontocetes overall have shown little responsiveness to impulsive sounds although it is likely that beaked whales are more reactive than most other odontocetes. Reactions could include alerting, startling, breaking off feeding dives and surfacing, diving or swimming away, change in vocalization, or showing no response at all. Beaked whales on Navy ranges have been observed leaving the area for a few days during sonar training exercises. It is reasonable to expect that animals may leave an area of more intense explosive activity for a few days, however most explosive use during Navy activities is short-duration consisting of only a single or few closely timed explosions (i.e., detonated within a few minutes) with a limited footprint due to a single detonation point. Because noise from most activities using explosives is short-term and intermittent and because detonations usually occur within a small area, behavioral reactions from beaked whales are likely to be short-term and moderate severity.

Impacts from Explosives Under Alternative 1 for Training Activities

Beaked whales may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for training activities for Baird's beaked whale, Cuvier's beaked whale, or the small beaked whale guild (*Mesoplodon spp*.). Impact ranges for these species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be conducted as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of Baird's beaked whale, Cuvier's beaked whale, or the small beaked whale guild (Mesoplodon spp.).

Impacts from Explosives Under Alternative 1 for Testing Activities

Beaked whales may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for testing activities for Baird's beaked whale, Cuvier's beaked whale, or the small beaked whale guild (*Mesoplodon spp.)*. Impact ranges for these species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 would not result in the incidental taking of Baird's beaked whale, Cuvier's beaked whale, or the small beaked whale guild (Mesoplodon spp.).

Impacts from Explosives Under Alternative 2 for Training Activities

Potential annual impacts under Alternative 2 from training with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Training Activities. The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 would not result in the incidental taking of Baird's, Cuvier's, and Mesoplodon spp. beaked whales.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of Baird's beaked whale, Cuvier's beaked whale, or the small beaked whale guild (Mesoplodon spp.) incidental to those activities.

Pinnipeds and Mustelids

Pinnipeds include phocid seals (true seals) and otariids (sea lions and fur seals), and mustelids include sea otters.

As described in Section 3.4.2.1.1.5 (Behavioral Reactions), mustelids have similar or reduced hearing capabilities compared to pinnipeds (specifically otariids). Thus, it is reasonable to assume that mustelids use their hearing similarly to that of otariids, and the types of impacts from exposure explosions may also be similar to those described below for pinnipeds, including behavioral reactions, physiological stress, masking, and hearing loss. Additionally, mustelids spend the majority of their time with their heads above the water's surface and live too far inshore to likely be exposed to or impacted by explosions.

If a pinnipeds or mustelid were to experience TTS from explosive sounds, it may have reduced ability to detect biologically important sounds until their hearing recovers. Recovery from TTS begins almost immediately after the noise exposure ceases and can take a few minutes to a few days, depending on the severity of the initial shift, to fully recover. Threshold shifts do not necessarily affect all hearing frequencies equally, and typically manifest themselves at the exposure frequency or within an octave above the exposure frequency. Noise from explosions is broadband with most energy below a few hundred Hertz; therefore, any hearing loss from exposure to explosive sounds is likely to be broadband with effects predominantly at lower frequencies. During the short period that a pinniped had TTS, social calls from conspecifics could be more difficult to detect or interpret; however, most pinniped vocalizations may be above the frequency of TTS induced by an explosion. Killer whales are one of the pinniped primary predators. Killer whale vocalizations are typically above a few kHz, well above the region of hearing that is likely to be affected by exposure to explosive energy. Therefore, TTS in pinnipeds due to sound from explosions is unlikely to reduce detection of killer whale calls. Pinnipeds may use sound underwater to find prey and feed; therefore, a TTS could have a minor and temporary effect on a phocid seal's ability to locate prey.

Research and observations of auditory masking in marine mammals due to impulsive sounds are discussed in Section 3.4.2.2.1.4 (Masking). Explosions introduce low-frequency, broadband sounds into the environment, which could mask hearing thresholds in pinnipeds that are nearby, although sounds from explosions last for only a few seconds at most. Masking due to time-isolated detonations would not be significant. Activities that have multiple detonations such as some naval gunfire exercises could create some masking for pinnipeds in the area over the short duration of the event. Potential costs to pinnipeds and mustelids from masking are similar to those discussed above for TTS, with the primary difference being that the effects of masking are only present when the sound from the explosion is present within the water and the effect is over the moment the sound has ceased.

Research and observations (see Behavioral Responses from Explosives) show that pinnipeds may be the least sensitive taxonomic group to most noise sources. They are likely to only respond to loud impulsive sound sources at close ranges by startling, jumping into the water when hauled out, or even cease foraging, but only for brief periods before returning to their previous behavior. Pinnipeds may even experience TTS before exhibiting a behavioral response (Southall et al., 2007). Because noise from most activities using explosives is short-term and intermittent, and because detonations usually occur within a small area, behavioral reactions from phocid seals are likely to be short-term and low severity.

Physiological stress could be caused by injury or hearing loss and could accompany any behavioral reaction as well. Research and observations of physiological stress in marine mammals are discussed in Section 3.4.2.2.1.3 (Physiological Stress). Due to the short-term and intermittent use of explosives, physiological stress is also likely to be short-term and intermittent. Long-term consequences from physiological stress due to the sound of explosives would not be expected.

California Sea Lions

Impacts from Explosives Under Alternative 1 for Training Activities

California sea lions may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for training activities. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

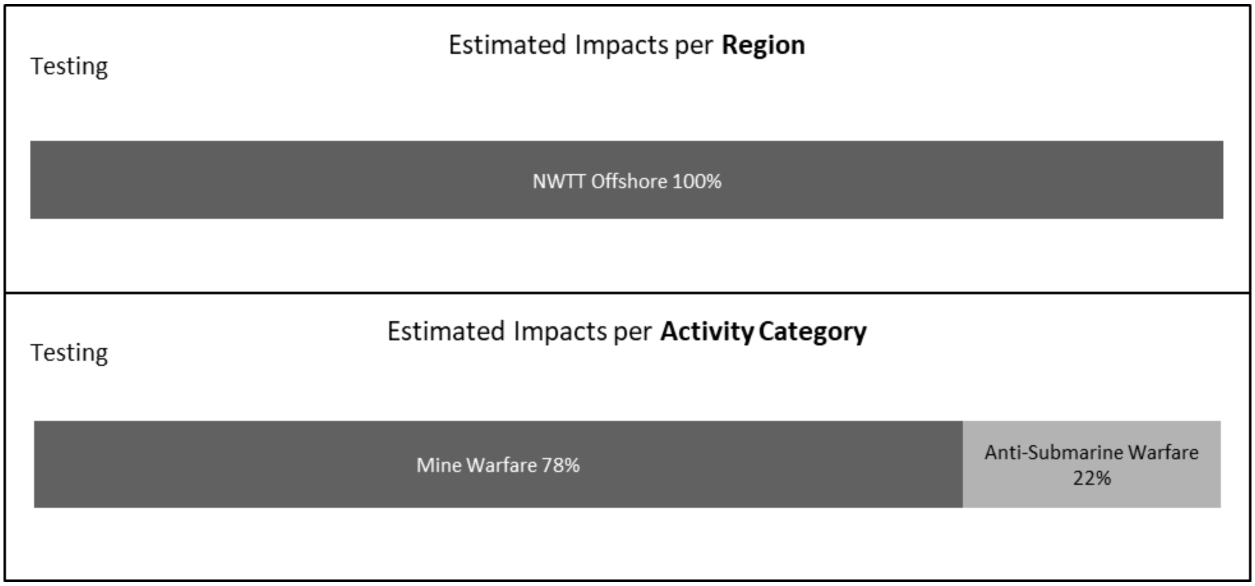
Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of California sea lions.

Impacts from Explosives Under Alternative 1 for Testing Activities

California sea lions may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates behavioral reactions, TTS, PTS (see Figure 3.4-85 and Table 3.4-102). Impact ranges for these species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives). Estimated impacts apply to the U.S. stock (see Table 3.4-102).

As described above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. PTS in an individual could have no to minor long-term consequences for individuals although a single minor long-term consequence for an individual is unlikely to lead to long-term consequences for a population. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 will result in the unintentional taking California sea lions incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.



Notes: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent. Estimated impacts most years would be less based on fewer explosions.

Figure 3.4-85: California Sea Lion Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing Under Alternative 1 and Alternative 2

Table 3.4-102: Estimated Impacts on Individual California Sea Lion Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1 and Alternative 2

Estimated Impacts by Effect								
Stock	***Training***				***Testing***			
	Behavioral	***TTS***	***PTS***	***Injury***	***Behavioral***	***TTS***	***PTS***	***Injury***
U.S. Stock	0	0	0	0	1	3	1	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1 and Alternative 2.

Impacts from Explosives Under Alternative 2 for Training Activities

Potential annual impacts under Alternative 2 from training with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Training Activities. The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 would not result in the incidental taking of California sea lions.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts on these species under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities (see Figure 3.4-85 and Table 3.4-102).

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking California sea lions incidental to those activities.

Steller Sea Lions (one DPS is Endangered Species Act-Listed)

The Eastern U.S. stock of Steller sea lions is not listed under the Endangered Species Act. All impacts estimated by the quantitative analysis are on the Eastern U.S. stock. The Western U.S. stock of Steller sea lions is listed endangered under the ESA; however, Steller sea lions from the Western U.S. stock are rare in the Study Area.

Impacts from Explosives Under Alternative 1 for Training Activities

Steller sea lions may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for training activities. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of Steller sea lions.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 1 may affect ESA-listed Steller sea lions. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

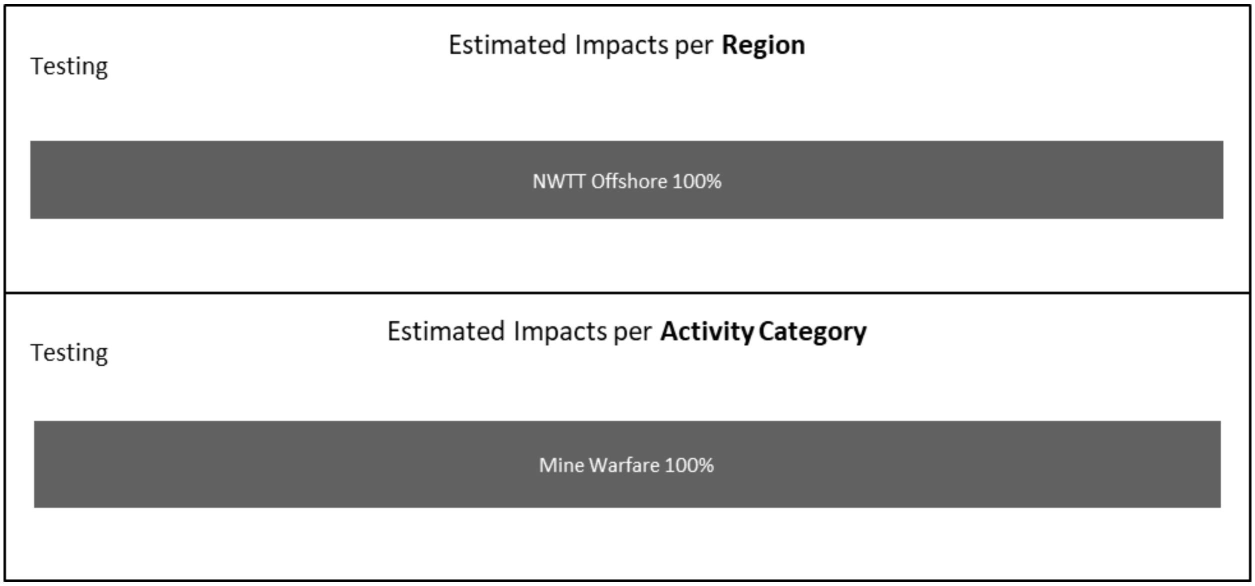
Impacts from Explosives Under Alternative 1 for Testing Activities

Steller sea lions may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates TTS (see Figure 3.4-86 and Table 3.4-103). Impact ranges for these species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives). Estimated impacts apply to the Eastern U.S. stock (see Table 3.4-103).

As described above, even a few minor to moderate TTS reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 will result in the unintentional taking Steller sea lions incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 1 may affect ESA-listed Steller sea lions. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.



Notes: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent. Estimated impacts most years would be less based on fewer explosions.

Figure 3.4-86: Steller Sea Lion Impacts Estimated per Year from the Maximum Number of Explosions During Testing Under Alternative 1 and Alternative 2

Table 3.4-103: Estimated Impacts on Individual Steller Sea Lion Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1 and Alternative 2

Estimated Impacts by Effect								
Stock	***Training***				***Testing***			
	Behavioral	***TTS***	***PTS***	***Injury***	***Behavioral***	***TTS***	***PTS***	***Injury***
Eastern U.S.	0	0	0	0	0	1	0	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1 and Alternative 2.

Impacts from Explosives Under Alternative 2 for Training Activities

Potential annual impacts under Alternative 2 from training with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Training Activities. The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 would not result in the incidental taking of Steller sea lions.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 2 may affect ESA-listed Steller sea lions. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts on these species under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities (see Table 3.4-103).

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking Steller sea lions incidental to those activities.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 2 may affect ESA-listed Steller sea lions. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

Guadalupe Fur Seals (Endangered Species Act-listed)

Impacts from Explosives Under Alternative 1 for Training Activities

Guadalupe fur seals may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for training activities. Impact ranges for these species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during training or testing activities as described under Alternative 1 would not result in the incidental taking of Guadalupe fur seals.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 1 may affect ESA-listed Guadalupe fur seals. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

Impacts from Explosives Under Alternative 1 for Testing Activities

Guadalupe fur seals may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for testing activities. Impact ranges for these species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of Guadalupe fur seals.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 1 may affect ESA-listed Guadalupe fur seals. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

Impacts from Explosives Under Alternative 2 for Training Activities

Potential annual impacts under Alternative 2 from training with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Training Activities. The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 would not result in the incidental taking of Guadalupe fur seals.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 2 may affect ESA-listed Guadalupe fur seals.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts on these species under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 would not result in the incidental taking Guadalupe fur seals.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 2 may affect ESA-listed Guadalupe fur seals.

Northern Fur Seals

Impacts from Explosives Under Alternative 1 for Training Activities

Northern fur seals may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for training activities. Impact ranges for these species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of northern fur seals.

Impacts from Explosives Under Alternative 1 for Testing Activities

Northern fur seals may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates no impacts for testing activities. Impact ranges for these species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives).

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 would not result in the incidental taking of Northern fur seals.

Impacts from Explosives Under Alternative 2 for Training Activities

Potential annual impacts under Alternative 2 from training with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Training Activities. The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 would not result in the incidental taking of northern fur seals.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts on these species under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 would not result in the incidental taking Northern fur seals.

Harbor Seals

Impacts from Explosives Under Alternative 1 for Training Activities

Harbor seals may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates TTS and PTS (see Figure 3.4-87 and tabular results in Appendix E, Estimated Marine Mammal and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors under Navy Training and Testing Activities). Estimated impacts most years would be less based on fewer explosions. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives). Estimated impacts apply to multiple stocks (see Table 3.4-104).

As described above, even a few minor to moderate TTS to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. PTS in an individual could have no to minor long-term consequences for individuals although a single minor long-term consequence for an individual is unlikely to lead to long-term consequences for a population. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will result in the unintentional taking of harbor seals incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Impacts from Explosives Under Alternative 1 for Testing Activities

Harbor seals may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates behavioral reactions, TTS, and PTS (see Figure 3.4-87 and Table 3.4-104). Impact ranges for these species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives). Estimated impacts apply multiple stocks (see Table 3.4-104).

As described above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. PTS in an individual could have no to minor long-term consequences for individuals although a single minor long-term consequence for an individual is unlikely to lead to long-term consequences for a population. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stocks would not be expected.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 will result in the unintentional taking of harbor seals incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Notes: Region and Activity bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent. Estimated impacts most years would be less based on fewer explosions.

Figure 3.4-87: Harbor Seal Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing Under Alternative 1 and Alternative 2

Table 3.4-104: Estimated Impacts on Individual Harbor Seal Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts by Effect								
Stock	***Training***				***Testing***			
	Behavioral	***TTS***	***PTS***	***Injury***	***Behavioral***	***TTS***	***PTS***	***Injury***
California	0	0	0	0	5	6	1	0
Hood Canal	0	4	1	0	0	0	0	0
Oregon/Washington Coastal	0	0	0	0	3	3	0	0
Southeast Alaska - Clarence Strait	0	0	0	0	0	0	0	0
Southern Puget Sound	0	0	0	0	0	0	0	0
Washington Northern Inland Waters	0	30	5	0	0	0	0	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

Impacts from Explosives Under Alternative 2 for Training Activities

Potential annual impacts under Alternative 2 from training with explosives would be similar to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Training Activities (see Table 3.4-105). The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of harbor seals incidental to those activities.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts on these species under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities (see Table 3.4-105).

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking harbor seals incidental to those activities.

Table 3.4-105: Estimated Impacts on Individual Harbor Seal Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 2

Estimated Impacts by Effect								
Stock	***Training***				***Testing***			
	Behavioral	***TTS***	***PTS***	***Injury***	***Behavioral***	***TTS***	***PTS***	***Injury***
California	0	0	0	0	5	6	1	0
Hood Canal	0	7	1	0	0	0	0	0
Oregon/Washington Coastal	0	0	0	0	3	3	0	0
Southeast Alaska - Clarence Strait	0	0	0	0	0	0	0	0
Southern Puget Sound	0	0	0	0	0	0	0	0
Washington Northern Inland Waters	0	50	8	0	0	0	0	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Northern Elephant Seals

Impacts from Explosives Under Alternative 1 for Training Activities

Northern elephant seals may be exposed to sound or energy from explosions associated with training activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates TTS and PTS (see Figure 3.4-88 and Table 3.4-106). Estimated impacts most years would be less based on fewer explosions. Impact ranges for this species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives). Estimated impacts apply to the California stock (see Table 3.4-106).

As described above, even a few minor to moderate TTS to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. PTS in an individual could have no to minor long-term consequences for individuals although a single minor long-term consequence for an individual is unlikely to lead to long-term consequences for a population. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will result in the unintentional taking of northern elephant seals incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Impacts from Explosives Under Alternative 1 for Testing Activities

Northern elephant seals may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 1, estimates behavioral reactions, TTS, and PTS (see Figure 3.4-88 and Table 3.4-106). Impact ranges for these species are discussed in Section 3.4.2.2.2.2 (Impact Ranges for Explosives). Estimated impacts apply to the California stock (see Table 3.4-106).

As described above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. PTS in an individual could have no to minor long-term consequences for individuals although a single minor long-term consequence for an individual is unlikely to lead to long-term consequences for a population. Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 will result in the unintentional taking of Northern elephant seals incidental to those activities. The Navy will request authorization from NMFS as required by Section 101(a)(5)(A) of the MMPA.

Notes: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent. Estimated impacts most years would be less based on fewer explosions.

Figure 3.4-88: Northern Elephant Seal Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing Under Alternative 1

Table 3.4-106: Estimated Impacts on Individual Northern Elephant Seal Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts by Effect								
Stock	***Training***				***Testing***			
	Behavioral	***TTS***	***PTS***	***Injury***	***Behavioral***	***TTS***	***PTS***	***Injury***
California	0	2	1	0	7	8	3	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 1.

Impacts from Explosives Under Alternative 2 for Training Activities

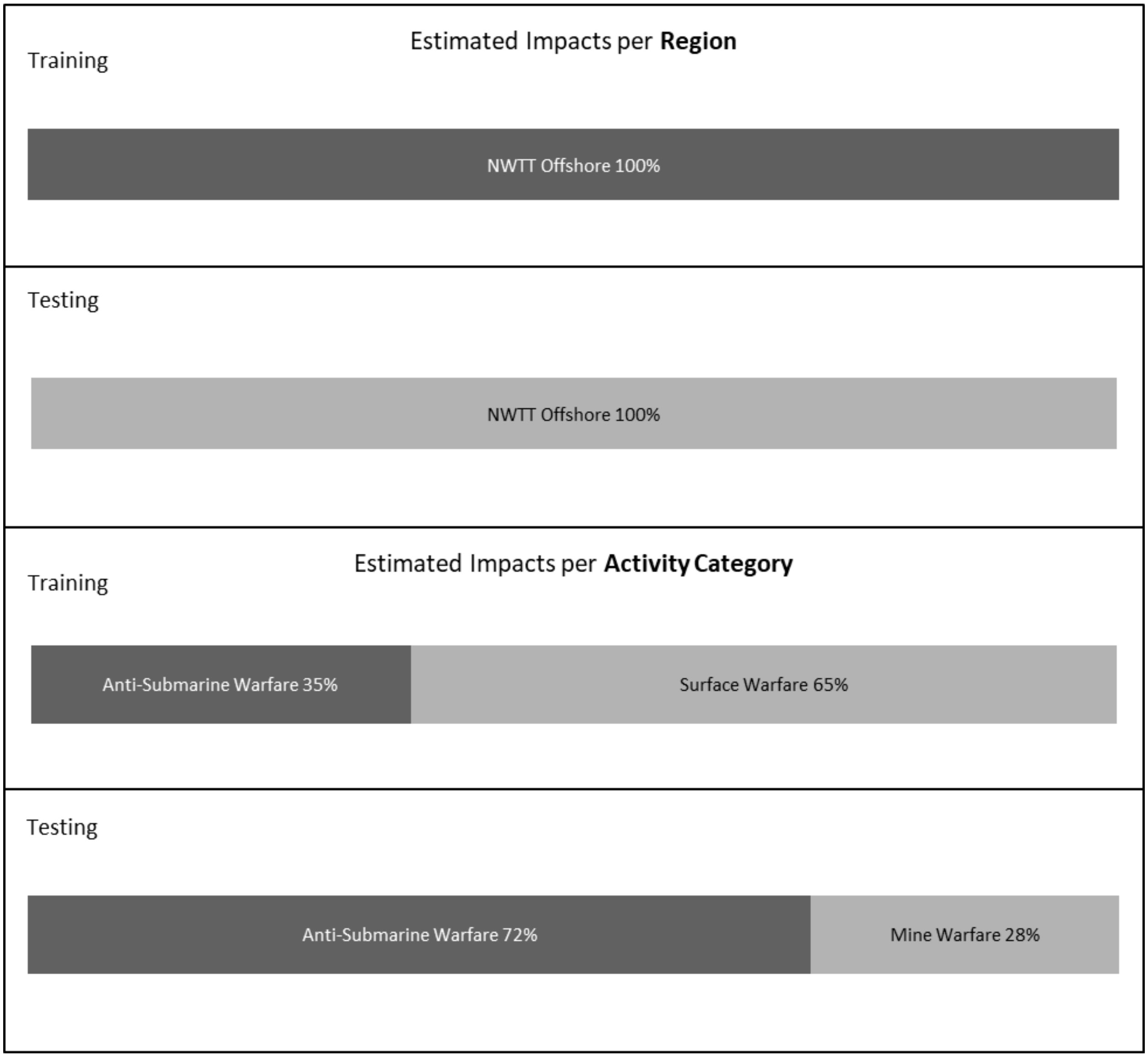
Potential annual impacts under Alternative 2 from training with explosives would be similar to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Training Activities (see Figure 3.4-89 and Table 3.4-107). The primary distinction is that explosive use would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the potential for impacts from training under Alternative 2 may increase slightly based on the slight increase in explosive use compared to Alternative 1.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of northern elephant seals incidental to those activities.

Impacts from Explosives Under Alternative 2 for Testing Activities

Annual explosive use during testing activities under Alternative 2 would be identical to annual explosive use under Alternative 1. Therefore, potential annual impacts on these species under Alternative 2 from testing with explosives would be identical to the maximum use year impacts shown and discussed above in Impacts from Explosives Under Alternative 1 for Testing Activities (see Figure 3.4-89 and Table 3.4-107).

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking Northern elephant seals incidental to those activities.



Notes: Region and Activity Category bar charts show categories +/- 0.5 percent of the estimated impacts, which could result in a total of 99–101 percent. Estimated impacts most years would be less based on fewer explosions.

Figure 3.4-89: Northern Elephant Seal Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing Under Alternative 2

Table 3.4-107: Estimated Impacts on Individual Northern Elephant Seal Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 2

Estimated Impacts by Effect								
Stock	***Training***				***Testing***			
	Behavioral	***TTS***	***PTS***	***Injury***	***Behavioral***	***TTS***	***PTS***	***Injury***
California	0	5	2	0	7	8	3	0

Note: Estimated impacts are based on the maximum number of activities in a given year under Alternative 2.

Northern Sea Otters

Sea otters that occur along the coast of Washington are the result of reintroduction efforts of the northern sea otter (from Amchitka Island, Alaska) in 1969 and 1970 (Lance et al., 2004; Sato, 2018), and are not listed as threatened or endangered under the ESA (Carretta et al., 2017c). There is a single stock in Washington waters (the northern sea otter [*Enhydra lutris kenyoni*]) and a single stock in California (the southern sea otter [*Enhydra lutris nereis*]). Only the Washington stock of sea otter is known to occur in the Study Area (Carretta et al., 2017c) and is expected to only be present in the shallow, nearshore areas of the Offshore portion of the Study Area.

Sea otters seldom range more than 2 km from shore, because they are benthic foragers and limited by their ability to dive to the seafloor; although some individuals, particularly juvenile males, may travel farther offshore (Calambokidis et al., 1987; Laidre et al., 2009; Muto et al., 2017; Riedman & Estes, 1990). (Ghoul & Reichmuth, 2014a) have shown that sea otters are not especially well adapted for hearing underwater, which suggests that the function of this sense has been less important in their survival and evolution than in comparison to pinnipeds. Sea otters in this region are mainly concentrated off the coast of the Olympic Peninsula and the western Strait of Juan de Fuca, with only rare sightings in Puget Sound. Sea otters do not typically occur in Inland Waters, thus activities occurring in these areas would not overlap with sea otter presence.

Impacts from Explosives Under Alternative 1 for Training Activities

Northern sea otters would likely not be exposed to sound or energy from explosions associated with training activities throughout the year. Sea otters primarily inhabit shallow coastal areas and spend the majority of their time floating at the surface with their ears above the water. Training activities involving explosives would be concentrated in the NWTT Offshore Area. Detonations would generally occur greater than 50 NM from shore, far from the nearshore areas that sea otters inhabit. Thus, impacts are highly unlikely due to limited use of explosives nearshore and the unlikely occurrence of sea otters overlapping with explosions during training activities.

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of Northern sea otters.

Impacts from Explosives Under Alternative 1 for Testing Activities

Northern sea otters would likely not be exposed to sound or energy from explosions associated with testing activities throughout the year. Sea otters primarily inhabit shallow coastal areas and spend the majority of their time floating at the surface with their ears above the water. All testing involving explosives would occur in the Offshore Area, and, with the exception of mine countermeasure and neutralization testing, would typically occur at distances greater than 50 NM from shore. Still, the distance from mine countermeasure and neutralization testing area to sea otter habitat would greatly exceeds the range to potential behavioral impacts estimated for the largest explosive proposed for these activities. Thus, impacts are highly unlikely due to the ranges to impacts and the unlikely occurrence of sea otters overlapping with explosions during testing activities.

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 would not result in the incidental taking of Northern sea otters.

Impacts from Explosives Under Alternative 2 for Training Activities

Northern sea otters would likely not be exposed to sound or energy from explosions associated with training activities throughout the year. Sea otters primarily inhabit shallow coastal areas and spend the majority of their time floating at the surface with their ears above the water. Training activities involving explosives would be concentrated in the NWTT Offshore Area. Detonations would generally occur greater than 50 NM from shore, far from the nearshore areas that sea otters inhabit. Thus, impacts are highly unlikely due to limited use of explosives nearshore and the unlikely occurrence of sea otters overlapping with explosions during training activities.

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 would not result in the incidental taking of Northern sea otters.

Impacts from Explosives Under Alternative 2 for Testing Activities

Testing activities with explosives is identical under Alternative 1 and Alternative 2; therefore, the locations, types, and severity of predicted impacts would be the same.

Considering these factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 would not result in the incidental taking of Northern sea otters.

3.4.2.2.2.4 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 Navy activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would remove the potential for explosive impacts on marine mammals, but would not measurably improve the overall distribution or abundance of marine mammals.

3.4.2.3 Energy Stressors

The energy stressors that may impact marine mammals include in-water electromagnetic devices and high-energy lasers. Only one new energy stressor (high-energy lasers) used in testing activities differs from the energy stressors that were previously analyzed in the 2015 NWTT Final EIS/OEIS. Use of low-energy lasers and in-air electromagnetic devices were analyzed and dismissed as energy stressors in the 2015 NWTT Final EIS/OEIS in Section 3.0.5.3.2.2 (Lasers) and Section 3.0.5.3.2.1 (Electromagnetic – Airborne Electromagnetic Energy). However, at that time high-energy laser weapons were not part of the proposed action for the Study Area. (National Marine Fisheries Service, 2015c; National Oceanic and Atmospheric Administration, 2015a, 2015b)

3.4.2.3.1 Impacts from In-Water Electromagnetic Devices

For the 2015 analysis of in-water electromagnetic devices as energy stressors, see Section 3.4.3.3 (Energy Stressors) in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015c; National Oceanic and Atmospheric Administration, 2015a). Since the 2015 NWTT Final EIS/OEIS, and with the increased use of undersea power cables associated with offshore energy generation, there has been renewed scientific interest in electromagnetic fields possibly affecting migrating marine mammals (Gill et al., 2014; Kremers et al., 2014; Kremers et al., 2016; Zellar et al., 2017). Horton et al. (2017) have indicated that future experiments involving empirical observation of free-ranging animals are still required for there to be sufficient evidence demonstrating causal relations between marine mammal movement decisions and environmental cues such as the earth’s magnetic field. These additional scientific findings do not change in any way the rationale for the dismissal of in-water electromagnetic devices as presented in the 2015 analyses. As presented and at the most basic level, the Navy does not anticipate any impacts from the use of in-water electromagnetic devices because the electromagnetic field is the simulation of a ship’s magnetic field, having no greater impact than that of a passing ship. The number and location of activities using in-water electromagnetic devices would not change under this Supplemental from the ongoing activities. The analyses presented in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015c; National Oceanic and Atmospheric Administration, 2015a) remain valid; impacts to marine mammals from the use of in-water electromagnetic devices are not expected.

3.4.2.3.1.1 Impacts from In-Water Electromagnetic Devices Under Alternative 1

<u>Impacts from In-Water Electromagnetic Devices Under Alternative 1 for Training Activities</u>

Under Alternative 1, the number of proposed training activities involving the use of in-water electromagnetic devices is the same as presented in the 2015 NWTT Final EIS/OEIS (see Table 3.0-9). These activities would occur in the same Inland Waters locations and same manner as previously analyzed. Therefore, as stated in the 2015 NWTT Final EIS/OEIS and based on the new science summarized above, the impact of in-water electromagnetic devices on marine mammals is not expected.

The use of in-water electromagnetic devices during training activities as described under Alternative 1 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of in-water electromagnetic devices during training activities, as described under Alternative 1, would have no effect on Southern Resident killer whale critical habitat. The use of in-water electromagnetic devices may affect ESA-listed marine mammals. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

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

Under Alternative 1 and as shown on Table 3.0-9, there are no testing events involving the use of in-water electromagnetic devices.

3.4.2.3.1.2 Impacts from In-Water Electromagnetic Devices Under Alternative 2

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

Under Alternative 2, the number of proposed training activities involving the use of in-water electromagnetic devices is the same as presented in the 2015 NWT Final EIS/OEIS (see Table 3.0-9) and the same as under Alternative 1. As presented under Alternative 1, the impact of in-water electromagnetic devices on marine mammals is not expected.

The use of in-water electromagnetic devices during training activities as described under Alternative 2 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of in-water electromagnetic devices during training activities, as described under Alternative 2, would have no effect on Southern Resident killer whale critical habitat. The use of in-water electromagnetic devices may affect ESA-listed marine mammals.

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

Under Alternative 2 and as shown on Table 3.0-9, there are no testing events involving the use of in-water electromagnetic devices.

3.4.2.3.1.3 Impacts from In-Water Electromagnetic Devices 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. Other military activities not associated with this Proposed Action would continue to occur. In-water electromagnetic devices 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 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 in-water electromagnetic devices on individual marine mammals, but would not measurably improve the status of marine mammal populations or subpopulations.

3.4.2.3.2 Impacts from High-Energy Lasers

As described in Section 3.0.3.3.2.2 (High-Energy Lasers) of this Supplemental, high-energy laser weapons testing activities involve evaluating the effectiveness of a high-energy laser deployed from a surface ship or helicopter to create small but critical failures in potential targets from short ranges.

The primary concern is the potential for a marine mammal to be exposed to the laser beam at or near the water's surface, which could result in injury or death. However, marine mammals could only be exposed if the laser beam missed the target. The potential for marine mammals to be directly hit by a high-energy laser beam that missed the target was evaluated using statistical probability modeling (Appendix F, Military Expended Material and Direct Strike Impact Analyses) to estimate the potential direct strike exposures to a marine mammal for a worst-case scenario. Model input values include high-energy laser use data (e.g., number of high-energy laser exercises and laser beam footprint), size of the testing area, marine mammal density data, and animal cross-sectional area. To estimate the probability of hitting a marine mammal in a worst-case scenario (based on assumptions listed below), the impact area for all laser testing events was summed over one year in the Offshore portion of the Study Area under each alternative. Finally, the marine mammal species with the highest average seasonal density within the Offshore area was used in the analysis. This approach ensures that all other species with a lower density would have a lower probability of being struck by a laser missing the target.

Within the statistical probability model, the estimated potential for a marine mammal strike is influenced by the following assumptions:

- The model is two-dimensional and assumes that all animals would be at or near the surface 100 percent of the time, when in fact marine mammals spend up to 90 percent of their time under the water (Costa, 1993).
- The model assumes the animal is stationary and does not account for any movement of the marine mammal or any potential avoidance of the training or testing activity.

3.4.2.3.2.1 Impacts from High-Energy Lasers Under Alternative 1

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

High-energy lasers 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 54 testing activities per year involving the use of high-energy lasers in the Offshore portion of the Study Area.

The marine mammal species with the highest average seasonal density in the Offshore portion of the Study Area (Dall's porpoise) was used in the statistical probability analysis presented in Appendix F (Military Expended Material and Direct Strike Impact Analyses). Based on the probability analysis in Appendix F, the results indicate that no Dall's porpoise would be struck by a high-energy laser in the course of a year. Considering the assumptions outlined above, there is a high level of certainty in the conclusion that no marine mammals that occur in the Study Area would be struck by a high-energy laser.

The use of high-energy lasers during testing activities as described under Alternative 1 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of high-energy lasers during testing activities, as described under Alternative 1, would have no effect on Southern Resident killer whale critical habitat. The use of high energy lasers may affect ESA-listed marine mammals. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

3.4.2.3.2.2 Impacts from High-Energy Lasers Under Alternative 2

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

High-energy lasers would not be used during training activities under Alternative 2, so there would be no impacts.

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

As discussed in Section 3.0.3.3.2.2 (High-Energy Lasers) and presented in Table 3.0-10, the location, number of testing activities, and potential effects associated with high-energy laser use would be the same under Alternatives 1 and 2. Refer to Section 3.4.2.3.2.1 (Impacts from High-Energy Lasers Under Alternative 1) for a discussion of impacts on marine mammals associated with high-energy laser use.

The use of high-energy lasers during testing activities as described under Alternative 2 would not result in the incidental taking of marine mammal.

Pursuant to the ESA, the use of high-energy lasers during testing activities, as described under Alternative 2, would have no effect on Southern Resident killer whale critical habitat. The use of high energy lasers may affect ESA-listed marine mammals.

3.4.2.3.2.3 Impacts from High-Energy Lasers 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. Other military activities not associated with this Proposed Action would continue to occur. High-energy lasers as listed above would not be introduced into the marine environment. Therefore, existing environmental conditions would remain unchanged.

3.4.2.4 Impacts from Physical Disturbance and Strike

The physical disturbance and strike stressors that may impact marine mammals 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.

3.4.2.4.1 Impacts from Vessel and In-Water Devices

The Navy did not request authorization under MMPA or ESA for take of a marine mammal as a result of vessel or in-water device strike in the 2015 NWTT Final EIS/OEIS. Since the analysis presented in the 2015 NWTT Final EIS/OEIS, there have been new scientific findings made available regarding acute and chronic disturbance to cetaceans and pinnipeds as a result of vessel use. Unlike civilian vessel uses found to be sources of acute and chronic disturbance, Navy vessels do not purposefully approach marine mammals or conduct repeated and frequent transits through enclosed bodies of water and near shorelines to view marine mammals. As a result, Navy vessel use in the Study Area does not equate with the types of focused, frequent, and numerous vessels present or transiting a given area that studies have found constitute acute and chronic disturbance to marine mammals. For discussion of physical disturbance from vessels and in water devices, see Section 3.4.2.1.1.3 (Physiological Stress); for vessel noise, see Section 3.4.2.1.3 (Impacts from Vessel Noise); and for behavioral reactions to vessels see Section 3.4.2.1.1.5 (Behavioral Reactions – Behavioral Reactions to Vessels).

Reviews of the literature on vessel strikes mainly involve collisions between commercial vessels and whales (Cascadia Research, 2017b; Currie et al., 2017a; Douglas et al., 2008; Jensen & Silber, 2004; Laist et al., 2001; Lammers et al., 2013; Monnahan et al., 2015; Nichol et al., 2017; Rockwood et al., 2017). The ability of any ship to detect a marine mammal and avoid a collision depends on a variety of factors, including environmental conditions, ship design, size, speed, and manning, as well as the behavior of the animal (Conn & Silber, 2013; Currie et al., 2017a; Gende et al., 2011; Silber et al., 2010; Vanderlaan & Taggart, 2007; Wiley et al., 2016). In areas of both high whale density and a high volume of vessel traffic, such as the Strait of Juan de Fuca and its entrance, whales are predicted to be susceptible to elevated risk for vessel strike (Nichol et al., 2017).

Large Navy vessels (greater than 18 m in length) within the offshore areas of the Study Area operate differently from commercial vessels in ways important to the prevention of whale collisions. For example, the average speed of large Navy ships ranges between 10 and 15 knots, and submarines generally operate at speeds in the range of 8 and 13 knots, while a few specialized vessels can travel at faster speeds. By comparison, this is slower than most commercial vessels where normal design speed for a container ship is typically 24 knots (Bonney & Leach, 2010). Even given the advent of "slow steaming" by commercial vessels in recent years due to fuel prices (Barnard, 2016; Maloni et al., 2013), this generally reduces the design speed by only a few knots, given that 21 knots would be considered slow, 18 knots is considered "extra slow," and 15 knots is considered "super slow" (Bonney & Leach, 2010). Small Navy craft (less than 50 ft. in length), have much more variable speeds (0–50 knots or more, depending on the mission). While these speeds are considered averages and representative of most events, some Navy vessels need to operate outside of these parameters during certain situations. Differences between most Navy ships and commercial ships also include the following disparities:

- The Navy has several standard operating procedures for vessel safety that could result in a secondary benefit to marine mammals through a reduction in the potential for vessel strike, as discussed in the 2015 NWTT Final EIS/OEIS Section 5.1.2 (Vessel Safety). For example, ships operated by or for the Navy have personnel assigned to stand watch at all times, day and night, when moving through the water (i.e., when the vessel is underway). Watch personnel undertake extensive training in accordance with the U.S. Navy Lookout Training Handbook or civilian equivalent. A primary duty of watch personnel is to ensure safety of the ship, which includes the requirement to detect and report all objects and disturbances sighted in the water that may be indicative of a threat to the ship and its crew, such as debris, a periscope, surfaced submarine, or surface disturbance. Per safety requirements, watch personnel also report any marine mammals sighted that have the potential to be in the direct path of the ship, as a standard collision avoidance procedure. As described in Section 5.3.4.1 (Vessel Movement) of this Supplemental, Navy vessels are required to operate in accordance with applicable navigation rules. Applicable rules include the Inland Navigation Rules (33 Code of Federal Regulations 83) and International Regulations for Preventing Collisions at Sea (72 Collision Regulations), which were formalized in the Convention on the International Regulations for Preventing Collisions at Sea, 1972. These rules require that vessels proceed at a safe speed so proper and effective action can be taken to avoid collision and so vessels can be stopped within a distance appropriate to the prevailing circumstances and conditions. In addition to complying with navigation requirements, Navy ships transit at speeds that are optimal for fuel conservation, to maintain ship schedules, and to meet mission requirements. Vessel captains use the totality of the circumstances to ensure the vessel is traveling at appropriate speeds in accordance with navigation rules. Depending on the circumstances, this may involve adjusting speeds during periods of reduced visibility or in certain locations.
- Many Navy ships have their bridges positioned closer to the bow, offering good visibility ahead of the ship.

- There are often aircraft associated with the training or testing activity, which can detect marine mammals in the vicinity or ahead of a vessel's present course.
- Navy ships are generally much more maneuverable than commercial merchant vessels if marine mammals are spotted and it becomes necessary to change direction.
- Navy ships operate at the slowest speed possible consistent with either transit needs, or training or testing need. While minimum speed is intended as a fuel conservation measure particular to a certain ship class, secondary benefits include being better able to spot and avoid objects in the water, including marine mammals.
- In many cases, Navy ships will likely move randomly or with a specific pattern within a sub-area of the Study Area for a period of time, from one day to two weeks, as compared to straight line point-to-point commercial shipping.
- Navy overall crew size is much larger than merchant ships, allowing for more potential observers on the bridge.
- When submerged, submarines are generally slow moving (to avoid detection), and therefore marine mammals at depth with a submarine are likely able to avoid collision with the submarine. When a submarine is transiting on the surface, there are Lookouts serving the same function as they do on surface ships.
- The Navy will implement mitigation to avoid potential impacts from vessel strikes on marine mammals (see Chapter 5, Mitigation). Mitigation includes training Lookouts and watch personnel with the Marine Species Awareness Training (which provides information on sighting cues, visual observation tools and techniques, and sighting notification procedures), requiring vessels to maneuver to maintain a specified distance from marine mammals during vessel movements.

Data from the ports of Vancouver, British Columbia; Seattle, Washington; and Tacoma, Washington 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 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 vessel traffic in Southeast Alaska (Nuka Research & Planning Group, 2012). 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 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, 6 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.

Many marine mammals in the Study Area (especially large whales) have seasonal ranges that include the remainder of the U.S. West Coast, Hawaii, and Alaska (beyond the Behm Canal portion of the Study Area). Between 1986 and 2017, there have been 12 fin whales killed as a result of vessel strikes found in the Inland Waters portion of the Study Area (Towers et al., 2018b). For the latest five-year reporting periods, NMFS Technical Memoranda documented 65 vessel strikes to marine mammals off the U.S West Coast (Washington and California) (Carretta et al., 2017b), 38 vessel strikes to humpback whales in

Hawaii (Bradford & Lyman, 2015), and approximately 14 vessel strikes to marine mammals in Alaska (Helker et al., 2017).

Navy policy (Chief of Naval Operations Instruction 3100.6 H) is to report all whale strikes by Navy vessels. By information agreement, that information has been provided to NMFS on an annual basis. Only the Navy and the U.S. Coast Guard report vessel strike to NMFS in this manner, so all statistics are skewed by a lack of comprehensive reporting by all vessels that may experience vessel strike.

Vessel strike records from the Navy have been kept since 1995, and there have been two Navy vessel strikes to marine mammals in the NWTT Study Area, up to and through January 2019.

The fate of the two whales that were struck by Navy vessels in the Study Area is unknown. Although it does not preclude the possibility that a serious injury or mortality may have occurred, in neither of these two cases were there indications of serious injuries; there was no blood in the water, the whales did not appear injured, and there were no whale strandings or mortalities reported within an associated time frame in the Study Area. For purposes of the analysis in this Supplemental, it is assumed that any whale struck by any vessel would have sustained serious injury or mortality, although evidence of whales displaying diagnostic but healed injuries and scars indicates that some struck whales may survive, dependent on a variety of factors (Bradford & Lyman, 2015; Carretta et al., 2017b; Fulling et al., 2017; Helker et al., 2017; Ritter, 2012; Rockwood et al., 2017; Towers et al., 2018b; Van Waerebeek et al., 2007).

The projected Navy vessel use has not significantly changed over time and is not projected to significantly change under the proposed alternatives. Integration of the Navy's Marine Species Awareness Training began in 2006 and was fully integrated across the Navy by 2009, resulting in a decrease in strike incidents Navy-wide. These factors and adaptation of additional mitigation measures since 2009 makes the period since 2009 the most appropriate for calculation of future expected strikes; while the Navy does not anticipate vessel strikes to marine mammals within the NWTT Study Area during the proposed activities, Navy vessel strikes in the Study Area for the period between 2009 and 2018 can be used to determine a statistical probability of future Navy vessel strike as a rate parameter of a Poisson distribution. To estimate the probability of 0, 1, 2, 3,… n vessel strikes involving Navy vessels over the time period considered in this Supplemental, a simple computation can be generated: $P(X) = P(X-1)\mu/X$, where P(X) is the probability of occurrence in a unit of time (or space) and μ is the number of occurrences in a unit of time (or space). For the 10-year period from 2009 through 2018, if μ is based on two strikes over 10 years (2/10=0.20) then $\mu = 0.20$. Plugging 0.20 into the $P(0) = e\text{-}\mu$ yields a values of P(0)=0.20 strikes per year; and estimated probability of 1.40 Navy vessel strikes over a 7-year period in NWTT. As shown in Table 3.4-108, within any given year during the period of time considered in this Supplemental, there is approximately a 25 percent probability that no Navy vessel strikes will occur, a 35 percent chance one strike would occur, a 24 percent chance of two strikes, and an 11 percent chance of three strikes occurring per year.

Table 3.4-108: Poisson Probability of Striking "X" Number of Whales When Expecting 1.40 Total Strikes over a 7-year Period in the NWTT Study Area

Predicted Number of Strikes Per Year	NWTT Study Area
No strikes	25%
1 strike	35%
2 strikes	24%
3 strikes	11%

As indicated in Section 3.0.3.4.2 (Vessels), most Navy activities involve the use of vessels. These activities could be widely dispersed throughout the Study Area and the year. Under the two action alternatives in NWTT, the proposed actions would not result in any appreciable changes from the frequency and manner in which the Navy has operated vessels and would remain consistent with the range of variability observed over the last decade. Consequently, the Navy is not significantly changing the locations or frequency at which vessels are used and therefore does not anticipate a change in the number of strikes expected to occur. The difference in the number of events between Alternative 1 and Alternative 2 is described in Section 3.0.3.4.2 (Vessels) and is not likely to change the low probability of a vessel strike in any meaningful way.

There has been no significant development since the 2015 NWTT Final EIS/OEIS with regard to the potential for physical disturbance from in-water devices such as torpedoes or unmanned surface or submerged vehicles. For a discussion on the types of activities that use in-water devices see Appendix B (Activity Stressor Matrices), and for where they are used and how many events would occur under each alternative, see Section 3.0.3.4.3 (In-Water Devices) and Table 3.0-13. As presented in the 2015 NWTT Final EIS/OEIS (Section 3.4.3.4.2, Impacts from In-water Device Strikes), there have been no recorded or reported instances of a marine species strike by a torpedo or any other Navy in-water device at any location in the world before 2015, and there have been none since. For this reason, physical disturbance and strike impacts from in-water devices are not expected.

Consistent with analysis in the 2015 NWTT Final EIS/OEIS and the action alternatives in this Supplemental as shown in Tables 3.0-12 and 3.0-13, none of the action alternatives have any appreciable changes in locations or frequency of Navy vessel or in-water device use. Although Navy vessel and in-water device use varies based on military missions and combat operations (e.g., world crisis, disaster relief, humanitarian assistance), planned and unplanned deployment vessel and in-water device availability due to maintenance, and funding and logistic concerns, future vessel and in-water device use in the Study Area is projected to remain within the range of variability observed over the last decade.

3.4.2.4.1.1 Impacts from Vessels and In-Water Devices Under Alternative 1 for Vessel Movement

Under Alternative 1 and as shown on Tables 3.0-12 and 3.0-13, use of vessels and in-water devices will increase over the ongoing levels of activity in the Offshore and Inland Waters portions of the Study Area, but decrease in Behm Canal. Based on the analysis presented above, the Navy does not expect a vessel or in-water device strike to occur. However, under Alternative 1 the Navy is seeking authorization for a take to account for the possibility of an accidental strike and the potential risk associated with any Navy vessel movement within the Study Area. The Navy will request authorization for mortality or serious injury from vessel strike to no more than one large whale in any given year of the following species: blue whale, fin whale, Eastern North Pacific gray whale, Hawaii DPS humpback whale, minke whale, sei whale, or sperm whale.

The use of vessels and in-water devices as described under Alternative 1 is not expected to but may result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of vessels and in-water devices, as described under Alternative 1, may overlap Southern Resident killer whale critical habitat and may affect ESA-listed marine mammals. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

3.4.2.4.1.2 Impacts from Vessels and In-Water Devices Under Alternative 2 for Vessel Movement

Under Alternative 2 and as shown in Tables 3.0-12 and 3.0-13, the proposed use of vessels and in-water devices will increase over Alternative 1 and ongoing levels of activity in the Offshore and Inland Waters portions of the Study Area, but decrease in Behm Canal. There would be no meaningful difference in the use of vessels and in-water devices between Alternative 1 and Alternative 2, so the predicted impacts would be the same as described above in Section 3.4.2.4.1.1 (Impacts from Vessels and In-water Devices Under Alternative 1 for Vessel Movement) regarding impacts from vessels and in-water devices. Under Alternative 2, the Navy is seeking authorization for a take to account for the possibility of an accidental strike and the potential risk associated with any Navy vessel movement within the Study Area. The Navy will request authorization for mortality or serious injury from vessel strike to no more than one large whale in any given year of the following species: blue whale, fin whale, Eastern North Pacific gray whale, Hawaii DPS humpback whale, minke whale, sei whale, or sperm whale.

The use of vessels and in-water devices as described under Alternative 2 is not expected to but may result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of vessels and in-water devices, as described under Alternative 2, may overlap Southern Resident killer whale critical habitat and may affect ESA-listed marine mammals.

3.4.2.4.1.3 Impacts from Vessels and In-Water Devices 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. Other military activities not associated with this Proposed Action would continue to occur. Vessels and in-water devices 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 vessels and in-water devices within the marine environment where training and testing activities have historically been conducted. Therefore, discontinuing Navy training and testing activities under the No Action Alternative would lessen the potential for impacts from vessels and in-water devices on individual marine mammals, but would not measurably improve the status of marine mammal populations or subpopulations.

3.4.2.4.2 Impacts from Military Expended Materials

For the analysis of impacts from military expended material as physical disturbance stressors, see Section 3.4.3.4.3 (Impacts from Military Expended Material) in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015c; 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 marine mammals 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.

3.4.2.4.2.1 Impacts from Military Expended Material Under Alternative 1

Impacts from Military Expended Material Under Alternative 1 for Training Activities

Under Alternative 1 and as presented in Section 3.0 (Introduction), training activities using military expended materials will decrease in comparison to the 2015 NWTT Final EIS/OEIS (Tables 3.0-14 through 3.0-17). While the number of training activities using military expended material would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015c; National Oceanic and Atmospheric Administration, 2015a) remain valid; physical disturbance and strike impacts to marine mammals resulting from military expended materials are not expected.

The use of military expended material during training activities as described under Alternative 1 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of military expended material during training activities, as described under Alternative 1, may overlap Southern Resident killer whale critical habitat and may affect ESA-listed marine mammals. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

Impacts from Military Expended Material Under Alternative 1 for Testing Activities

Under Alternative 1 and as presented in Section 3.0 (Introduction), testing activities using military expended materials will decrease in comparison to the 2015 NWTT Final EIS/OEIS (Tables 3.0-14 through 3.0-17). While the number of testing activities using military expended material would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015c; National Oceanic and Atmospheric Administration, 2015a) remain valid; physical disturbance and strike impacts to marine mammals resulting from military expended materials are not expected.

The use of military expended material during testing activities as described under Alternative 1 would not result in the incidental taking of marine mammal.

Pursuant to the ESA, military expended material during testing activities, as described under Alternative 1, may overlap Southern Resident killer whale critical habitat and may affect ESA-listed marine mammals. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

3.4.2.4.2.2 Impacts from Military Expended Material Under Alternative 2

Impacts from Military Expended Material Under Alternative 2 for Training Activities

Under Alternative 2 and as presented in Section 3.0 (Introduction), training activities using military expended materials will increase in comparison to the 2015 NWTT Final EIS/OEIS and Alternative 1 (Tables 3.0-14 through 3.0-17). While the number of training activities using military expended material would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015c; National

Oceanic and Atmospheric Administration, 2015a) remain valid; physical disturbance and strike impacts to marine mammals resulting from military expended materials are not expected.

The use of military expended material during training activities as described under Alternative 2 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of military expended material during training activities, as described under Alternative 2, may overlap Southern Resident killer whale critical habitat and may affect ESA listed marine mammals.

Impacts from Military Expended Material Under Alternative 2 for Testing Activities

Under Alternative 2 and as presented in Section 3.0 (Introduction), testing activities using military expended materials will increase in comparison to the 2015 NWTT Final EIS/OEIS and Alternative 1 (Tables 3.0-14 through 3.0-17). While the number of testing activities using military expended material would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015c; National Oceanic and Atmospheric Administration, 2015a) remain valid; physical disturbance and strike impacts to marine mammals resulting from military expended materials are not expected.

The use of military expended material during testing activities as described under Alternative 2 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of military expended material during testing activities, as described under Alternative 2, may overlap Southern Resident killer whale critical habitat and may affect ESA-listed marine mammals.

3.4.2.4.2.3 Impacts from Military Expended Material 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. Other military activities not associated with this Proposed Action would continue to occur. Military expended material 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 military expended materials 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 military expended materials on individual marine mammals, but would not measurably improve the status of marine mammal populations or subpopulations.

3.4.2.4.3 Impacts from Seafloor Devices

For the analysis of impacts from seafloor devices as physical disturbance stressors, see Section 3.4.3.4.4 (Impacts from Seafloor Devices) in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015c; 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 seafloor devices as presented in the 2015 analyses. There have been no known instances of physical disturbance or strike to any marine mammals as a result of training and testing activities involving the use of seafloor devices prior to or since the 2015 NWTT Final EIS/OEIS.

3.4.2.4.3.1 Impacts from Seafloor Devices Under Alternative 1

Impacts from Seafloor Devices Under Alternative 1 for Training Activities

Under Alternative 1 and as presented in Section 3.0 (Introduction), training activities that use seafloor devices will increase in comparison to the 2015 NWTT Final EIS/OEIS (Table 3.0-18). While the number of training activities using seafloor devices would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015c; National Oceanic and Atmospheric Administration, 2015a) remain valid; physical disturbance and strike impacts to marine mammals resulting from seafloor devices are not expected.

The use of seafloor devices during training activities as described under Alternative 1 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of seafloor devices during training activities, as described under Alternative 1, would have no effect on Southern Resident killer whale critical habitat. The use of seafloor devices may affect ESA-listed marine mammals. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

Impacts from Seafloor Devices Under Alternative 1 for Testing Activities

Under Alternative 1 and as presented in Section 3.0 (Introduction), testing activities that use seafloor devices will increase in comparison to the 2015 NWTT Final EIS/OEIS (Table 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, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015c; National Oceanic and Atmospheric Administration, 2015a) remain valid; physical disturbance and strike impacts to marine mammals resulting from seafloor devices are not expected.

The use of seafloor devices during testing activities as described under Alternative 1 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of seafloor devices during testing activities, as described under Alternative 1, may overlap Southern Resident killer whale critical habitat and may affect ESA-listed marine mammals. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

3.4.2.4.3.2 Impacts from Seafloor Devices Under Alternative 2

Impacts from Seafloor Devices Under Alternative 2 for Training Activities

Under Alternative 2 and as presented in Section 3.0 (Introduction), training activities that use seafloor devices will increase in comparison to the 2015 NWTT Final EIS/OEIS but are the same as proposed under Alternative 1 (Table 3.0-18). While the number of training activities using seafloor devices would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015c; National Oceanic and Atmospheric Administration, 2015a) remain valid; physical disturbance and strike impacts to marine mammals resulting from seafloor devices are not expected.

The use of seafloor devices during training activities as described under Alternative 2 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of seafloor devices during training activities, as described under Alternative 2, would have no effect on Southern Resident killer whale critical habitat. The use of seafloor devices may affect ESA-listed marine mammals.

Impacts from Seafloor Devices Under Alternative 2 for Testing Activities

Under Alternative 2 and as presented in Section 3.0 (Introduction), testing activities that use seafloor devices will increase in comparison to the 2015 NWTT Final EIS/OEIS and as proposed under Alternative 1 (Table 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, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015c; National Oceanic and Atmospheric Administration, 2015a) remain valid; physical disturbance and strike impacts to marine mammals resulting from seafloor devices are not expected.

The use of seafloor devices during testing activities as described under Alternative 2 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of seafloor during testing activities, as described under Alternative 2, may affect ESA-listed marine mammals, but may overlap Southern Resident killer whale critical habitat.

3.4.2.4.3.3 Impacts from Seafloor Devices 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. Other military activities not associated with this Proposed Action would continue to occur. Seafloor devices 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 seafloor devices 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 seafloor devices on individual marine mammals, but would not measurably improve the status of marine mammal populations or subpopulations.

3.4.2.5 Entanglement Stressors

The entanglement stressors that may impact marine mammals include (1) wires and cables, (2) decelerators/parachutes, and (3) biodegradable polymer. Biodegradable polymer is a new sub-stressor not previously analyzed in the 2015 NWTT Final EIS/OEIS. For the analysis of wires and cables and decelerators/parachutes as entanglement stressors, see Section 3.4.3.5 (Entanglement Stressors) in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015c; National Oceanic and Atmospheric Administration, 2015a).

3.4.2.5.1 Impacts from Wires and Cables

Wires and cables include fiber optic cables, guidance wires, and sonobuoy wires as detailed in Section 3.0 (Introduction) 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 involving the use of wires and cables associated with Navy training and testing activities prior to or since the 2015 NWTT Final EIS/OEIS.

3.4.2.5.1.1 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), training activities that use wires and cables will increase in comparison to the 2015 NWTT Final EIS/OEIS (Table 3.0-19). While the number of training activities using wires and cables would increase as proposed under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), 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; entanglement impacts to marine mammals resulting from wires and cables associated with Navy activities are not expected.

The use of wires and cables during training activities as described under Alternative 1 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of wires and cables during training activities, as described under Alternative 1, would have no effect on Southern Resident killer whale critical habitat. The use of wires and cables may affect ESA-listed marine mammals. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

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

Under Alternative 1 and as presented in Section 3.0 (Introduction), testing activities that use wires and cables will increase in comparison to the 2015 NWTT Final EIS/OEIS (Table 3.0-19). While the number of testing activities using wires and cables would increase under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), 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; entanglement impacts to marine mammals resulting from wires and cables associated with Navy activities are not expected.

The use of wires and cables during testing activities as described under Alternative 1 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of wires and cables during testing activities, as described under Alternative 1, may overlap Southern Resident killer whale critical habitat and may affect ESA-listed marine mammals. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

3.4.2.5.1.2 Impacts from Wires and Cables Under Alternative 2

Impacts from Wires and Cables Under Alternative 2 for Training Activities

Under Alternative 2 and as presented in Section 3.0 (Introduction), training activities that use wires and cables will increase in comparison to the 2015 NWTT Final EIS/OEIS and in comparison to Alternative 1 (Table 3.0-19). While the number of training activities using wires and cables would increase as proposed under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), 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; entanglement impacts to marine mammals resulting from wires and cables associated with Navy activities are not expected.

The use of wires and cables during training activities as described under Alternative 2 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of wires and cables during training activities, as described under Alternative 2, would have no effect on Southern Resident killer whale critical habitat. The use of wires and cables may affect ESA-listed marine mammals.

Impacts from Wires and Cables Under Alternative 2 for Testing Activities

Under Alternative 2 and as presented in Section 3.0 (Introduction), testing activities that use wires and cables will increase in comparison to the 2015 NWTT Final EIS/OEIS and in comparison to Alternative 1 (Table 3.0-19). While the number of testing activities using wires and cables would increase proposed under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), 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; entanglement impacts to marine mammals resulting from wires and cables associated with Navy activities are not expected.

The use of wires and cables during testing activities as described under Alternative 2 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of wires and cables during testing activities, as described under Alternative 2, may overlap Southern Resident killer whale critical habitat and may affect ESA-listed marine mammals.

3.4.2.5.1.3 Impacts from Wires and Cables 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. Other military activities not associated with this Proposed Action would continue to occur. Wires and cables 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 wires and cables 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 wires and cables on individual marine mammals, but would not measurably improve the status of marine mammal populations or subpopulations.

3.4.2.5.2 Impacts from Decelerators/Parachute

Decelerators/parachutes are described in Section 3.0 (Introduction) 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 decelerators/parachutes as presented in the 2015 analyses. There have been no known instances of entanglement of any marine mammals as a result of Navy training and testing activities involving the use of decelerators/parachutes prior to or since the 2015 NWTT Final EIS/OEIS.

3.4.2.5.2.1 Impacts from Decelerators/Parachutes Under Alternative 1

<u>Impacts from Decelerators/Parachutes Under Alternative 1 for Training Activities</u>

Under Alternative 1 and as presented in Section 3.0 (Introduction), training activities that use decelerators/parachutes will increase in comparison to the 2015 NWTT Final EIS/OEIS (Table 3.0-20). While the number of training activities using decelerators/parachutes would increase as proposed under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), 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; entanglement impacts to marine mammals resulting from decelerators/parachutes associated with Navy activities are not expected.

The use of decelerators/parachutes during training activities as described under Alternative 1 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of decelerators/parachutes during training activities, as described under Alternative 1, would have no effect on Southern Resident killer whale critical habitat. The use of decelerators/parachutes may affect ESA-listed marine mammals. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

<u>Impacts from Decelerators/Parachutes Under Alternative 1 for Testing Activities</u>

Under Alternative 1 and as presented in Section 3.0 (Introduction), testing activities that use decelerators/parachutes will increase in comparison to the 2015 NWTT Final EIS/OEIS (Table 3.0-20). While the number of testing activities using decelerators/parachutes would increase as proposed under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), 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; entanglement impacts to marine mammals resulting from decelerators/parachutes associated with Navy activities are not expected.

The use of decelerators/parachutes during testing activities as described under Alternative 1 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of decelerators/parachutes during testing activities, as described under Alternative 1, would have no effect on Southern Resident killer whale critical habitat. The use of decelerators/parachutes may affect ESA-listed marine mammals. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

3.4.2.5.2.2 Impacts from Decelerators/Parachutes Under Alternative 2

Impacts from Decelerators/Parachutes Under Alternative 2 for Training Activities

Under Alternative 2 and as presented in Section 3.0 (Introduction), training activities that use decelerators/parachutes will increase in comparison to the 2015 NWTT Final EIS/OEIS and as proposed under Alternative 1 (Table 3.0-20). While the number of training activities using decelerators/parachutes would increase as proposed under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), 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; entanglement impacts to marine mammals resulting from decelerators/parachutes associated with Navy activities are not expected.

The use of decelerators/parachutes during training activities as described under Alternative 2 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of decelerators/parachutes during training activities, as described under Alternative 2, would have no effect on Southern Resident killer whale critical habitat. The use of decelerators/parachutes may affect ESA-listed marine mammals.

Impacts from Decelerators/Parachutes Under Alternative 2 for Testing Activities

Under Alternative 2 and as presented in Section 3.0 (Introduction), testing activities that use decelerators/parachutes will increase in comparison to the 2015 NWTT Final EIS/OEIS and as proposed under Alternative 1 (Table 3.0-20). While the number of testing activities using decelerators/parachutes would increase as proposed under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), 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; entanglement impacts to marine mammals resulting from decelerators/parachutes associated with Navy activities are not expected.

The use of decelerators/parachutes during testing activities as described under Alternative 2 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of decelerators/parachutes during testing activities, as described under Alternative 2, would have no effect on Southern Resident killer whale critical habitat. The use of decelerators/parachutes may affect ESA-listed marine mammals.

3.4.2.5.2.3 Impacts from Decelerators/Parachutes 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. Other military activities not associated with this Proposed Action would continue to occur. Decelerators/parachutes 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 decelerators/parachutes 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 decelerators/parachutes on individual marine mammals, but would not measurably improve the status of marine mammal populations or subpopulations.

3.4.2.5.3 Impacts from Biodegradable Polymer

A new type of expended material is used during the existing countermeasure testing activity that involves the use of biodegradable polymers. The proposed use of biodegradable polymers in this Supplemental is in addition to other entanglement stressors that were previously analyzed in the 2015 NWTT Final EIS/OEIS. Marine vessel stopping payloads are systems designed to deliver the appropriate measure(s) to affect a vessel's propulsion and associated control surfaces to significantly slow and potentially stop the advance of the vessel. Marine vessel stopping proposed activities include the use of biodegradable polymers. The biodegradable polymers that the Navy uses are designed to temporarily interact with the propeller(s) of a target craft rendering the craft ineffective. Based on the constituents of the biodegradable polymer the Navy proposes to use, it is anticipated that the material will break down into small pieces within a few days to weeks. This will break down further and dissolve into the water column within weeks to a few months. The final products, which are all environmentally benign, will be dispersed quickly to undetectable concentrations. Unlike other entanglement stressors, biodegradable polymers only retain their strength for a relatively short period of time; therefore, the potential for entanglement by a marine mammal would be limited. Furthermore, the longer the biodegradable polymer remains in the water, the weaker it becomes, making it more brittle and likely to break. A marine mammal would have to encounter the biodegradable polymer immediately after it was expended for it to be a potential entanglement risk. If an animal were to encounter the polymer a few hours after it was expended, it is very likely that it would break easily and would no longer be an entanglement stressor.

3.4.2.5.3.1 Impacts from Biodegradable Polymers Under Alternative 1

Impacts from Biodegradable Polymers Under Alternative 1 for Training Activities

Biodegradable polymers would not be used during training activities under Alternative 1.

Impacts from Biodegradable Polymers Under Alternative 1 for Testing Activities

Biodegradable polymers were not part of the proposed action analyzed in the 2015 NWTT Final EIS/OEIS. Under Alternative 1 in this Supplemental and as presented in Section 3.0 (Introduction), testing activities that involve marine vessel stopping payloads using biodegradable polymer will occur in the Inland Waters portion of the Study Area a maximum of four times annually (Table 3.0-21). Marine mammals most likely to be present in the Dabob Bay Range Complex or at the Keyport Range are harbor porpoise, harbor seal, California sea lion, and Steller sea lion, although it is possible for any marine mammal species inhabiting the Inland Waters portion of the Study Area to be at either of those two locations.

As detailed for Southern Resident killer whales in Section 3.4.1.16.1 (Status and Management), the designated Southern Resident killer whale critical habitat includes most of the Inland Waters portion of the Study Area but does not include any of Hood Canal (where the Dabob Bay Range Complex is located), the Keyport Range Site, or waters shallower than 20 ft. (6.1 m) relative to the extreme high water tidal datum as detailed in (National Marine Fisheries Service, 2016c; National Marine Fisheries Service: Northwest Region, 2006). The primary constituent elements of the Southern Resident killer whale’s critical habitat have been identified as (1) water quality to support growth and development; (2) prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth; and (3) passage conditions to allow for migration, resting, and foraging (National Marine Fisheries Service: Northwest Region, 2006). At the Keyport Range, there is only limited overlap between the periphery of the range site and the designated Southern Resident killer whale's critical habitat (National Marine Fisheries Service, 2010), but more importantly, none of the elements of the critical habitat should be impacted by the use of biodegradable polymers in those portions of the Keyport Range that do overlap the critical habitat.

The number of proposed testing activities involving biodegradable polymers in the Inland Waters is relatively low. Based on this limited number of annual activities, the concentration of biodegradable polymers within the two Inland Waters locations of the Study Area would likewise be low, and the Navy does not anticipate that any marine mammals would become entangled by biodegradable polymers.

The use of biodegradable polymers during testing activities as described under Alternative 1 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of biodegradable polymers during testing activities, as described under Alternative 1, would have no effect on Southern Resident killer whale critical habitat. The use of biodegradable polymers may affect ESA-listed marine mammals. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

3.4.2.5.3.2 Impacts from Biodegradable Polymers Under Alternative 2

Impacts from Biodegradable Polymers Under Alternative 2 for Training Activities

Biodegradable polymers would not be used during training activities under Alternative 2.

Impacts from Biodegradable Polymers Under Alternative 2 for Testing Activities

Biodegradable polymers were not part of the proposed action analyzed in the 2015 NWTT Final EIS/OEIS. The proposed use of biodegradable polymers under Alternative 2 in this Supplemental is the same as under Alternative 1 (see Table 3.0-21). As a result, the expected impacts are the same between the two alternatives and as described in detail above under Alternative 1; Navy does not anticipate that any marine mammals would become entangled by biodegradable polymers.

The use of biodegradable polymers during testing activities as described under Alternative 2 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of biodegradable polymers during testing activities, as described under Alternative 2, would have no effect on Southern Resident killer whale critical habitat. The use of biodegradable polymers may affect ESA-listed marine mammals.

3.4.2.5.3.3 Impacts from Biodegradable Polymers 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. Other military activities not associated with this Proposed Action would continue to occur. Biodegradable polymers 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 biodegradable polymers within the marine environment where training and testing activities have historically been conducted. Therefore, discontinuing training and testing activities would lessen the potential for impacts from biodegradable polymers on individual marine mammals, but would not measurably improve the status of marine mammal populations or subpopulations.

3.4.2.6 Ingestion Stressors

The ingestions stressors that may impact marine mammals 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, decelerators/parachutes, and biodegradable polymers) as detailed in Section 3.0.3.6 (Ingestion Stressors) in this Supplemental. Use of biodegradable polymer as part of an existing testing activity is a new ingestion stressor that was not previously analyzed in the 2015 NWTT Final EIS/OEIS, but it has been analyzed in this Supplemental as part of military expended materials – other than munitions.

3.4.2.6.1 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 marine mammals prior to or since the 2015 NWTT Final EIS/OEIS.

3.4.2.6.1.1 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 (Introduction), Tables 3.0-14 and 3.0-16, training use of military expended materials – munitions will decrease in comparison to ongoing activities and as discussed in the 2015 NWTT Final EIS/OEIS. While training use of military expended material would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015c; National Oceanic and Atmospheric Administration, 2015a) would not change. NMFS determined that use of ingestion stressors would not result in the incidental taking of marine mammals pursuant to the MMPA and that the likelihood of ESA-listed species ingesting expended materials was so low as to be discountable and therefore was not likely to adversely affect ESA-listed species. Given that under Alternative 1, the use of military expended materials – munitions has decreased in comparison to the 2015 analyses, impacts to marine mammal from military expended materials – munitions as ingestion stressors is not expected.

The use of military expended materials – munitions during training activities as described under Alternative 1 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of military expended materials – munitions during training activities, as described under Alternative 1, may overlap Southern Resident killer whale critical habitat and may affect ESA-listed marine mammals. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

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

Under Alternative 1 and as presented in Section 3.0 (Introduction), Tables 3.0-14 and 3.0-16, testing use of military expended materials – munitions will increase in comparison to ongoing activities and as discussed 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, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015c; National Oceanic and Atmospheric Administration, 2015a) would not change. NMFS determined that use of ingestion stressors would not result in the incidental taking of marine mammals pursuant to the MMPA and that the likelihood of ESA-listed species ingesting expended materials was so low as to be discountable and therefore was not likely to adversely affect ESA-listed species. Given that under Alternative 1, the use of military expended materials – munitions has decreased in comparison to the 2015 analyses, impacts to marine mammal from military expended materials – munitions as ingestion stressors is not expected.

The use of military expended materials – munitions during testing activities as described under Alternative 1 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of military expended materials – munitions during testing activities, as described under Alternative 1, would have no effect on Southern Resident killer whale critical habitat. The use of military expended materials – munitions may affect ESA-listed marine mammals. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

3.4.2.6.1.2 Impacts from Military Expended Materials – Munitions Under Alternative 2

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

Under Alternative 2 and as presented in Section 3.0 (Introduction), Tables 3.0-14 and 3.0-16, training use of military expended materials – munitions will increase slightly (by less than 1 percent) in comparison to ongoing activities and as discussed in the 2015 NWTT Final EIS/OEIS and proposed under Alternative 1. While training use of military expended material would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015c; National Oceanic and Atmospheric Administration, 2015a) would not change. NMFS determined that use of ingestion stressors would not result in the incidental taking of marine mammals pursuant to the MMPA and that the likelihood of ESA-listed species ingesting expended materials was so low as to be discountable and therefore was not likely to adversely affect ESA-listed species. Impacts as ingestion stressors from the use of military expended materials – munitions are not expected.

The use of military expended materials – munitions during training activities as described under Alternative 2 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of military expended materials – munitions during training activities, as described under Alternative 2, may overlap Southern Resident killer whale critical habitat and may affect ESA-listed marine mammals.

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 will increase in comparison to ongoing activities and are the same as under Alternative 1 in this Supplemental. Given the alternatives are the same and as presented above for Alternative 1 for testing, impacts from ingestion stressors from the use of military expended materials – munitions are not expected.

The use of military expended materials – munitions during testing activities as described under Alternative 1 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of military expended materials – munitions during testing activities, as described under Alternative 1, would have no effect on Southern Resident killer whale critical habitat. The use of military expended materials – munition may affect ESA-listed marine mammals.

3.4.2.6.1.3 Impacts from Military Expended Materials – Munitions 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. Other military activities not associated with this Proposed Action would continue to occur. Military expended materials 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 military expended materials 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 military expended materials on individual marine mammals, but would not measurably improve the status of marine mammal populations or subpopulations.

3.4.2.6.2 Impacts from Military Expended Materials – Other than Munitions

There is a new type of expended material used during the existing countermeasure testing activity that involves the use of biodegradable polymers. The proposed use of biodegradable polymers for testing activities in this Supplemental is in addition to other ingestion stressors that were previously analyzed in the 2015 NWTT Final EIS/OEIS. For the analysis of all other military expended materials – other than munitions ingestion stressors, see Section 3.4.3.6 (Ingestion Stressors) in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015c; National Oceanic and Atmospheric Administration, 2015a).

As stated in Section 3.0.3.5.3 (Biodegradable Polymer), based on the constituents of the biodegradable polymer the Navy proposes to use, it is anticipated that the material will break down into small pieces within a few days to weeks. This will break down further and dissolve into the water column within weeks to a few months. These small pieces will break down further and dissolve into the water column within weeks to a few months and could potentially be incidentally ingested by marine mammals. The final products, which are all environmentally benign, will be dispersed quickly to undetectable concentrations. Because the final products of the breakdown are all environmentally benign, the Navy does not expect the use of biodegradable polymer to have any negative impacts for marine mammals.

As detailed for Southern Resident killer whales in Section 3.4.1.16.1 (Status and Management), the designated Southern Resident killer whale critical habitat includes most of the Inland Waters portion of the Study Area, but does not include any of Hood Canal (where the Dabob Bay Range Complex is located) or the 18 DoD installations within Puget Sound as detailed in (National Marine Fisheries Service, 2016c; National Marine Fisheries Service: Northwest Region, 2006). The primary constituent elements of the Southern Resident killer whale's critical habitat have been identified as (1) water quality to support growth and development; (2) prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth; and (3) passage conditions to allow for migration, resting, and foraging (National Marine Fisheries Service: Northwest Region, 2006). At Keyport there may be some overlap with the designated critical habitat and the use of biological polymers, but none of the features of the critical habitat should be impacted by the use of biodegradable polymers at that location.

3.4.2.6.2.1 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 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 will decrease in comparison to ongoing activities and as discussed in the 2015 NWTT Final EIS/OEIS. The new biodegradable polymers ingestion sub stressor would not be used during training activities under Alternative 1. While training use of military expended material would change under this Supplemental, the analysis presented in Section 3.4.3.6 (Ingestion Stressors) in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015c; National Oceanic and Atmospheric Administration, 2015a) would not change. NMFS determined that use of ingestion stressors would not result in the incidental taking of marine mammals pursuant to the MMPA and that the likelihood of ESA-listed species ingesting expended materials was so low as to be discountable and therefore was not likely to adversely affect ESA-listed species. Given that under Alternative 1, the use of military expended materials – other than munitions has decreased in comparison to the 2015 analyses, impacts to marine mammal from military expended materials – other than munitions as ingestion stressors is not expected.

The use of military expended materials – other than munitions during training activities as described under Alternative 1 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of military expended materials – other than munitions during training activities, as described under Alternative 1, would have no effect on Southern Resident killer whale critical habitat. The use of military expended materials – other than munitions may affect ESA-listed marine mammals. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

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

Under Alternative 1 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 will increase in comparison to ongoing activities and as discussed in the 2015 NWTT Final EIS/OEIS. This includes testing activities that use biodegradable polymers, which are proposed to be conducted in the Dabob Bay Range Complex and at the Keyport Range. Marine mammals most likely to be present in the Dabob Bay Range Complex or at Keyport are harbor porpoise, harbor seal, California sea lion, and Steller sea lion. The number of proposed testing activities involving biodegradable polymers is relatively low (a maximum of four times annually), as shown in Section 3.0.3.5.3 (Biodegradable Polymer), Table 3.0-21. In addition, biodegradable polymer fragments would only be temporarily available within the water column as they tend to disintegrate fairly quickly. Because the final products of the breakdown are all environmentally benign, the Navy does not expect the use biodegradable polymer to have any negative impacts for marine mammals.

While training use of military expended material would change under this Supplemental, the analysis presented in Section 3.4.3.6 (Ingestion Stressors) in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015c; National Oceanic and Atmospheric Administration, 2015a) would not change. NMFS determined that use of ingestion stressors would not result in the incidental taking of marine mammals pursuant to the MMPA and that the likelihood of ESA-listed species ingesting expended materials was so low as to be discountable and therefore was not likely to adversely affect ESA-listed species. Therefore, impacts on marine mammals from ingestion stressors under Alternative 1 are not expected.

The use of military expended materials – other than munitions during testing activities as described under Alternative 1 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of military expended materials – other than munitions during testing activities, as described under Alternative 1, would have no effect on Southern Resident killer whale critical habitat. The use of military expended materials – other than munitions may affect ESA-listed marine mammals. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA.

3.4.2.6.2.2 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 will slightly increase in comparison to ongoing activities and Alternative 1. The new biodegradable polymers ingestion sub stressor would not be used during training activities under Alternative 2. While training use of military expended material would change under this Supplemental, the analysis presented in Section 3.4.3.6 (Ingestion Stressors) in the 2015 NWTT Final EIS/OEIS, the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015c; National Oceanic and Atmospheric Administration, 2015a) would not change. NMFS determined that use of ingestion stressors would not result in the incidental taking of marine mammals pursuant to the MMPA and that the likelihood of ESA-listed species ingesting expended materials was so low as to be discountable and therefore was not likely to adversely affect ESA-listed species. Impacts to marine mammal from military expended materials – other than munitions as ingestion stressors is not expected.

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 will increase in comparison to ongoing activities and are the same as proposed under Alternative 1 in this Supplemental. Given the alternatives are the same and as presented above for Alternative 1 for testing, the conclusions are the same. Impacts from ingestion stressors from the use of military expended materials – other than munitions are not expected.

The use of military expended materials – other than munitions during testing activities as described under Alternative 2 would not result in the incidental taking of marine mammals.

Pursuant to the ESA, the use of military expended materials – other than munitions during testing activities, as described under Alternative 2, would have no effect on Southern Resident killer whale critical habitat. The use of military expended materials – other than munitions may affect ESA-listed marine mammals.

3.4.2.6.2.3 Impacts from Military Expended Materials – Other than Munitions 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. Other military activities not associated with this Proposed Action would continue to occur. Military expended materials 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 military expended materials 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 military expended materials on individual marine mammals, but would not measurably improve the status of marine mammal populations or subpopulations.

3.4.2.7 Impacts from Secondary Stressors

As discussed in Section 3.4.3.7 (Impacts from Secondary Stressors) of the 2015 NWTT Final EIS/OEIS, secondary stressors from military training and testing activities were analyzed for potential indirect impacts on marine mammals via habitat degradation or an effect on prey availability. These stressors included (1) explosives, (2) explosive byproducts and unexploded ordnance, (3) metals, (4) chemicals, and (5) transmission of marine mammal diseases and parasites. Analyses of the potential impacts on sediments and water quality from the proposed training and testing activities were also discussed in detail in Section 3.1 (Sediments and Water Quality) of the 2015 NWTT Final EIS/OEIS. The analysis of explosives, explosive byproducts, metals, chemicals, and the transmission of diseases and parasites and their potential to indirectly impact marine mammals and their habitat has not appreciably changed from the presentation in 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 Final 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., 2015). 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, which 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 Sciences Group, 2005). These analyses concluded the Navy test activities "…had limited and perhaps negligible effects on the natural environment" (Environmental Sciences Group, 2005). 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 marine mammals from the training and testing activities in the Study Area would be negligible and would have no long-term effect on habitat.

Secondary stressors from training and testing activities were analyzed for potential indirect impacts on marine mammal prey availability. Underwater explosions could impact other species in the food web, including prey species that marine mammals feed upon. The impacts of explosions would differ depending upon the type of prey species in the area of the detonation. A reduction in availability of prey may cause animals to forage for longer periods, travel to alternate locations, or abandon foraging efforts (National Oceanic and Atmospheric Administration, 2015b). In the 2015 analysis of training and testing within the Study Area, NMFS determined that secondary stressors would not result in harassment and/or the incidental taking of marine mammals from Navy training and testing activities (National Oceanic and Atmospheric Administration, 2015b) and that secondary stressors would not result in significant adverse impacts or jeopardize the continued existence of any ESA listed marine mammals (National Marine Fisheries Service, 2014).

3.4.3 Summary of Impacts (Combined Impacts of All Stressors) on Marine Mammals

As listed in Section 3.0.3 (Identification of Stressors for Analysis), this section evaluates the potential for combined impacts of all identified stressors resulting from the Proposed Action. The analysis and conclusions for the potential impacts from each of the individual stressors are discussed in Sections 3.4.2.1 (Acoustic Stressors) through 3.4.2.7 (Impacts from Secondary Stressors) and, for ESA-listed species, summarized in Section 3.4.4 (Endangered Species Act Determinations).

Understanding the combined effects of stressors on marine organisms in general and marine mammal populations in particular is extremely difficult to predict (National Academies of Sciences Engineering and Medicine, 2017). Recognizing the difficulties with measuring trends in marine mammal populations, the focus has been on indicators for adverse impacts, including health and other population metrics (National Academies of Sciences Engineering and Medicine, 2017). This recommended use of population indicators is the approach Navy presented in the 2015 NWTT Final EIS/OEIS Section 3.4.3 (Summary of Impacts [Combined Impacts of All Stressors] on Marine Mammals) and formed part of the 2015 analyses by NMFS in their MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), and the Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2014).

Stressors associated with military readiness activities do not typically occur in isolation but rather occur in some combination. For example, mine neutralization activities include elements of acoustic, physical disturbance and strike, entanglement, ingestion, and secondary stressors that are all coincident in space and time. An analysis of the combined impacts of all stressors considers the potential consequences of additive stressors and synergistic stressors, as described below. This analysis makes the reasonable assumption, which is supported by the Navy Acoustic Effects Model, that the majority of exposures to stressors are non-lethal, and instead focuses on consequences potentially impacting marine mammal fitness (e.g., physiology, behavior, reproductive potential).

There are generally two ways that a marine mammal could be exposed to multiple additive stressors. The first would be if a marine mammal were exposed to multiple sources of stress from a single event or activity within a single event (e.g., a mine warfare event may include the use of a sound source and a vessel). The potential for a combination of these impacts from a single activity would depend on the range to effects of each of the stressors and the response or lack of response to that stressor. Most of the activities proposed under Alternative 1 generally involve the use of moving platforms (e.g., ships, torpedoes, and aircraft) that may produce one or more stressors; therefore, it is likely that if a marine mammal were within the potential impact range of those activities, it may be impacted by multiple stressors simultaneously. Individual stressors that would otherwise have minimal to no impact, may combine to have a measurable response. However, due to the wide dispersion of stressors, speed of the platforms, general dynamic movement of many military readiness activities, and behavioral avoidance exhibited by many marine mammal species, it is very unlikely that a marine mammal would remain in the potential impact range of multiple sources or sequential events. Exposure to multiple stressors is more likely to occur at an instrumented range where military readiness activities using multiple platforms may be concentrated during a particular event. In such cases involving a relatively small area on an instrumented range, a behavioral reaction resulting in avoidance of the immediate vicinity of the activity would reduce the likelihood of exposure to additional stressors. Nevertheless, the majority of the proposed activities are unit-level military readiness activities which are conducted in the open ocean. Unit-level events occur over a small spatial scale (one to a few square miles) and with few participants (usually one or two) or short duration (the order of a few hours or less); larger-scale training and testing events occur in other Navy training and testing locations (e.g., the Southern California Range Complex or the Hawaii Range Complex).

Secondly, a marine mammal could be exposed to multiple military readiness activities over the course of its life; however, military readiness activities are generally separated in space and time in such a way that it would be unlikely that any individual marine mammal would be exposed to stressors from multiple activities within a short timeframe. However, animals with a home range intersecting an area of concentrated Navy activity have elevated exposure risks relative to animals that simply transit the area through a migratory corridor.

Multiple stressors may also have synergistic effects. For example, marine mammals that experience temporary hearing loss or injury from acoustic stressors could be more susceptible to physical strike and disturbance stressors via a decreased ability to detect and avoid threats. Marine mammals that experience behavioral and physiological consequences of ingestion stressors could be more susceptible to entanglement and physical strike stressors via malnourishment and disorientation. These interactions are speculative, and without data on the combination of multiple Navy stressors, the synergistic impacts from the combination of Navy stressors are difficult to predict in any meaningful way. Research and monitoring efforts have included before, during, and after-event observations and surveys, data collection through conducting long-term studies in areas of Navy activity, occurrence surveys over large geographic areas, biopsy of animals occurring in areas of Navy activity, and tagging studies where animals are exposed to Navy stressors. These efforts are intended to contribute to the overall understanding of what impacts may be occurring overall to animals in these areas. To date, the findings from the research and monitoring and the regulatory conclusions from previous analyses by NMFS in the MMPA authorization (National Oceanic and Atmospheric Administration, 2015b) and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2014) have been that the majority of impacts from military readiness activities are not expected to have deleterious impacts on the fitness of any individuals or long-term consequences to populations of marine mammals and not likely to jeopardize listed species or destroy or adversely modify critical habitat.

3.4.3.1 Combined Impacts of All Stressors Under Alternative 1

Although potential impacts on certain marine mammal species from military readiness activities under Alternative 1 may include injury to individuals, those injuries are not expected to lead to long-term consequences for populations. The potential impacts anticipated from Alternative 1 are summarized in Sections 3.4.4 (Endangered Species Act Determinations) and 3.4.5 (Marine Mammal Protection Act Determinations) for each regulation applicable to marine mammals. For a discussion of cumulative impacts, see Chapter 4 (Cumulative Impacts). For a discussion of mitigation, see Chapter 5 (Mitigation).

3.4.3.2 Combined Impacts of All Stressors Under Alternative 2

As detailed previously in this section, some military readiness activities proposed under Alternative 2 would be an increase over what is proposed for Alternative 1. However, this increase is not expected to significantly increase the potential for impacts over what is analyzed for Alternative 1. The analysis presented in Section 3.4.3.1 (Combined Impacts of All Stressors Under Alternative 1) would similarly apply to Alternative 2. The combined Impacts of all stressors for military readiness activities under Alternative 2 are not expected to have deleterious impacts or long-term consequences to populations of marine mammals.

3.4.3.3 Combined Impacts of All Stressors 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. Other military activities not associated with this Proposed Action would continue to occur. The stressors described 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.

3.4.3.4 Summary of Monitoring and Observations During Navy Activities Since 2015

As provided in detail in the 2015 NWTT Final EIS/OEIS Section 3.4.4.1 (Summary of Monitoring and Observations During Navy Activities), the results of previous monitoring and research since 2006 taking place in and around Navy ranges and occurring before, during, and after navy training and testing events, has been included as part of the Navy analyses as well as the analyses by NMFS in their MMPA authorization (National Oceanic and Atmospheric Administration, 2015b), and the Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2014).

Since 2006, the Navy, non-Navy marine mammal scientists, and research groups and institutions have conducted scientific monitoring and research in and around ocean areas in the Atlantic and Pacific where the Navy has been and proposes to continue training and testing. The analysis provided in this Supplemental will be the third time Navy training and testing activities at-sea have been comprehensively analyzed in the Study Area. Data collected from Navy monitoring, scientific research findings, and annual reports have been provided to NMFS, and this public[5] record is informative as part of the analysis of impacts to marine mammals in general for a variety of reasons, including species distribution, habitat use, and evaluation of potential responses to Navy activities.

Monitoring is performed using a variety of methods, including visual surveys from surface vessels and aircraft, as well as passive acoustics before, during, and after Navy activities have been conducted. The Navy also has continued to contribute to funding of basic research, including behavioral response studies specifically designed to determine the effects to marine mammals from the Navy's main mid-frequency surface ship anti-submarine warfare sonar and other acoustic sources of potential impact.

The majority of the training and testing activities Navy is proposing for the foreseeable future in the Study Area are similar if not nearly identical to activities that have been occurring in the same locations for decades. For example, the mid-frequency sonar system on the destroyers homeported in the Study

[5] Navy monitoring reports are available at the Navy website; (www.navymarinespeciesmonitoring.us/) and also at the NMFS website (https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities).

Area has the same sonar system components in the water as those first deployed in the 1970s. While the signal analysis and computing processes onboard these ships have been upgraded with modern technology, the sonar transducers, which puts signals into the water, have not changed. For this reason, the history of past marine mammal observations, research, and monitoring reports remain applicable to the analysis of effects from the proposed future training and testing activities.

It is still the case that in the Pacific, the vast majority of scientific field work, research, and monitoring efforts have been expended in Southern California and Hawaii, where Navy training and testing activities have been more concentrated. Since 2006, the Navy has been submitting exercise reports and monitoring reports to NMFS for the Navy's range complexes in the Pacific and the Atlantic. These publically available exercise reports, monitoring reports, and the associated research findings have been integrated into adaptive management decisions regarding the focus for subsequent research and monitoring as determined in collaborations between Navy, NMFS, Marine Mammal Commission, and other marine resource subject matter experts using an adaptive management approach. For example, see the 2017 U.S. Navy Annual Marine Species Monitoring Report for the Pacific that was made available to the public in April 2018 (U.S. Department of the Navy, 2018a).

In the Study Area, there are no Major Exercises, training and testing events are by comparison to other Navy areas less frequent and are in general small in scope, so as a result the majority of Navy's research effort has been focused elsewhere. Since the 2015 NWTT Final EIS/OEIS, research funded by Navy in the Pacific Northwest has included but is not limited to the following:

- Passive acoustic monitoring, tagging, and data analysis modeling to understand the offshore distribution of Southern Resident killer whales in the Pacific Northwest as executed by the National Marine Fisheries Service Northwest Fisheries Science Center and the Marine Physical Laboratory at Scripps Institution of Oceanography (Hanson et al., 2015, 2017; Hanson et al., 2018; Rice et al., 2017).
- Marine mammal aerial surveys covering the Inland Waters of Puget Sound to better derive the abundance, distribution, and density of populations of marine mammals inhabiting that area. This work was a Navy-funded collaboration between Smultea Environmental Services, National Marine Fisheries Service Alaska Fisheries Science Center, and the Washington Department of Fish & Wildlife (Jefferson et al., 2016; Jefferson et al., 2017; Smultea et al., 2015; Smultea et al., 2017).
- The Pacific Northwest pinniped satellite tracking study performed by National Marine Fisheries Service Alaska Fisheries Science Center and the Washington Department of Fish and Wildlife involved affixing data tags on pinnipeds at Naval Base Bangor, Naval Base Bremerton, Naval Station Everett to establish the baseline habitat movements, distribution, and seasonal use (DeLong et al., 2017).
- Three years of fieldwork involving photo-identification, biopsy, visual survey, and satellite tagging of blue, fin, and humpback whales were undertaken by Oregon State University. This research provided seasonal movement tracks, distribution, and behavior of these species in addition to biopsy samples used for sex determination and individual identifications, as well as stock structure information (Mate et al., 2017; U.S. Department of the Navy, 2018a).

- Continued deployment of passive acoustic recorders (Ecological Acoustic Recorders - EARS) in the waters of Washington State to monitor marine mammal vocalizations (Rice et al., 2015a; Rice et al., 2017; Trickey et al., 2015)
- Deployment of an autonomous passive-acoustic glider survey in the Quinault Range Site off the Washington coast to test the general functionality of the technology for cetacean density estimation (Klinck et al., 2015).

As detailed in the 2015 NWTT Final EIS/OEIS, these reporting, monitoring, and research efforts have added to the baseline data for marine mammals inhabiting the Study Area. In addition, subsequent research and monitoring has continued to broaden the sample of observations regarding the general health of marine mammal populations in locations where Navy has been conducting training and testing activities for decades, which has been considered in the analysis of marine mammal impacts presented in this Supplemental in the same manner that the previous findings were used in the 2015 NWTT Final EIS/OEIS, the NMFS authorization of takes under MMPA (National Oceanic and Atmospheric Administration, 2015b), and the NMFS Biological Opinion pursuant to the ESA (National Marine Fisheries Service, 2014).

This public record of training and testing activities, monitoring, and research from across the Navy range complexes in the Pacific and Atlantic now spans more than 13 years. Given that this record involves many of the same Navy training and testing activities being considered for the Study Area, includes all the marine mammal taxonomic families present in the Study Area, many of the same species, and some of the same populations as they seasonally migrate from other range complexes, this compendium of Navy reporting is directly applicable to the Study Area.

It was the Navy's assessment in the 2015 NWTT Final EIS/OEIS and that of NMFS as reflected in their analysis of previous Navy training and testing in the Study Area (National Marine Fisheries Service, 2014; National Oceanic and Atmospheric Administration, 2015b), that it was unlikely there would be impacts to populations of marine mammals (such as whales, dolphins, and pinnipeds) having any long-term consequences as a result of the proposed continuation of training and testing in the Study Area. This assessment of likelihood is based on four indicators from areas in the Pacific where Navy training and testing has been ongoing for decades: (1) evidence suggesting or documenting increases in the numbers of marine mammals present, (2) examples of documented presence and site fidelity of species and long-term residence by individual animals of some species, (3) use of training and testing areas for breeding and nursing activities, and (4) 13 years of comprehensive monitoring data indicating a lack of any observable effects to marine mammal populations such as direct mortalities or strandings occurring as a result of Navy training and testing activities. Consistent with the presentation in the 2015 NWTT Final EIS/OEIS, the evidence from Navy range complexes to date and since 2015 continues to suggest the viability of marine mammal populations where Navy trains and tests, and an absence of any direct evidence suggesting Navy training and testing has had or may have any long-term consequences to marine mammal populations. Barring any evidence to the contrary, therefore, what limited and evidence there is from the monitoring reports and additional other focused scientific investigations should be considered in the analysis of impacts to marine mammals. For the NWTT Study Area in particular and since the analysis in 2015, examples include:

- the most current information suggesting that the ESA-listed blue whale population in the Pacific, which includes the NWTT Study Area as part of their habitat, may have recovered and been at a stable level based on recent surveys and scientific findings (Barlow, 2016; Campbell et al., 2015; Carretta et al., 2017c; Monnahan et al., 2015; Rockwood et al., 2017; Širović et al., 2015b; Valdivia et al., 2019);

- an increase in sei whales off the Washington and Oregon coast in recent years, with more groups of sei whales sighted in the most recent NMFS survey than in all previous NMFS surveys combined (Barlow, 2016);
- the population of Guadalupe fur seals, which is listed as threatened under the ESA, has been growing and has been expanding their range to include the Pacific Northwest, where they were primarily known only from stranding records and archeological evidence (Aurioles-Gamboa & Camacho-Rios, 2007; Etnier, 2002; Lambourn et al., 2012; National Marine Fisheries Service, 2017a; Norris, 2017b; Rick et al., 2009);
- trend analysis and survey data indicate that the California stock of harbor seals in the NWTT Study Area is at carrying capacity (Carretta et al., 2017d; DeLong & Jeffries, 2017);
- multi-year aerial surveys in Puget Sound, in the Strait of Juan de Fuca, and the San Juan Islands have observed the reoccupation and recovery of harbor porpoises in those waters since the 1970s (Carretta et al., 2017c; Jefferson et al., 2016);
- increases in the numbers of the Pacific Coast Feeding Group of gray whales seasonally feeding along the northern Washington coast and the Strait of Juan de Fuca (Scordino et al., 2017); and
- the increasing number of fin whales seen since 1999 between Vancouver Island and Washington state, "… may reflect recovery of the local populations in the North Pacific" (Towers et al., 2018b).

To summarize and bring up to date the findings from the 2015 NWTT Final EIS/OEIS based on the best available science, the evidence from reporting, monitoring, and research over more than a decade indicates that while the Proposed Action will result in harassment of marine mammals and may include injury to some individuals, these impacts are expected to be inconsequential at the level of their marine mammal populations. There is no direct evidence that routine Navy training and testing spanning decades has negatively impacted marine mammal populations at any Navy Range Complex or the NWTT Study Area. In fact for some of the most intensively used Navy training and testing areas in the Pacific, evidence such as the continued multi-year presence of long-term resident individual animals and small populations (Baird et al., 2015; Baird et al., 2016; Baird et al., 2017; Baird, 2018; Baird et al., 2018; Schorr et al., 2014; Schorr et al., 2018; U.S. Department of the Navy, 2017b), resident females documented with and without calves from year to year, and high abundances on the Navy ranges for some species in comparison to other off-range locations (Moore & Barlow, 2017; Schorr et al., 2018; U.S. Department of the Navy, 2017b) provide indications of generally healthy marine mammal populations. It therefore remains that based on the best available science, including data developed in exercise and monitoring reports submitted to NMFS for more than a decade, that long-term consequences for marine mammal populations are unlikely to result from Navy training and testing activities in the Study Area.

3.4.4 Endangered Species Act Determinations

Pursuant to the ESA, the Navy has determined that the activities presented in this Supplemental may affect the North Pacific right whale, blue whale, fin whale, Western North Pacific gray whale, Mexico DPS humpback whale, Central America DPS humpback whale, sei whale, sperm whale, Eastern North Pacific Southern Resident killer whale, Guadalupe fur seal, and Western DPS Steller sea lion. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA for these listed species. The Navy has also determined that Navy training and testing activities may overlap designated critical habitat, as defined by the ESA, for the Eastern North Pacific Southern Resident killer whale. The Navy will consult with NMFS as required by section 7(a)(2) of the ESA with regard to these determinations.

3.4.5 Marine Mammal Protection Act Determinations

The Navy is seeking a Letter of Authorization in accordance with the MMPA from NMFS for the use of certain stressors (the use of sonar and other transducers, explosives, and vessels), as described under the Preferred Alternative (Alternative 1). The use of sonar and other transducers may result in Level A and Level B harassment of certain marine mammals. The use of explosives may result in Level A harassment and Level B harassment of certain marine mammals. The use of vessels may result in Level A harassment or mortality due to potential physical strike. Refer to Section 3.4.2. 1.2 (Impacts from Sonar and Other Transducers) for details on the estimated impacts from sonar and other transducers, Section 3.4.2.2.2 (Impacts from Explosives) for impacts from explosives, and Section 3.4.2.4.1 (Impacts from Vessel and In-Water Devices) for details on the estimated impacts from vessels.

Based on the previous analyses for the same actions in NWTT as presented in the 2015 NWTT Final EIS/OEIS, consistent with the current MMPA authorization for Navy training and testing in the NWTT Study Area (National Oceanic and Atmospheric Administration, 2015b), and consistent with recent determinations for the same activities in other locations where Navy trains and tests,[6] the Navy has determined that weapon noise, vessel noise, aircraft noise, the use of in-water electromagnetic devices, in-air electromagnetic devices, high-energy lasers, in-water devices, seafloor devices, wires and cables, decelerators/parachutes, biodegradable polymers, and military expended materials are not expected to result in Level A or Level B harassment of any marine mammals.

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[6] Conclusions in this regard refer to the findings reached by the Navy and NMFS for many of the same actions in Southern California and Hawaii (FR 83[247]:66846-67031; December 27, 2018).

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Supplemental Environmental Impact Statement/

Overseas Environmental Impact Statement

Northwest Training and Testing

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3.5 Sea Turtles

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 to 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 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.

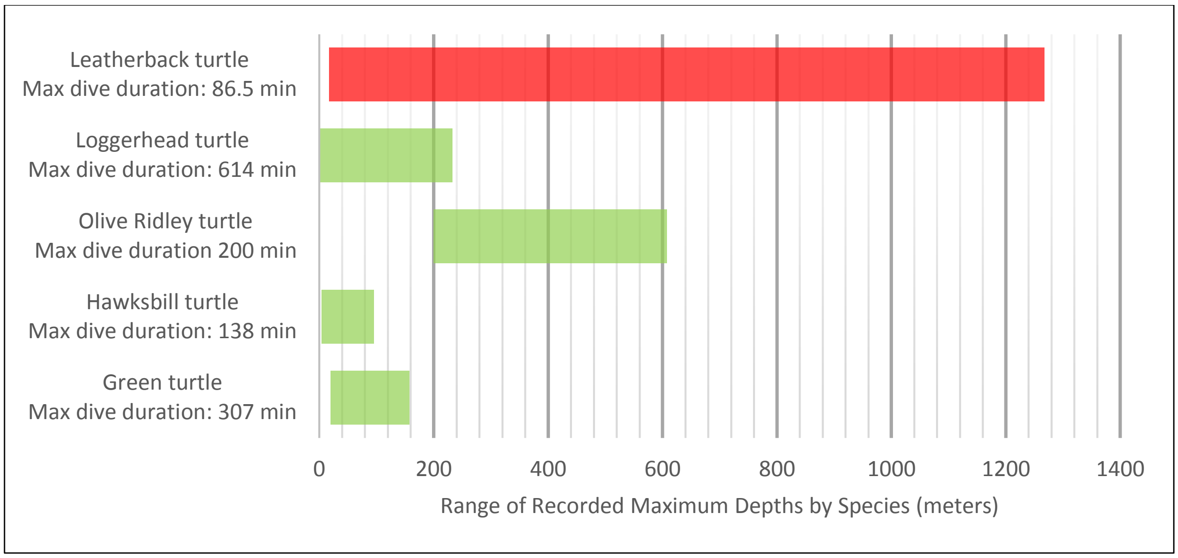
3.5.1.1 Diving

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.

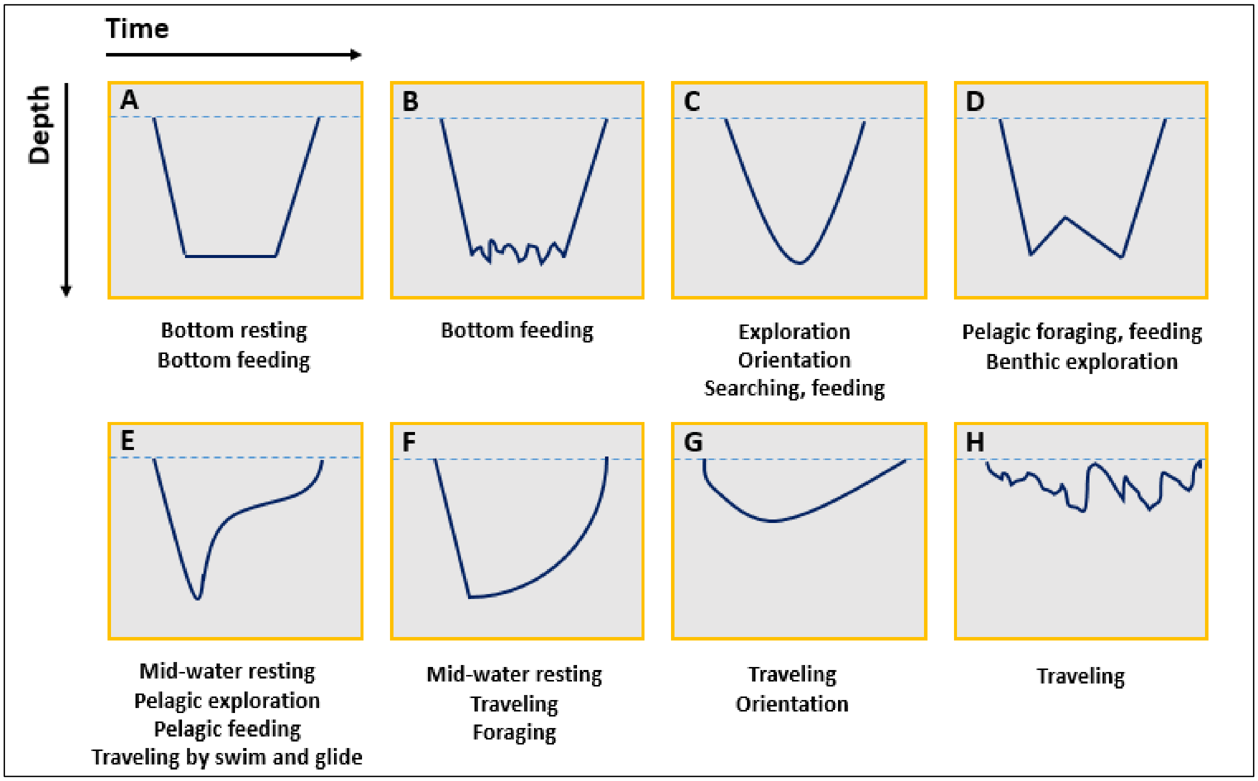
Hochscheid (2014) collected data from 57 studies published between 1986 and 2013, which summarized depths and durations of dives of datasets including an overall total of 538 sea turtles. Figure 3.5-1 presents the ranges of maximum dive depths for different sea turtle species that shows the unique diving 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).

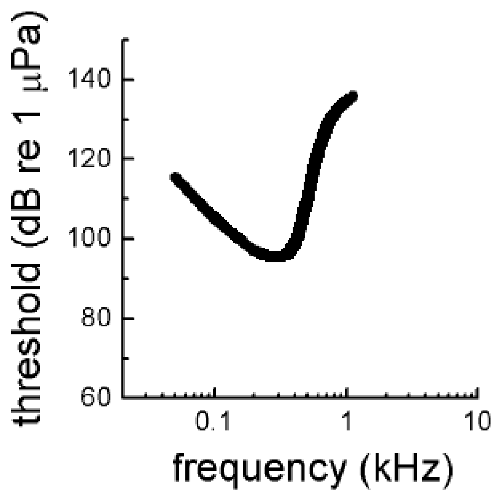
Notes: Profiles A-H, as reported in the literature and compiled by Hochscheid (2014). The depth and time arrows indicate the axis variables, but the figure does not represent true proportions of depths and durations for the various profiles. In other words, the depths can vary greatly, but behavioral 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 Turtle

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

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

3.5.1.3 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 and mortality (Bjorndal et al., 1994; Bjorndal, 1997), and hatchlings are at risk for ingesting small plastic fragments. Ingested plastics can also release toxins, such as bisphenol-A (commonly known as "BPA") and phthalates, or absorb heavy metals from the ocean and release those into tissues (Fukuoka et al., 2016; Teuten et al., 2007). 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 ESA, and has Critical Habitat designated within the Study Area. Although 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 offshore areas, 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 suggest 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 Phillippe (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.

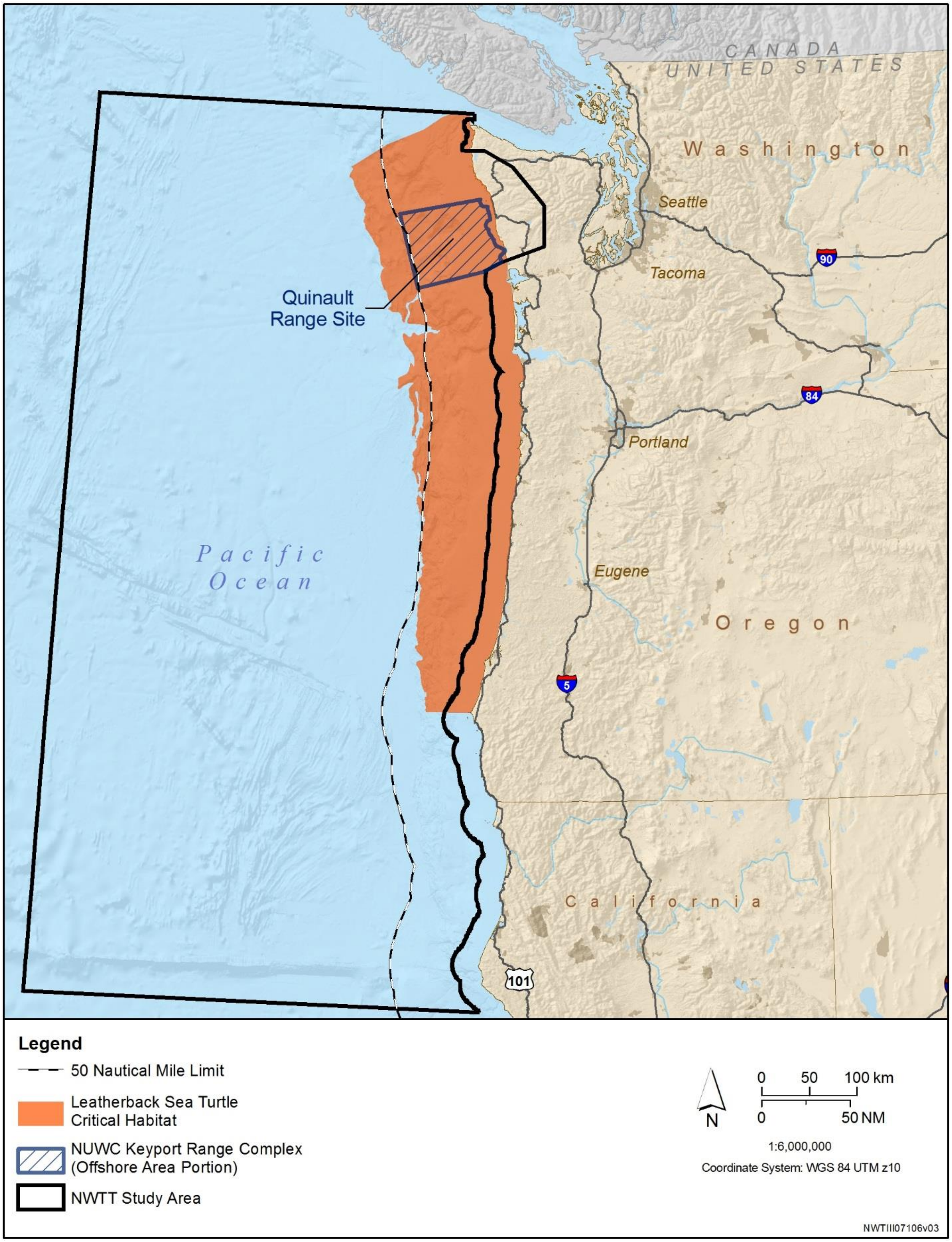


Figure 3.5-4: Designated Critical Habitat for the Leatherback Sea Turtle within the Study Area

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, NOAA 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.

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 in this Supplemental will supplement 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 lasers 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 previously 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, 2015a) 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-air explosions, in water explosions)
- **Energy** (in-water electromagnetic devices, high-energy lasers)
- **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, 2015a).

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 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 (Garcia-Parraga et al., 2014). Therefore, nitrogen decompression due to changes in diving behavior is not considered a potential consequence to diving sea turtles.

3.5.2.1.1.2 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.

3.5.2.1.1.3 Physiological Stress

A stress response is a suite of physiological changes meant to help an organism mitigate the impact of a stressor. If the magnitude and duration of the stress response is too great or too long, then it can have negative consequences to the animal (e.g., decreased immune function, decreased reproduction). Physiological stress is typically analyzed by measuring stress hormones, other biochemical markers, or vital signs. Physiological stress has been measured for sea turtles 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.

3.5.2.1.1.4 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, 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.

3.5.2.1.1.5 Behavioral Reactions

Behavioral responses fall into two major categories: Alterations in natural behavior patterns and avoidance. These types of reactions are not mutually exclusive and reactions may be combinations of behaviors or a sequence of behaviors. As described in Section 3.0.3.7 (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.

<u>**Behavioral Reactions to Impulsive Sound Sources**</u>

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.

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.

3.5.2.1.1.6 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 takes into account:

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

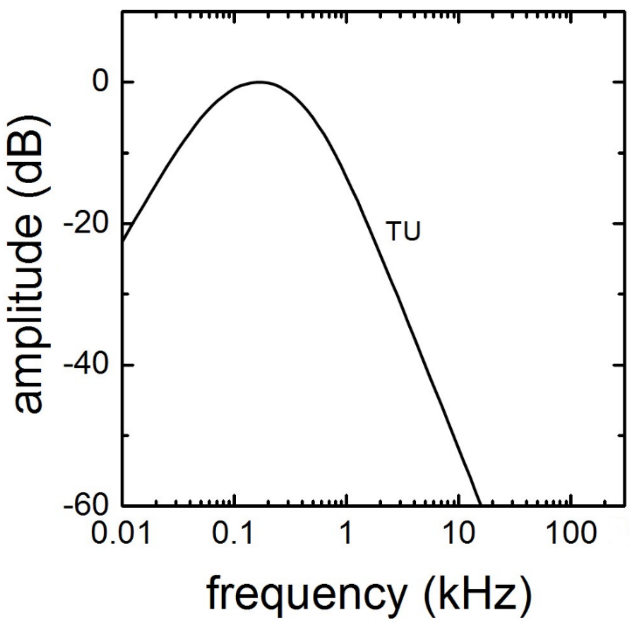
A further detailed explanation of this analysis is provided in the technical report titled *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2017b).

<u>Criteria and Thresholds Used to Predict Impacts from Sonar and Other Transducers</u>

Auditory Weighting Functions

Animals are not equally sensitive to noise at all frequencies. To capture the frequency-dependent nature of the effects of noise, auditory weighting functions are used. 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.

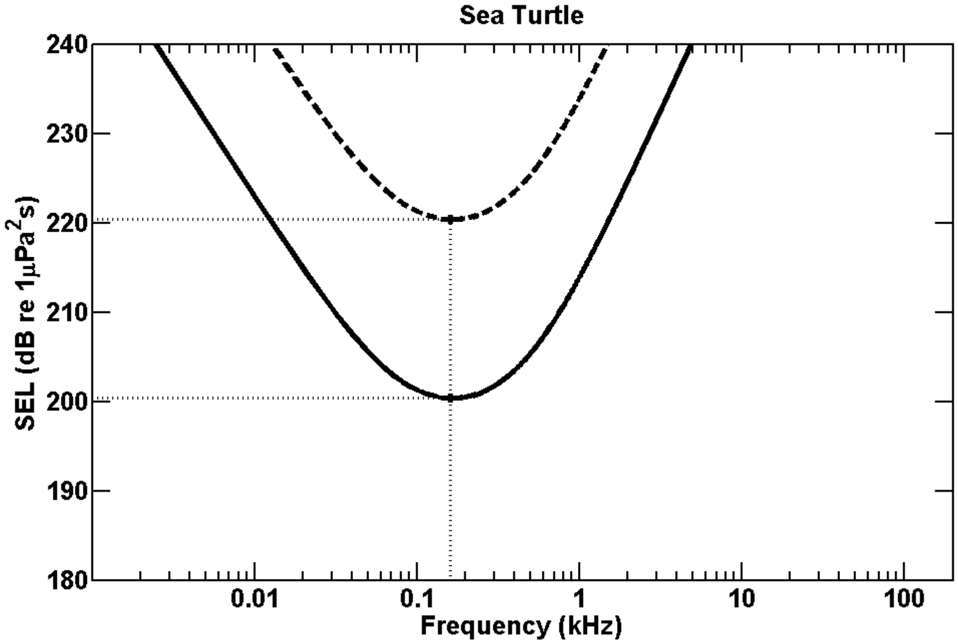


Source: (U.S. Department of the Navy, 2017a)
Notes: dB = decibels, kHz = kilohertz, TU = sea turtle species group

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.

3.5.2.1.2.2 Impact Ranges for Sonar and Other Transducers

Because sea turtle hearing range is limited to a narrow range of frequencies and thresholds for auditory impacts are relatively high, there are 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

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

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 will consult with the NMFS as required by section 7(a)(2) of the ESA.

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

General categories and characteristics of sonar systems and the number of hours these sonars would be operated during testing under Alternative 1 are described in Section 3.0.3.1.1 (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) will 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 will 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 will consult with the 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

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 (< 2k 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

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 kHz). 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 will 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 will 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 will consult 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 will consult 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 will consult 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.

Fragmentation

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

3.5.2.2.1.2 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 is 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 three 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 takes into account:

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

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

Criteria and Thresholds used to Predict Impacts on Sea Turtles from Explosives

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

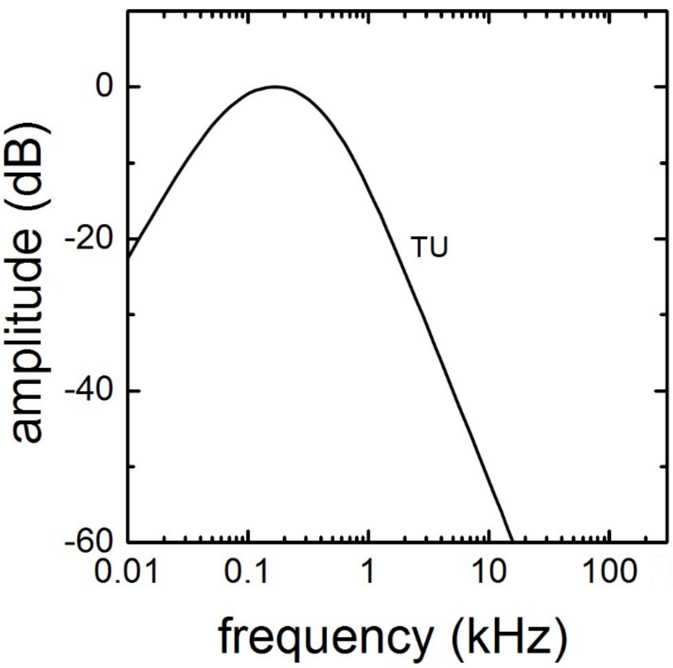
[1] Impulse delivered over 20% of the estimated lung resonance period. See U.S. Department of the Navy (2017a).
[2] Threshold for one percent risk used to assess mitigation effectiveness. Note: dB re 1 µPa = decibels referenced to 1 micropascal, SPL = sound pressure level, M = animal mass (kg), D = animal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

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.

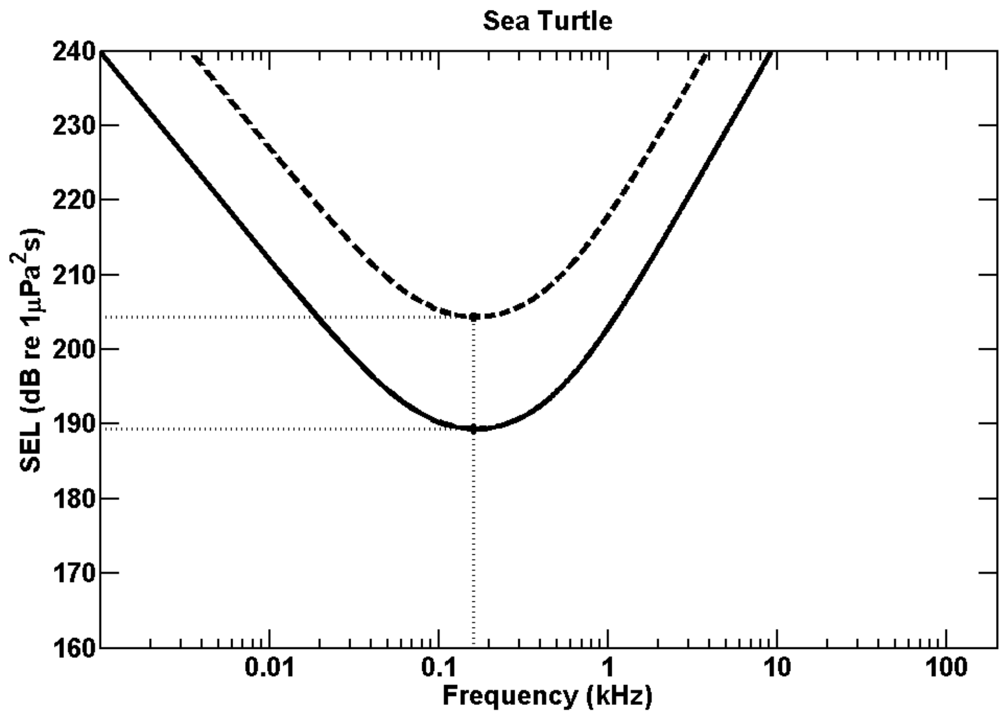


Source: (U.S. Department of the Navy, 2017a)
Notes: dB = decibels, kHz = kilohertz, TU = sea turtle hearing group

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.

3.5.2.2.2.2 Impact Ranges for 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 are shown for a range of explosive bins, from E1 (up to 0.25 lb. net explosive weight) to E11 (greater than 500 lb. to 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 through 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	***Ranges to Non-Auditory Injury (m)*** [1]	
	Animal Mass of 250 kg	***Animal Mass of 1000 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.

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

Bin	Ranges to Mortality (m)	
	Animal Mass of 250 kg[1]	Animal Mass of 1000 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.

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	**Source Depth (m)**	**Cluster Size**	**Range to PTS (m)**	**Range to TTS (m)**
E1	0.1	1	37 (35–40)	69 (65–70)
		16	37 (35–40)	69 (65–70)
		18	37 (35–40)	69 (65–70)
	18.25	1	35 (35–35)	65 (65–65)
		16	35 (35–35)	65 (65–65)
		18	35 (35–35)	65 (65–65)
E2	0.1	1	48 (45–50)	88 (80–90)
		5	48 (45–50)	88 (80–90)
E3	10	1	99 (85–170)	197 (150–370)
		12	99 (85–170)	197 (150–370)
		19	99 (85–170)	197 (150–370)
	18.25	1	80 (80–85)	154 (150–200)
		12	80 (80–85)	154 (150–200)
		19	80 (80–85)	154 (150–200)

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

Range to Effects for Explosives Bin: Sea turtles[1]				
Bin	**Source Depth (m)**	**Cluster Size**	**Range to PTS (m)**	**Range to TTS (m)**
E4	10	1	100 (100–100)	190 (190–190)
		2	100 (100–100)	190 (190–190)
	30	1	105 (100–140)	262 (190–675)
		2	105 (100–140)	262 (190–675)
	70	1	106 (100–160)	206 (190–350)
		2	106 (100–160)	206 (190–350)
	90	1	103 (100–150)	197 (190–320)
		2	103 (100–150)	197 (190–320)
E5	0.1	1	128 (120–130)	243 (230–250)
		8	128 (120–130)	243 (230–250)
		20	128 (120–130)	243 (230–250)
E7	10	1	255 (250–260)	471 (440–500)
	30	1	419 (240–1,025)	722 (440–1,025)
	70	1	269 (240–460)	681 (440–1,275)
	90	1	258 (240–420)	620 (440–1,025)
E8	45.75	1	434 (280–975)	956 (525–2,025)
E10	0.1	1	481 (470–490)	863 (850–875)
		2	481 (470–490)	863 (850–875)
E11	91.4	1	929 (525–1,775)	2,122 (1,000–3,775)
	200	1	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.

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				
Bin	**Source Depth (m)**	**Cluster Size**	**Range to PTS (m)[1]**	**Range to TTS (m)[1]**
E1	0.1	1	0 (0–0)	0 (0–0)
		18	0 (0–0)	2 (2–2)
E2	0.1	1	0 (0–0)	1 (1–1)
		5	0 (0–0)	2 (2–2)
E3	10	1	4 (3–5)	27 (25–35)
		12	16 (13–21)	116 (85–230)
	18.25	1	3 (3–3)	17 (16–17)
		12	10 (10–10)	70 (70–90)
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)
		20	5 (5–6)	26 (25–190)
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]Average distance (m) to TTS and PTS are depicted above the minimum and maximum distances which are in parentheses. Values depict ranges to TTS and PTS based on the SEL metric.

3.5.2.2.2.3 Impacts from Explosives Under Alternative 1

Impacts from Explosives Under Alternative 1 During Training Activities

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. Detonations would generally occur greater than 50 NM from shore.

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 will consult with NMFS as required by section 7(a)(2) of the ESA.

Impacts from Explosives Under Alternative 1 During Testing Activities

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 will occur in the Offshore Area, and with the exception of mine countermeasure and neutralization testing (new testing activities in Phase III), will typically 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 in the Offshore Area. Although this activity would occur closer to shore, it would typically occur in water depths greater than 100 feet.

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., ceasing deployment of an explosive bomb) if a sea turtle is observed in the mitigation zone whenever and wherever applicable activities occur. In addition to procedural mitigation, the Navy will implement mitigation 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 will consult 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

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 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.

Training and testing activities involving in-water electromagnetic devices that would occur inside Puget Sound or the Strait of Juan de Fuca, where leatherback sea turtles are not expected to occur are not analyzed further in this Supplemental. They are analyzed for impacts in the offshore area.

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 are designed to disable surface targets, rendering them immobile. The primary concern for high-energy weapons testing is the potential for a sea turtle to be struck by a high-energy laser beam at or near the water's surface, which could result in injury or death, resulting from traumatic burns from the beam. Sea turtles could be exposed to a laser only if the beam missed the target. Should the laser strike the sea surface, individual sea turtles at or near the surface could be exposed. The potential for exposure to a high-energy laser beam decreases as the water depth increases. Because laser platforms are typically helicopters and ships, sea turtles 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 lasers 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. Therefore, high-energy lasers are not analyzed for potential impacts on leatherback sea turtles.

3.5.2.3.1 Impacts from In-Water Electromagnetic Devices

For the 2015 analysis of in-water electromagnetic devices as energy stressors, see Section 3.5.3.2 (Energy 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, 2015b). Since the 2015 NWTT Final EIS/OEIS and with the increased use of undersea power cables associated with offshore energy generation, there has been renewed scientific interest in electromagnetic fields possibly affecting leatherback sea turtles and other marine animals within the offshore areas of the Study Area (Gill et al., 2014; Kremers et al., 2014; Kremers et al., 2016; Zellar et al., 2017). Horton et al. (2017) have indicated that future experiments involving empirical observation of free-ranging animals are still required for there to be sufficient evidence demonstrating causal relations between marine mammal movement decisions and environmental cues such as the earth's magnetic field. These additional scientific findings do not change in any way the rationale for the dismissal of in-water electromagnetic devices as presented in the 2015 analyses. As presented and at the most basic level, Navy does not anticipate any impacts from the use of in-water electromagnetic devices because the electromagnetic field is the simulation of a ship's magnetic field, having no greater impact than that of a passing ship. The number and location of activities using in-water electromagnetic devices would not change under this Supplemental from the ongoing activities. The analyses 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, 2015b) remain valid; impacts to sea turtles from the use of in-water electromagnetic devices are not anticipated.

3.5.2.3.1.1 Impacts from In-Water Electromagnetic Devices Under Alternative 1

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

Under Alternative 1, the number of proposed training activities involving the use of in-water electromagnetic devices would remain the same as those proposed in the 2015 NWTT Final EIS/OEIS (Table 3.0-9). The activities would occur in the same locations and in a similar manner as were analyzed previously. Therefore, the impacts to leatherback sea turtles would be the same. As stated in the 2015 NWTT Final EIS/OEIS, the impact of in-water electromagnetic devices on leatherback sea turtles would be inconsequential because (1) the area exposed to the stressor is extremely small; (2) the number of activities involving the stressor is low; (3) exposures would be localized, temporary, and would cease with the conclusion of the activity; and (4) even for susceptible species, the consequences of exposure are limited to temporary disruptions to navigation and orientation.

Because of the low number of exposures to leatherback sea turtle prey species, impacts from the use of in-water devices are not likely measurable. Therefore, 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 in-water electromagnetic devices during training activities as described under Alternative 1 may affect leatherback sea turtles and would have no effect on designated critical habitat for the leatherback sea turtle. The Navy will consult with the NMFS, as required by section 7(a)(2) of the ESA, in that regard.

<u>**Impacts from In-Water Electromagnetic Devices Under Alternative 1 for Testing Activities**</u>

No in-water electromagnetic devices are proposed for testing activities under Alternative 1.

3.5.2.3.1.2 Impacts from In-Water Electromagnetic Devices Under Alternative 2

<u>**Impacts from In-Water Electromagnetic Devices Under Alternative 2 for Training Activities**</u>

Under Alternative 2, the number of proposed training activities involving the use of in-water electromagnetic devices is the same as presented in the 2015 NWT Final EIS/OEIS (see Table 3.0 9) and the same as under Alternative 1. As presented under Alternative 1, the impact of in-water electromagnetic devices on sea turtles are not expected.

Because of the low number of exposures to leatherback sea turtle prey species, impacts from the use of in-water devices are not likely measurable. Therefore, 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 in-water electromagnetic devices during training activities as described under Alternative 2 may affect leatherback sea turtles and would have no effect on designated critical habitat for the leatherback sea turtle.

<u>**Impacts from In-Water Electromagnetic Devices Under Alternative 2 for Testing Activities**</u>

Under Alternative 1 and as shown on Table 3.0-9, there are no testing events involving the use of in-water electromagnetic devices.

3.5.2.3.1.3 Impacts from In-Water Electromagnetic Devices Under the No Action Alternative

Under the No Action Alternative, proposed training and testing activities would not occur. Other military activities not associated with this Proposed Action would continue to occur. Energy 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 energy 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 the potential for impacts from in-water electromagnetic devices 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.

3.5.2.3.2 Impacts from High-Energy Lasers

As stated previously, high-energy lasers are not analyzed for potential impacts on sea turtles.

3.5.2.3.2.1 Impacts from High-Energy Lasers Under Alternative 1

<u>**Impacts from High-Energy Lasers Under Alternative 1 for Training Activities**</u>

High-energy lasers 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 54 testing activities per year involving the use of high energy lasers in the Offshore portion of the Study Area. As stated previously, high-energy lasers 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.

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 lasers 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 lasers are proposed for training activities under Alternative 2.

Impacts from High-Energy Lasers Under Alternative 2 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 2, there would be up to 54 testing activities per year involving the use of high energy lasers in the Offshore portion of the Study Area. As stated previously, high-energy lasers 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.

Because of the unlikely exposure of sea turtle prey items to high-energy lasers, 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 lasers 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. Other military activities not associated with this Proposed Action would continue to 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. (National Oceanic and Atmospheric Administration, 2015a). Section 5.3.4 (Physical Disturbance and Strike Stressors) in Chapter 5 (Mitigation) includes 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 10,300 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 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: two aircraft carriers, six 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

<u>Impacts from Vessels and In-Water Devices Under Alternative 1 for Training Activities</u>

Under Alternative 1, the combined number of proposed training activities involving the movement of vessels and the use of in-water devices would decrease compared to those proposed in the 2015 NWTT Final EIS/OEIS (Table 3.0-12 and Table 3.0-13). Vessel movement would decrease substantially in the Offshore Area (from 1,116 to 569 annual activities). There is an increase in the use of in-water devices (from 493 to 555 annual activities), 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 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 of 62 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 will 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 of 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 because of the (1) wide dispersal of large vessels in open ocean areas and the widespread, (2) certain in-water devices do not have a realistic potential 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.

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 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 will consult 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 involving the movement of vessels and the use of in-water devices would increase compared to 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 (from 138 to 308 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.

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 because (1) wide dispersal of large vessels in open ocean areas and the widespread, (2) certain in-water devices do not have a realistic potential 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.

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, military expended materials, and seafloor devices as summarized above under Alternative 1 testing activities may affect the ESA-listed leatherback sea turtle. The Navy will consult 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 number of proposed training activities involving the movement of vessels or the use of in-water devices would be slightly greater than Alternative 1 and greater than those proposed in the 2015 NWTT Final EIS/OEIS (Table 3.0-12 and Table 3.0-13). Vessel movement would increase slightly in the Study Area compared to Alternative 1 (569 for Alternative 1 compared to 604) but would decrease (1,156 to 604) 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 (620 for Alternative 1 compared to 648) and an increase from levels presented in the 2015 NWTT final EIS/OEIS (494 to 648) (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 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 electromagnetic devices on leatherback sea turtles would remain inconsequential because of the (1) wide dispersal of large vessels in open ocean areas and the widespread, (2) certain in-water electromagnetic devices do not have a realistic potential 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. 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 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 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 slightly in the Offshore Area compared to Alternative 1 (from 308 to 317) and more than double compared to numbers presented in the 2015 NWTT final EIS/OEIS (from 138 to 317 annual activities).

There would also be a slight increase in the use of in-water devices compared to Alternative 1 (1,181 for Alternative 1 compared to 1,212) and a significant increase from levels presented in the 2015 NWTT final EIS/OEIS (740 to 1,212) (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 because of the (1) wide dispersal of large vessels in open ocean areas and the widespread, (2) certain in-water devices do not have a realistic potential 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. Other military activities not associated with this Proposed Action would continue to 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, 2015b). 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), training activities using military expended materials will 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 from (Tables 3.0-14 through 3.0-17) is combined, the number of items proposed to be expended 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 of training activities using 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, 2015b) remain 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 will consult 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), testing activities using military expended materials will increase in comparison to the 2015 NWTT Final EIS/OEIS (Tables 3.0-14 through 3.0-17). While the number of testing activities using 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, 2015b) remain 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 will consult 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 training activities using 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, 2015b) remain 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 testing activities using 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, 2015c; National Oceanic and Atmospheric Administration, 2015a) remain 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. Other military activities not associated with this Proposed Action would continue to 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 turtles 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, 2015b). 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 will 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, 2015b) remain 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 will consult 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 Offshore Areas 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, 2015b), and be the same as 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, 2015b) remain 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. Other military activities not associated with this Proposed Action would continue to 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. Marine vessel-stopping payloads are systems designed to deliver the appropriate measure(s) to affect a vessel's propulsion and associated control surfaces to significantly slow and potentially stop the advance of the vessel. Marine vessel-stopping proposed activities include the use of biodegradable polymers. The biodegradable polymers that the Navy uses are designed to temporarily interact with the propeller(s) of a target craft, rendering the craft ineffective. Based on the constituents of the biodegradable polymer the Navy proposes to use, it is anticipated that the material will break down into small pieces within a few days to weeks. These small pieces will break down further and dissolve into the water column within weeks to a few months. The final products, which are all environmentally benign, will be dispersed quickly to undetectable concentrations.

Unlike other entanglement stressors, biodegradable polymers only retain their strength for a relatively short period of time, and therefore the potential for entanglement by a sea turtles would be limited. Furthermore, the longer the biodegradable polymer remains in the water, the weaker it becomes, making it more brittle and likely to break. A sea turtle would have to encounter the biodegradable polymer immediately after it was expended for it to be a potential entanglement risk. If an animal were to encounter the polymer a few hours after it was expended, it is very likely that it would break easily and would no longer be an entanglement stressor.

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, 2015b).

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

Impacts from Wires and Cables Under Alternative 1 for Training Activities

Under Alternative 1 and as presented in Section 3.0 (Introduction), activities that use of wires and cables during training activities will increase in comparison to the 2015 NWTT Final EIS/OEIS (Table 3.0-19). While the number of training activities using wires and cables 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, 2015b) remains valid; entanglement impacts to sea turtles resulting from wires and cables seafloor devices 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 will consult 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.

Impacts from Wires and Cables Under Alternative 1 for Testing Activities

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 will consult 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

Impacts from Wires and Cables Under Alternative 2 for Training Activities

Under Alternative 2, the number of wires and cables that would be expended during training activities in the Offshore portion of the Study 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 410 sonobuoy wires). More sonobuoys are proposed for inland waters, but leatherback sea turtles do not occur in these locations. 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.

Impacts from Wires and Cables Under Alternative 2 for Testing Activities

Under Alternative 2, the number of expended wires and cables would increase compared to what was analyzed in the 2015 NWTT Final EIS/OEIS (16 additional fiber optic cables, 60 additional guidance wires, and 3,161 additional sonobuoy wires). Compared to Alternative 1, Alternative 2 testing activities would expend an additional 20 guidance wires and an additional 1,106 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 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 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. Other military activities not associated with this Proposed Action would continue to 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 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. Additional decelerators/parachutes are proposed to be used in the Inland Waters; however, leatherback sea turtles are not expected to enter inland waters. 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 (1) of 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 the (3) 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 will consult 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 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 approximately 1,181 to 2,724. 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 (1) of 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 the (3) 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 will consult 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 (611 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 87 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 Alternative 1, Alternative 2 testing activities would expend in the Offshore Area 840 additional small decelerators/parachutes, with no increases in the number of medium-size decelerators/parachutes or 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 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. Other military activities not associated with this Proposed Action would continue to 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 will 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, 2015b) 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 will consult 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 will increases 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, 2015b) 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 will consult 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 slightly 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, 2015b), 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, 2015b) 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 under Alternative 2 training activities as ingestion stressors from the use of military expended materials – munitions 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.

<u>**Impacts from Military Expended Materials – Munitions Under Alternative 2 for Testing Activities**</u>

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 will increase in comparison to ongoing activities and are the same as under Alternative 1 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, 2015b) 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 under Alternative 2 testing activities as ingestion stressors from the use of military expended materials –munitions 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. Other military activities not associated with this Proposed Action would continue to 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

<u>**Impacts from Military Expended Materials – Other than Munitions Under Alternative 1 for Training Activities**</u>

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, Table 3.0-21, and Table 3.0-22). When the amounts of military expended materials – other than munitions (fragments from targets, chaff and flare components, and biodegradable polymers) 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, 2015b) 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 will consult 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, 2015b) 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 will consult 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 will 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, 2015b) 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 will 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, 2015b) 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 under Alternative 2 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 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. Other military activities not associated with this Proposed Action would continue to 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, explosive 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., 2015). 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 Sciences Group, 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 Sciences Group, 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 will consult with NMFS as required by section 7(a)(2) of the ESA for secondary stressors under Alternative 1.

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Supplemental Environmental Impact Statement/
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3.6 Birds

This section analyzes potential impacts on birds (e.g., seabirds, shorebirds, upland terrestrial birds) found in the Northwest Training and Testing (NWTT) Study Area. For purposes of this Supplemental Environmental Impact Statement (EIS)/Overseas EIS (OEIS) (Supplemental), the Study Area for birds remains the same as that identified in the 2015 NWTT Final EIS/OEIS, which for birds includes the Offshore Area, Inland Waters, and Western Behm Canal, Alaska. Section 2.1 (Description of the Northwest Training and Testing Study Area) provides detailed descriptions of these areas. Similar to the 2015 NWTT Final EIS/OEIS, this section provides an overview of the species, distribution, and occurrence of birds that are either resident or migratory through the Study Area, as well as new information released since the publication of the Final EIS/OEIS.

Section 3.6.2 (Environmental Consequences) of this Supplemental analyzes potential impacts of the proposed action on birds in the Study Area and summarizes the combined impacts on these birds and determinations under the Endangered Species Act (ESA), Migratory Bird Treaty Act (MBTA), and the Bald and Golden Eagle Protection Act.

3.6.1 Affected Environment

As presented in the 2015 NWTT Final EIS/OEIS, the habitat found within the Study Area supports a wide diversity of resident and migratory seabirds, shorebirds, waterfowl, passerines, and raptors. Descriptions of the climate, productivity, and oceanographic conditions were presented in the 2015 NWTT Final EIS/OEIS and are summarized below for each major component of the Study Area:

- Offshore Area. As described in Section 2.1.1 (Description of the Offshore Area) of the 2015 NWTT Final EIS/OEIS, the Olympic Military Operations Areas (MOAs) overlay both land and sea (extending to 3 NM off the Washington coast). The MOA lower limit is 6,000 feet (ft.) (1,800 meters [m]) above mean sea level but not below 1,200 ft. (366 m) above ground level at the higher terrain elevations of the mountains, and the upper limit is up to but not including 18,000 ft. (5,500 m) above mean sea level. Above the Olympic MOAs is the Olympic Air Traffic Control Assigned Airspace (ATCAA), which starts at 18,000 ft. (5,500 m). The ATCAA has an upper limit of 35,000 ft. (10,700 m). The Washington coastline within the Offshore Area contains numerous bays and inlets that provide sheltered waters for wintering waterfowl and seabirds, including ducks, gulls, and shorebirds. Along the coastline, winter bird populations are generally three times higher than the summer populations, which mostly include gulls and alcids (Calambokidis & Steiger, 1990; Falxa & Raphael, 2016). The Offshore Area contains important foraging areas for breeding and migrating birds.
- Inland Waters. The shorelines of the inland estuaries are generally rocky, with small beaches at the mouths of streams and rivers. Extensive mudflats associated with river deltas support large populations of shorebirds and waterfowl in the winter (Nysewander et al., 2005; Ward et al., 2015). The numerous bays and inlets provide sheltered waters for wintering waterfowl, shorebirds, and seabirds. The beaches and mudflats within Puget Sound are an important stopover and wintering habitat for numerous migratory birds.
- Western Behm Canal, Alaska. Similar to the Inland Waters of Washington, Behm Canal, which surrounds Revillagigedo Island, supports large populations of shorebirds and seabirds. Extensive mudflats associated with river deltas support seasonally large populations of shorebirds and waterfowl (Ames et al., 2000). About 200 marine and coastal bird species are common to the

southeast Alaska portion of the Study Area. Loons, grebes, cormorants, sea ducks, eagles, gulls, and alcids are year-round residents of the region.

The 2015 NWTT Final EIS/OEIS lists the bird species known to occur or anticipated to occur within the Study Area. The information regarding these species presence or absence in the Study Area has not changed since the publication of the 2015 NWTT Final EIS/OEIS. As such, the species list presented in the Final EIS/OEIS remains valid.

There are five ESA-listed bird species that may occur within the Study Area (see Table 3.6-1). These species include the marbled murrelet (*Brachyramphus marmoratus*), short-tailed albatross (*Phoebastria albatrus*), northern spotted owl (*Strix occidentalis caurina*), streaked horned lark (*Eremophila alpestris strigata*), and western snowy plover (*Charadrius nivosus*). The short-tailed albatross is listed as endangered under the ESA throughout this species' range. The northern spotted owl, streaked horned lark, and western snowy plover are listed as threatened throughout their ranges. The marbled murrelet is listed as threatened under the ESA in Washington, Oregon, and California. Any updated information on these species in regards to regulatory status and life history information is included in the species-specific discussions below.

Table 3.6-1: Status and Presence of ESA-listed Bird Species and Their Critical Habitat That May Occur in the Northwest Training and Testing Study Area

Species and Regulatory Status		Presence in the Study Area				
Common Name (Scientific Name)	**Federal Status**	**Critical Habitat**	**Offshore Area**	**Inland Waters**	**Western Behm Canal**[2]	**Land Portions**[1]
Marbled murrelet (*Brachyramphus marmoratus*)	Threatened	Coastal and under the Olympic MOAs[3]	✓	✓	✓	✓
Short-tailed albatross (*Phoebastria albatrus*)	Endangered	None designated in Study Area	✓			
Northern spotted owl (*Strix occidentalis caurina*)	Threatened	Under the Olympic MOAs[3]				✓
Streaked horned lark (*Eremophila alpestris strigata*)	Threatened	None designated in Study Area[3]	✓			✓
Western snowy plover (*Charadrius nivosus*)	Threatened	Southwestern corner of Olympic MOA A at Copalis Spit[3]	✓			✓

Note: MOA = Military Operating Area
[1]The Olympic MOAs overlay both land and sea (extending to 3 NM off the Washington coast), and include areas above 6,000 ft. (1,800 m) MSL but below 1,200 ft. (366 m) above ground level at the higher terrain elevations of the mountains.
[2]The marbled murrelet is not ESA-listed in Alaska, this species is listed as Threatened in other portions of its range.
[3]Potential overlap in coastal areas beneath the Olympic MOAs.

Eleven major taxonomic groups (orders) of birds represented in the Study Area may be impacted by NWTT activities. Birds may be found in air, at the water's surface, or within the water column of the Study Area. The birds within the Study Area are divided into five categories, based loosely on their geographic distribution and feeding habits: seabirds, shorebirds and wading birds, waterfowl, and raptors. Raptors are an additional category since 2015 and include, hawks, eagles, kites, ospreys, owls (Families Accipitridae, Falconidae, Pandionidae, Strigidae). These birds of prey inhabit forests and wetlands, with some species (e.g., bald eagles and ospreys) associated with aquatic habitats throughout the Study Area in the Offshore Area, Inland Waters, and Western Behm Canal, Alaska (Table 3.6-2 of the 2015 NWTT EIS/OEIS has been verified by updated references [American Ornithologists' Union (2017); Sibley (2014)]).

The distribution of each group within the Study Area are presented in Table 3.6-3 of the 2015 NWTT EIS/OEIS. Table 3.6-2 of this Supplemental (a new table) lists additional species that have new science to support their occurrence in additional areas identified since the Navy's 2015 NWTT EIS/OEIS.

3.6.1.1 Group Size

The Navy conducted a literature search for new information since the publication of the 2015 NWTT Final EIS/OEIS on group size that may change the analysis of potential impacts on birds. No new information is available on group size that would alter the analysis from the 2015 NWTT Final EIS/OEIS. As such, the additional description regarding group size presented in the 2015 NWTT Final EIS/OEIS remains valid. A summary of group size information for bird groups and specific species is included below.

A variety of group sizes and diversity may be encountered throughout the Study Area, ranging from migration of an individual bird to large concentrations of mixed-species flocks. Depending on season, location, and time of day, the number of birds observed (group size) will vary and will likely fluctuate from year to year. During spring and fall periods, diurnal and nocturnal migrants would likely occur in large groups as they migrate over open water.

Most seabird species nest in groups (colonies) on the ground of coastal areas or oceanic islands, where breeding colonies number from a few individuals to thousands (U.S. Geological Survey, 2016). Outside of the breeding season, most seabirds within the Order Procelliiformes are solitary, though they may join mixed-species flocks while foraging and can be associated with whales and dolphins (Onley & Scofield, 2007) or areas where prey density is high (U.S. Fish and Wildlife Service, 2005a). During the breeding season, these seabirds usually form large nesting colonies. Similarly, birds within the Order Pelecaniformes are typically colonial. Foraging occurs either singly or in small groups. For example, foraging can range from singles or pairs (murrelets) (Lorenz et al., 2016; U.S. Fish and Wildlife Service, 2017) and can extend upward into larger groups (terns) in which juveniles accompany adults to post-breeding foraging areas, where the water is calm and the food supply is good.

Table 3.6-2: Representative Birds of the Northwest Training and Testing Study Area

Family/Subfamily	Common Name	Scientific Name	Location within Study Area			
			Inland Waters	Offshore Area (coastal)	Offshore Area (pelagic)	Western Behm Canal, Alaska
Order PROCELLARIIFORMES						
Family DIOMEDEIDAE	Short-tailed albatross	*Phoebastria albatrus*			X	
	Laysan albatross	*Phoebastria immutabilis*			X	
	Black-footed albatross*	*Phoebastria nigripes*		X*	X	X*
Family PROCELLARIIDAE	Northern fulmar	*Fulmarus glacialis*			X	
	Pink-footed shearwater	*Puffinus creatopus*			X	
	Flesh-footed shearwater	*Puffinus carneipes*			X	
	Manx shearwater	*Puffinus puffinus*		X	X	
	Buller's shearwater	*Puffinus bulleri*			X	
	Sooty shearwater	*Puffinus griseus*		X	X	
	Short-tailed shearwater	*Puffinus tenuirostris*			X	
Family HYDROBATIDAE	Fork-tailed storm-petrel	*Oceanodroma furcata*		X	X	X
	Leach's storm-petrel	*Oceanodroma leucorhoa*		X	X	
Order PELECANIFORMES						
Family PELECANIDAE	Brown pelican	*Pelecanus occidentalis*	X	X		
Family PHALACROCORACIDAE	Brandt's cormorant	*Phalacrocorax penicillatus*	X	X		X
	Double-crested cormorant	*Phalacrocorax auritus*	X	X		X
	Pelagic cormorant	*Phalacrocorax pelagicus*	X	X		X
Order CICONIIFORME						
Family ARDEIDAE	Great blue heron*	*Ardea herodias*	X	X*	X*	X
	American bittern*	*Botaurus lentiginosus*	X	X*		X*

Table 3.6-2: Representative Birds of the Northwest Training and Testing Study Area (continued)

Family/Subfamily	Common Name	Scientific Name	Location within Study Area			
			Inland Waters	Offshore Area (coastal)	Offshore Area (pelagic)	Western Behm Canal, Alaska
Order CHARADRIIFORMES						
Family LARIDAE	Bonaparte's gull	*Larus philadelphia*	X	X		X
	Heermann's gull	*Larus heermanni*	X	X		
	Mew gull	*Larus canus*	X	X		X
	Ring-billed gull	*Larus delawarensis*	X	X		X
	California gull	*Larus californicus*	X	X	X	X
	Herring gull	*Larus argentatus*	X	X		X
	Thayer's gull	*Larus thayeri*	X	X	X	X
	Western gull	*Larus occidentalis*	X	X		
	Glaucous-winged gull	*Larus glaucescens*	X	X		X
	Glaucous gull	*Larus hyperboreus*	X	X		X
	Red-legged kittiwake	*Rissa brevirostris*		X	X	
	Sabine's gull	*Xema sabini*		X	X	
	Black-legged kittiwake	*Rissa tridactyla*		X	X	X
	Caspian tern	*Hydroprogne caspia*	X	X		X
	Common tern	*Sterna hirundo*	X	X		
	Arctic tern*	*Sterna paradisaea*	X*	X*	X	
	Aleutian tern*	*Sterna aleutica*				X*
	Red phalarope	*Phalaropus fulicarius*		X	X	
	Red-necked phalarope	*Phalaropus lobatus*	X	X	X	X
Family STERCORARIIDAE	Pomarine jaeger	*Stercorarius pomarinus*			X	
	Parasitic jaeger	*Stercorarius parasiticus*	X	X	X	X
	Long-tailed jaeger	*Stercorarius longicaudus*			X	
	South polar skua	*Stercorarius maccormicki*			X	
Family ALCIDAE	Common murre	*Uria aalge*	X	X	X	X
	Thick-billed murre*	*Uria lomvia*	X*	X*		X
	Pigeon guillemot	*Cepphus columba*	X	X		X
	Kittlitz's murrelet	*Brachyramphus brevirostris*				X
	Marbled murrelet	*Brachyramphus marmoratus*	X	X		X
	Xantus's murrelet*	*Synthliboramphus hypoleucus*		X*	X	

Table 3.6-2: Representative Birds of the Northwest Training and Testing Study Area (continued)

Family/Subfamily	Common Name	Scientific Name	Location within Study Area			
			Inland Waters	Offshore Area (coastal)	Offshore Area (pelagic)	Western Behm Canal, Alaska
	Ancient murrelet	*Synthliboramphus antiquus*	X	X	X	X
	Cassin's auklet*	*Ptychoramphus aleuticus*	X*	X	X	X*
	Parakeet auklet	*Aethia psittacula*			X	
	Rhinoceros auklet	*Cerorhinca monocerata*	X	X	X	X
	Horned puffin*	*Fratercula corniculata*	X*	X*	X	X*
	Tufted puffin	*Fratercula cirrhata*	X	X	X	X
Family SCOLOPACIDAE	Surfbird	*Aphriza virgata*	X	X		X
	Western sandpiper	*Calidris mauri*	X	X		X
	Spotted sandpiper	*Actitis macularia*	X	X		X
	Least sandpiper	*Calidris minutilla*	X	X		X
	Rock sandpiper	*Calidris ptilocnemis*	X	X		X
	Red knot	*Calidris canutus*	X	X		X
	Short-billed dowitcher	*Limnodromus griseus*	X	X		X
	Ruddy turnstone	*Arenaria interpres*	X	X		X
	Sanderling	*Calidris alba*	X	X		X
	Wandering tattler	*Tringa incana*		X		X
	Greater yellowlegs	*Tringa melanoleuca*	X	X		X
	Solitary sandpiper	*Tringa solitaria*	X	X		X
	Lesser yellowlegs	*Tringa flavipes*	X	X		X
	Whimbrel	*Numenius phaeopus*	X	X		X
	Black turnstone	*Arenaria melanocephala*	X	X		X
	Semipalmated sandpiper	*Calidris pusilla*	X	X		X
	Baird's sandpiper	*Calidris bairdii*	X	X		X
	Pectoral sandpiper	*Calidris melanotos*	X	X		X
	Dunlin	*Calidris alpina*	X	X		X
	Stilt sandpiper	*Calidris himantopus*	X			
	Ruff	*Philomachus pugnax*	X	X		
	Marbled godwit	*Limosa fedoa*	X	X		X
	Long-billed dowitcher	*Limnodromus scolopaceus*	X	X		X
	Wilson's snipe	*Gallinago delicata*	X	X		X

Table 3.6-2: Representative Birds of the Northwest Training and Testing Study Area (continued)

Family/Subfamily	Common Name	Scientific Name	Location within Study Area			
			Inland Waters	Offshore Area (coastal)	Offshore Area (pelagic)	Western Behm Canal, Alaska
Family CHARADRIINAE	Black-bellied plover	*Pluvialis squatarola*	X	X		X
	Semipalmated plover	*Charadrius semipalmatus*	X	X		X
	Killdeer	*Charadrius vociferus*	X	X		X
	American golden plover	*Pluvialis dominica*	X	X		
	Pacific golden plover	*Pluvialis fulva*	X	X		X
Family HAEMATOPODIDAE	Black oystercatcher	*Haematopus bachmani*	X	X		X
Family RECURVIROSTRIDAE	Black-necked stilt*	*Himantopus mexicanus*	X	X*		
Order GAVIIFORMES						
Family GAVIIDAE	Yellow-billed loon	*Gavia adamsii*	X	X		X
	Common loon	*Gavia immer*	X	X		X
	Pacific loon	*Gavia pacifica*	X	X		X
	Red-throated loon	*Gavia stellata*	X	X		X
Order GRUIFORMES						
Family RALLIDAE	American coot	*Fulica americana*	X	X		X
	Sora	*Porzana carolina*	X	X		
	Virginia rail	*Rallus limicola*	X	X		
Order PODICIPEDIFORMES						
Family PODICIPEDIDAE	Pied-billed grebe	*Podilymbus podiceps*	X	X		X
	Western grebe	*Aechmophorus occidentalis*	X	X		X
	Horned grebe	*Podiceps auritus*	X	X		X
	Red-necked grebe	*Podiceps grisegena*	X	X	X	X
	Eared grebe	*Podiceps nigricollis*	X	X		
	Clark's grebe	*Aechmophorus clarkii*	X	X		

Table 3.6-2: Representative Birds of the Northwest Training and Testing Study Area (continued)

Family/Subfamily	Common Name	Scientific Name	Location within Study Area			
			Inland Waters	Offshore Area (coastal)	Offshore Area (pelagic)	Western Behm Canal, Alaska
Order ANSERIFORMES						
Family ANATIDAE	Wood duck*	*Aix sponsa*	X	X*		X*
	Northern pintail	*Anas acuta*	X			X
	Green-winged teal	*Anas crecca*	X			X
	Mallard*	*Anas platyrhynchos*	X	X*	X	X
	Greater scaup	*Aythya marila*	X	X		X
	Canvasback*	*Aythya valisineria*	X	X*		
	Bufflehead*	*Bucephala albeola*	X	X*		X
	Long-tailed duck	*Clangula hyemalis*	X	X		X
	Harlequin duck	*Histrionicus*	X	X		X
	White-winged scoter	*Melanitta fusca*	X	X		X
	Black scoter	*Melanitta nigra*	X	X		X
	Surf scoter	*Melanitta perspicillata*	X	X		X
	Common merganser*	*Mergus merganser*	X	X*		X
	Red-breasted merganser	*Mergus serrator*	X	X		X
	Ruddy duck	*Oxyura jamaicensis*	X			
	Gadwall	*Anas strepera*	X			X
	Eurasian widgeon	*Anas penelope*	X			X
	American widgeon	*Anas americana*	X			X
	Blue-winged teal	*Anas discors*	X	X		X
	Cinnamon teal	*Anas cyanoptera*	X			
	Northern shoveler	*Anas clypeata*	X			X
	Redhead	*Aythya americana*	X			
	Ring-necked duck	*Aythya collaris*	X			X
	Lesser scaup	*Aythya affinis*	X			X
	Common goldeneye	*Bucephala clangula*	X	X		X
	Barrow's goldeneye	*Bucephala islandica*	X			X

Table 3.6-2: Representative Birds of the Northwest Training and Testing Study Area (continued)

Family/Subfamily	Common Name	Scientific Name	Location within Study Area			
			Inland Waters	Offshore Area (coastal)	Offshore Area (pelagic)	Western Behm Canal, Alaska
	Hooded merganser	*Lophodytes cucullatus*	X	X*		X
	Snow goose*	*Chen caerulescens*				
	Greater white-fronted goose	*Anser albifrons*	X	X		
	Trumpeter swan*	*Cygnus buccinator*	X	X*		X
	Tundra swan*	*Cygnus columbianus*	X	X*		
	Canada goose*	*Branta canadensis*	X	X*		X
	Brant*	*Branta bernicla*	X*	X*		X*
Order ACCIPITRIFORMES						
Family ACCIPITRIDAE	Bald eagle*	*Haliaeetus leucocephalus*	X			X
	Osprey*	*Pandion haliaetus*	X			X
	Sharp-shinned hawk*	*Accipiter striatus*	X			X
	Red-tailed hawk*	*Buteo jamiacensis*	X			X
Order FALCONIFORMES						
Family FALCONIDAE	American kestrel*	*Falco sparverius*	X			X
	Merlin*	*Falco columbarius*	X			X
	Peregrine Falcon*	*Falco peregrinus*	X			X
Order STRIGIFORMES						
Family TYTONIDAE	Barn owl*	*Tyto alba*	X			
Family STRIGIDAE	Great horned owl*	*Bubo virginianus*	X			X
	Spotted owl*	*Strix occidentalis*	X			
	Barred owl*	*Strix varia*	X			X
	Northern saw-whet owl*	*Aegolius acadicus*	X			X
	Western screech owl*	*Megascops kennicottii*	X			X
	Northern pygmy owl	*Glaucidium californicum*	X			X

Note: The list of species has been adapted from the 2015 NWTT Final EIS/OEIS with additions based on suggestions by subject matter experts. The list is not comprehensive of all bird species that occur within the Study Area; rather, it includes representative species of the order and families of birds that are likely to be affected by training and testing activities. Changes from the 2015 NWTT Final EIS/OEIS are noted with an asterisk.

3.6.1.2 Diving Information

Since the publication of the 2015 NWTT Final EIS/OEIS, the Navy conducted a literature search for new information on dive behavior that may change the analysis of potential impacts on birds. No new information is available on dive behavior that would alter the analysis from the 2015 NWTT Final EIS/OEIS. As such, the additional description regarding dive behavior presented in the 2015 NWTT Final EIS/OEIS remains valid. A summary of diving information for bird groups and specific species is included below.

Many of the seabird species found in the Study Area will dive, skim, or grasp prey at the water's surface or within the upper portion (1–2 m) of the water column (Cook et al., 2011; Jiménez et al., 2012; Sibley, 2014). Foraging strategies are species specific, such as plunge-diving or pursuit-diving. Plunge-diving, as used by terns and pelicans, is a foraging strategy in which the bird hovers over the water and dives into the water to pursue fish. Diving behavior in terns is limited to plunge-diving during foraging (Hansen et al., 2017). Dive durations are correlated with depth and range from a few seconds in shallow divers to several minutes in alcids (Ponganis, 2015). In general, tern species do not usually dive deeper than 3 ft. (0.9 m). Pursuit divers, a common foraging strategy of birds such as murrelets and shearwaters, usually float on the water and dive under to pursue fish and other prey. They most commonly eat fish, squid, and crustaceans (Burger et al., 2004). Marbled murrelets are reported to dive in ranges from 3 to 36 m (Jodice & Collopy, 1999).

3.6.1.3 Flight Altitudes

While foraging birds will be present near the water surface, migrating birds may fly at various altitudes. Flight altitudes for birds have traditionally been estimated from on the ground (or boat) observations, or from planes; however, flight altitude information increasingly relies on radar studies and telemetry techniques, where the bird's measured altitude is subtracted from the ground elevation (Poessel et al., 2018). Jongbloed (2016) completed a literature review to determine flight height of marine birds to assess potential risks from wind turbine collisions. This review found that most seabird species fly beneath the rotor blade altitudes of offshore wind turbines, which reduces the risk for collision. Some species such as sea ducks and loons may be commonly seen flying just above the water's surface, but the same species can also be spotted flying high enough (5,800 ft.) that they are barely visible through binoculars (Lincoln et al., 1998). While there is considerable variation, the favored altitude for most small birds appears to be between 500 ft. (152 m) and 1,000 ft. (305 m). Radar studies have demonstrated that 95 percent of the migratory movements occur at less than 10,000 ft. (3,050 m), with the bulk of the movements occurring under 3,000 ft. (914 m) (Lincoln et al., 1998). Weather factors may also influence flight heights. Tarroux et al. (2016) examined the flying tactics of Antarctic petrels, *Thalassoica antarctica,* in Antarctica revealing the flexibility of flight strategies. Birds tend to fly higher with favorable wind conditions and fly near ground level during strong winds. Birds were found to adjust their speed and heading during stronger winds to limit drift, however, they were able to tolerate a limited amount of drift (Tarroux et al., 2016). This was also found by Stumpf et al. (2011) for marbled murrelets using radar to quantify flight heights off of the Olympic Peninsula and by Sanzenbacher et al. (2014) off of Northern California. In summary, most marine birds can be expected to fly relatively close to the surface, but may range upwards in altitude depending on a number of factors such as wind speed and direction, precipitation avoidance, time of day or night, foraging behaviors, migration, and distance to coast.

3.6.1.4 Distance from Shore

Pelagic ranges, as a function of distance from shore, can range widely for different species. Much of the recent research regarding abundance and distribution as a function of distance from shore for marine birds was conducted to better understand potential impacts on marine birds from offshore energy development. Spiegel et al. (2017) tracked the movements of over 400 individuals of three species (northern gannets, red-footed loon, and surf-scooter) over the course of five years off of the mid-Atlantic coast. In general, all three species exhibited a largely near-shore, coastal, or in-shore distribution. Habitat use was concentrated in or around large bays, with the most extensive use at bay mouths. Northern gannets ranged much farther offshore than the other two species and covered a much larger area (including instances of individuals using both the Gulf of Mexico and the mid-Atlantic within a single season). Spiegel et al. (2017) determined that the differences among species distributions were likely due to differences in motility and distribution of their preferred prey. In summary, marine bird distance from shore can depend on a variety of factors, such as physiological abilities of a particular species to tolerate long distance and duration flights, mobility of prey, and seasonal variations in ranges. More recent information regarding the offshore occurrence of marbled murrelets is available since the publication of the 2015 NWTT Final EIS/OEIS and is discussed in more detail in Section 3.6.1.7 (Marbled Murrelet [*Brachyramphus marmoratus*]). Murrelet ranges in breeding periods are closer to breeding habitats. Winter ranges may extend further out to sea, with some reports out to 60 and, in rare instances, out to 300 kilometers (km) (Piatt and Naslund, 1995; Piatt and Ford, 1993)[1] ; however, all research to date indicates that such pelagic environments are rarely or never used by marbled murrelets (Adams et al., 2014; Falxa & Raphael, 2016; Lorenz et al., 2016; Raphael et al., 2007; U.S. Fish and Wildlife Service, 2016).

3.6.1.5 Hearing and Vocalization

The Navy conducted a literature search for new information since the publication of the 2015 NWTT Final EIS/OEIS on bird hearing and vocalizations that may change the analysis of potential impacts on birds. New information regarding hearing sensitivities of waterbirds, including various duck species and lesser scaups, is summarized below, along with recent publications that show differences in hearing sensitivities between freshwater divers and pelagic birds. This information is summarized below with an overview of the most current best available science regarding bird hearing and vocalization.

Although hearing range and sensitivity has been measured for many land birds, little is known of seabird hearing. The majority of the published literature on bird hearing focuses on terrestrial birds and their ability to hear in air. A review of 32 terrestrial and marine species indicates that birds generally have greatest hearing sensitivity between 1 and 4 kilohertz (kHz) (Beason, 2004; Dooling, 2002). Very few can hear below 20 hertz (Hz), most have an upper frequency hearing limit of 10 kHz, and none exhibit hearing at frequencies higher than 15 kHz (Dooling, 2002; Dooling & Popper, 2000). Hearing capabilities have been studied for only a few seabirds (Beason, 2004; Beuter et al., 1986; Crowell et al., 2015; Johansen et al., 2016; Thiessen, 1958; Wever et al., 1969); these studies show that seabird hearing ranges and sensitivity in air are consistent with what is known about bird hearing in general.

[1] Piatt and Ford (1993) used ship-based census data collected under the Outer Continental Shelf Environmental Assessment Program to assess the abundance and distribution of regional murrelet populations. In addition to fine-scale surveys at sea, Piatt and Ford (1995) determined that murrelets may extend, although rarely, out to 300 km in the Gulf of Alaska.

Auditory abilities have been measured in 10 diving bird species in-air using electrophysiological techniques (Crowell et al., 2015; Maxwell et al., 2017). All species tested had the best hearing sensitivity from 1 to 3 kHz. The red-throated loon (*Gavia stellata*) and northern gannet (*Morus bassanus*) (both non-duck species) had the highest thresholds while the lesser scaup (*Aythya affinis*) and ruddy duck (*Oxyura jamaicensis*) (both duck species) had the lowest thresholds (Crowell et al., 2015). Auditory sensitivity varied amongst the species tested, spanning over 30 decibels (dB) in the frequency range of best hearing. While electrophysiological techniques provide insight into hearing abilities, auditory sensitivity is more accurately obtained using behavioral techniques. Crowell et al. (2016) used behavioral methods to obtain an in-air audiogram of the lesser scaup. Hearing frequency range in air was similar to other birds, with best sensitivity at 2.86 kHz with a threshold of 14 dB referenced to (re) 20 micropascals (µPa). Maxwell et al. (2017) obtained the behavioral in-air audiogram of a great cormorant (Phalacrocorax carbo), and the most sensitive hearing was 18 dB re 20 µPa at 2 kHz.

Crowell et al. (2015) also compared the vocalizations of the same 10 diving bird species to the region of highest sensitivity of in-air hearing. Of the birds studied, vocalizations of only eight species were obtained due to the relatively silent nature of two of the species. The peak frequency of the vocalizations of seven of the eight species fell within the range of highest sensitivity of in-air hearing. Crowell et al. (2015) suggested that the colonial nesters tested had relatively reduced hearing sensitivity because they relied on individually distinctive vocalizations over short ranges. Additionally, Crowell et al. (2015) observed that the species with more sensitive hearing were those associated with freshwater habitats, which are relatively quieter compared to marine habitats with wind and wave noise.

Although important to seabirds in air, it is unknown if seabirds use hearing or vocalizations underwater for foraging, communication, predator avoidance or navigation (Crowell, 2016; Dooling & Therrien, 2012). Some scientists suggest that birds must rely on vision rather than hearing while underwater (Hetherington, 2008), while others suggest birds must rely on an alternative sense in order to coordinate cooperative foraging and foraging in low light conditions (e.g., night, depth) (Dooling & Therrien, 2012).

There is little known about the hearing abilities of birds underwater (Dooling & Therrien, 2012). In air, the size of the bird is usually correlated with the sensitivity to sound (Johansen et al., 2016); for example, songbirds tend to be more sensitive to higher frequencies and larger non-songbirds tend to be more sensitive to lower frequencies (Dooling & Popper, 2000). Two studies have tested the ability of a single diving bird, a great cormorant (*Phalacrocorax carbo sinensis*), to respond to underwater sounds (Hansen et al., 2017; Johansen et al., 2016). These studies suggests that the cormorant's hearing in air is less sensitive than birds of similar size; however, the hearing capabilities in water are better than what would be expected for a purely in-air adapted ear (Johansen et al., 2016). The frequency range of best hearing underwater was observed to be narrower than the frequency range of best hearing in air, with greatest sensitivity underwater observed around 2 kHz (about 71 dB re 1 µPa based on behavioral responses). Although results were not sufficient to be used to generate an audiogram, Therrien (2014) also examined underwater hearing sensitivity of long-tailed ducks (*Clangula hyemalis*) by examining behavioral responses. The research showed that auditory thresholds at frequencies within the expected range of best sensitivity (1, 2, and 2.86 kHz) are expected to be between 77 and 127 dB re 1 µPa.

Diving birds may not hear as well underwater, compared to other (non-avian) species, based on adaptations to protect their ears from pressure changes (Dooling & Therrien, 2012). Because reproduction and communication with conspecifics occurs in air, adaptations for diving may have evolved to protect in-air hearing ability and may contribute to reduced sensitivity underwater (Hetherington, 2008). There are many anatomical adaptations in diving birds that may reduce sensitivity both in air and underwater. Anatomical ear adaptations are not well investigated, but include cavernous tissue in the meatus and middle ear that may fill with blood during dives to compensate for increased pressure on the tympanum, active muscular control of the meatus to prevent water entering the ear, and interlocking feathers to create a waterproof outer covering (Crowell et al., 2015; Rijke, 1970; Sade et al., 2008). The northern gannet, a plunge diver, has unique adaptations to hitting the water at high speeds, including additional air spaces in the head and neck to cushion the impact and a thicker tympanic membrane than similar-sized birds (Crowell et al., 2015). All of these adaptions could explain the measured higher thresholds of diving birds.

3.6.1.6 General Threats

The Navy conducted a literature search for new information since the publication of the 2015 NWTT Final EIS/OEIS on general threats that may change the analysis of potential impacts on birds. The 2015 NWTT Final EIS/OEIS analyzed commercial and recreational fishing gear, predation by introduced species, habitat loss, disturbance and degradation of nesting and foraging areas by humans and domesticated animals, noise pollution from construction and other human activities, nocturnal collisions with power lines and artificial lights, collisions with aircraft, and pollution such as that from oil spills and plastic debris. In addition, seabird distribution, abundance, breeding, and other behaviors are affected by cyclical environmental events, such as the El Niño Southern Oscillation and Pacific Decadal Oscillation in the Pacific Ocean (Congdon et al., 2007; Vandenbosch, 2000). Other general threats include exposure to marine polychlorinated biphenyls (PCBs) in prey; changes in prey abundance, availability and quality; harmfal algal blooms, biotoxins and dead zones; derelict fishing gear that causes entanglement; energy development projects leading to mortality; disturbance, injury, and mortality in the marine environment from exposures to elevated sound levels; and climate change in the Pacific Northwest (U.S. Fish and Wildlife Service, 2009).

Since the publication of the 2015 NWTT Final EIS/OEIS, a more complete understanding of potential climate change-related impacts on water quality, which in turn may impact prey base, has been included in this Supplemental and summarized below. Section 3.1 (Sediments and Water Quality) describes the updated information included in this Supplemental in regards to potential impacts on water quality from climate change. These changes (e.g., air and sea temperatures, precipitation, frequency and intensity of storms, pH level of sea water, and sea level rise) may potentially impact seabirds by reducing overall marine productivity and biodiversity, which could affect the food resources, distribution, and reproductive success of seabirds (Aebischer et al., 1990; Congdon et al., 2007; Duffy, 2011; North American Bird Conservation Initiative & U.S. Committee, 2010). Other climate change-related threats include wildfires. Wildfire frequency in the western forests has nearly quadrupled when compared to the average of the period between 1970 and 1986 (U.S. Fish and Wildlife Service, 2009). The length of the fire season is longer, and the area burned is larger then it has been in the past. Scientists predict that wildfires will increase and that the area burned by fire in the Pacific Northwest will double by the 2040s and triple by the 2080s (U.S. Fish and Wildlife Service, 2009). This increase in fire frequency, duration, and severity would decrease the available habitat for birds. In the long term, climate change could be the largest threat to seabirds.

Specifically within the Study Area, the Navy's literature search found new information regarding recent regional impacts on seabirds associated with warming ocean temperatures. National Marine Fisheries Service (2016) noted a period of elevated air and sea temperatures have acted effectively as a heat wave in the Bering Sea and northern portion of the Gulf of Alaska, where 2016 temperatures represented a short-term climate event on top of a baseline overall warming trend. These warming trends have caused cyclic summer die-offs of seabirds in the past, with die-offs associated with starvation (U.S. Fish and Wildlife Service, 2015). Recent reports in 2016 of northen fulmars, kittiwakes, shearwaters, murres, and auklets carcasses washed ashore showed signs of starvation, likely due to warming temperature effects on prey base (Rieman & McIntyre, 1993).

Plastic debris is abundant and pervasive in the world oceans and, because of its durability, is continuing to increase. The ingestion of plastics by seabirds such as albatrosses and shearwaters occurs with high frequency and is of particular concern because of impacts on body condition and the transmission of toxic chemicals, both of which affect mortality and reproduction. The rates of plastic ingestion by seabirds are closely related to the concentrations of plastics in different areas of the ocean due to waste discharges and ocean currents and are increasing (Kain et al., 2016; Wilcox et al., 2015).

The impacts from entanglement of marine species in marine debris are clearly profound, and in many cases entanglements appear to be increasing despite efforts over four decades to reduce the threat. Many coastal states have undertaken certain efforts to reduce entanglement rates through marine debris clean-up measures and installed fishing line recycle centers at boat landings in part due to entanglement of seabirds and other marine species. One such program is Northwest Straits Initiative's Derelict Fishing Gear Program, which removes nets from Puget Sound waters using commercial divers under protocols that were designed in partnership with Washington State Department of Fish and Wildlife and Department of Natural Resources (Northwest Straits Foundation, 2017).

Fishing-related gear, balloons, and plastic bags were estimated to pose the greatest entanglement risk to marine fauna. In contrast, experts identified a broader suite of items of concern for ingestion, with plastic bags and plastic utensils ranked as the greatest threats. Entanglement and ingestion affected a similar range of taxa, although entanglement was rated as slightly worse because it is more likely to be lethal. Contamination was scored the lowest in terms of impact, affecting a smaller portion of the taxa and being rated as having solely non-lethal impacts (Wilcox et al., 2016).

3.6.1.7 Marbled Murrelet (*Brachyramphus marmoratus*)

The marbled murrelet (*Brachyramphus marmoratus*) was listed by the United States Fish and Wildlife Service (USFWS) as a threatened species in Washington, Oregon, and California in 1992 (57 Federal Register [FR] 45328). The marbled murrelet is not ESA-listed in Alaska. In 2016, the USFWS issued its Final Rule establishing approximately 3,698,100 acres (1,397,000 hectares) of critical habitat in Washington, Oregon, and California (see Figure 3.6-1). No critical habitat is currently designated or proposed for marine foraging areas for the murrelet. Although the final designation was published in 2016 after the publication of the 2015 NWTT Final EIS/OEIS, the extent of the critical habitat designated within the Study Area did not change. Therefore, there has been no change in the amount of critical habitat since the publication of the 2015 NWTT Final EIS/OEIS.

The 2015 NWTT Final EIS/OEIS analyzed potential impacts on marbled murrelets in the Offshore Area and Inland Waters portion of the Study Area in Washington and the Western Behm Canal in Alaska. As with the 2015 NWTT Final EIS/OEIS, the Study Area analyzed in this Supplemental includes areas off the coast of Oregon and Northern California beginning 12 nautical miles (NM) from the coastline and extends seaward.

Since the publication of the 2015 NWTT Final EIS/OEIS, the Navy's literature review, and information included in the 2016 USFWS Biological Opinion, new information is available regarding at-sea occurrence of marbled murrelets. Specifically, the foraging range for murrelets may extend farther than previously analyzed, out to 5 km offshore and out to 50 km offshore of Alaska (U.S. Fish and Wildlife Service, 2016);

however, murrelets tend to be distributed in marine waters adjacent to areas of suitable breeding habitat (Falxa & Raphael, 2016; Raphael et al., 2007).

The species' wintering range is poorly understood but includes most of the marine areas used for foraging during the breeding season (Raphael et al., 2007). Murrelets exhibit seasonal redistributions during non-breeding seasons. Generally, murrelets are more dispersed and found farther offshore in winter in some areas, although higher concentrations still occur close to shore and in protected waters (U.S. Fish and Wildlife Service, 2016). The farthest offshore records of murrelet distribution are 60 km off the coast of Northern California in October (2011), 46 km off the coast of Oregon in February (2012) (Adams et al., 2014), and at least 300 km off the coast in Alaska (Piatt et al., 2007); however, these pelagic occurrences are considered rare.

Marbled murrelets generally forage in waters within 1 mi. (1.6 km) of the shore (Raphael et al., 2007; U.S. Fish and Wildlife Service, 2005a) out to depths of about 1,300 ft. (400 m) and are reported to dive at least as deep as 90 ft. (27 m), based on their capture in gillnets set at this depth. The species' wintering range is poorly documented but includes most of the marine areas used for foraging during the breeding season (Raphael et al., 2007). Marbled murrelets are unique among alcids in their use of old-growth forest stands (Falxa & Raphael, 2016). Marbled murrelets do not build a nest but use natural features, such as moss, clumps of mistletoe, or piles of needles as a nest site on tree limbs. Nests are in large conifers in coastal old-growth forests in the Pacific Northwest (Lorenz et al., 2016). Nesting season is asynchronous between April 1 and September 23. During the breeding season, murrelets trend to forage in well-defined areas along the shoreline in relatively shallow marine waters. Important features in nesting habitat are large, mossy limbs in forest canopy (Lorenz et al., 2016).

Since the publication of the 2015 NWTT Final EIS/OEIS, the Navy's literature review, and information included in the 2016 USFWS Biological Opinion, new information is available regarding nesting ecology of marbled murrelet. Falxa and Raphael (2016) assessed various terrestrial and marine factors that were important for murrelet spatial distribution and also determined that prey abundance in waters in close proximity to breeding habitat was likely contributing to murrelet declines. Falxa and Raphael (2016) also studied contributing factors to declining spatial distributions in nesting habitats and determined that fire was the major cause of declines in Washington State on federal properties and timber harvesting the major factor on non-federal lands. Further, (Falxa & Raphael) found no similar trends in Oregon and California; spatial distributions in these areas appear to be relatively stable compared to declining distributions in Washington State.

The latest marbled murrelet population density estimates for Conservation Zones 1 through 5 are a density of 2.75 birds per square kilometer in 2015 for the population throughout all conservation zones, and a population size throughout all conservation zones of 19,700 birds (see Figure 3.6-1 in the 2015 NWTT Final EIS/OEIS). Conservation Zones 1 through 5 range from the Puget Sound region in Washington State (Conservation Zone 1), to the west coast of Washington (Conservation Zone 2), the northern part of the Oregon Coast (Conservation Zone 3), the Southern Oregon Coast and Northern California Coast (Conservation Zone 4), and the Central California Coast (Conservation Zones 5). The annual population rate of change for Zone 1 and 3 between 2001 and 2016 was -4.9 percent and 1.1 percent, respectively. The other zones (Conservation Zones 2, 4, and 5) are in the process of being sampled, and data should be available for use in this analysis in the future (Lynch et al., 2017).

3.6.1.8 Short-Tailed Albatross (*Phoebastria albatrus*)

The short-tailed albatross (*Phoebastria albatrus*) was formerly in the genus *Diomedea* and known as Steller's albatross; it is the largest of the North Pacific albatrosses. The short-tailed albatross is listed as endangered under the ESA throughout its range. No critical habitat is designated for this species because little is known about its life in the open ocean (U.S. Fish and Wildlife Service, 2005b). The short-tailed albatross is a surface-foraging species. Since the publication of the 2015 NWTT Final EIS/OEIS, the 2016 USFWS Biological Opinion included more recent information regarding nesting ecology and life history information; however, these new sources concern recovery efforts and fisheries interactions reductions in the western Pacific outside of the Study Area. New information, however, is available from Orben et al. (2018), who suggest that juveniles show strong seasonal changes in distributions, traveling more in winter and occupying regions not typically used by adults. While adult short-tailed albatrosses forage over both oceanic and neritic habitats across the North Pacific, concentrating along biologically productive shelf-break areas, juveniles appear to use shelf-based habitats more, especially in the Sea of Okhotsk, Bering Sea, and along the US west coast (Orben et al., 2018). During their initial flight years, juvenile short-tailed albatrosses use a large portion of the North Pacific from tropical to arctic waters, including the transition zone, California Current system, sub-arctic gyres, and the marginal seas: the Bering Sea and Sea of Okhotsk (Orben et al., 2018). As juvenile albatrosses age, habitat use switches away from pelagic regions to shelf break and slope habitats, becoming more similar to adult distributions, as anticipated from prior studies summarized in the 2015 NWTT Final EIS/OEIS and 2016 USFWS Biological Opinion, yet juveniles continue to explore new regions with low levels of spatial fidelity (Orben et al., 2018).

3.6.1.9 Northern Spotted Owl (*Strix occidentalis caurina*)

The northern spotted owl was listed as threatened throughout its range in 1990 (55 FR 26114), and revised critical habitat for this species was designated in 2012 (77 FR 71875). The northern spotted owl is a landbird and does not forage in the marine environment. Spotted owl occurrence in the Study Area is limited to lands beneath the Olympic MOAs, where nesting and foraging habitat exists. Designated critical habitat for this species also exists beneath the Olympic MOAs (see Figure 3.6-2). USFWS revised the recovery plan for the northern spotted owl in 2011 (U.S. Fish and Wildlife Service, 2011).

The Navy conducted a literature search for new information since the publication of the 2015 NWTT Final EIS/OEIS for the northern spotted owl that may change the analysis of potential impacts on this species. Since the publication of the 2015 NWTT Final EIS/OEIS, there have been no updates to the regulatory status, life history information, or species-specific threats that would alter the analysis from the 2015 NWTT Final EIS/OEIS. As such, the additional description regarding the northern spotted owl presented in the 2015 NWTT Final EIS/OEIS remains valid.

3.6.1.10 Streaked Horned Lark (*Eremophila alpestris strigata*)

The streaked horned lark is endemic to the Pacific Northwest and is a subspecies of the wide-ranging horned lark. The streaked horned lark is listed as threatened and critical habitat was designated in 2013 at four locations along the Washington coast, nine islands in the lower Columbia River, and three national wildlife refuge sites in the Willamette Valley (78 FR 61451), all of which are outside of the Study Area (Figure 3.6-3). Since the publication of the 2015 NWTT Final EIS/OEIS, there have been no updates to the regulatory status, life history information, or species-specific threats that would alter the analysis from the 2015 NWTT Final EIS/OEIS. This species is a ground-nesting song bird species that would not occur in areas used for training or testing activities addressed in this Supplemental. As such, the additional description regarding streaked horned lark presented in the 2015 NWTT Final EIS/OEIS remains valid.

3.6.1.11 Western Snowy Plover (*Charadrius nivosus nivosus*)

The Pacific Coast population of the western snowy plover was listed as threatened under the ESA in 1993 (58 FR 12864). Critical habitat was designated in 2012 along the coasts of California, Oregon and Washington (77 FR 36727) (see Figure 3.6-4). The Pacific Coast population is defined as those individuals that nest within 50 miles (80 km) of the Pacific Ocean on the mainland coast, peninsulas, offshore islands, bays, estuaries, or rivers of the United States and Baja California, Mexico.

The Navy conducted a literature search for new information since the publication of the 2015 NWTT Final EIS/OEIS for the western snowy plover that may change the analysis of potential impacts on this species. New information is available on overall population trends for this species, which were reported in the 2015 NWTT Final EIS/OEIS as declining across the range of this species within the Study Area. These declines have been attributed to poor reproductive success resulting from human disturbance, predation, and inclement weather. Invasive species encroachment that has degraded nesting habitats, along with urban development, have contributed to declines in active nesting (U.S. Fish and Wildlife Service, 2007). Between 2006 and 2009, the population declined significantly, but it has remained fairly stable since 2012 (Olesiuk, 2008). The western snowy plover currently nests at three sites in Washington and forages primarily in the tide zone or near the intertidal zone capturing prey from the surface. In 2015, the population at these sites was estimated at 77 adults. In 2015 the two main breeding sites contained 26 breeding pairs over a four-year average and had greater than or equal to one fledgling in the years 2011, 2014, and 2015. The highest number of fledglings since 2007 occurred in 2015, when an estimated 69–77 chicks fledged (Stinson, 2016a). The Washington total in 2016 was estimated to be 102 birds found in all surveyed beaches over the summer window (Washington Department of Fish and Wildlife, 2016). There were 66 birds surveyed during the 2017 range-wide western snowy plover winter window survey (Washington Department of Fish and Wildlife, 2017). Although new information on population trends has become available, the remaining information regarding life history described in the 2015 NWTT Final EIS/OEIS remains valid.

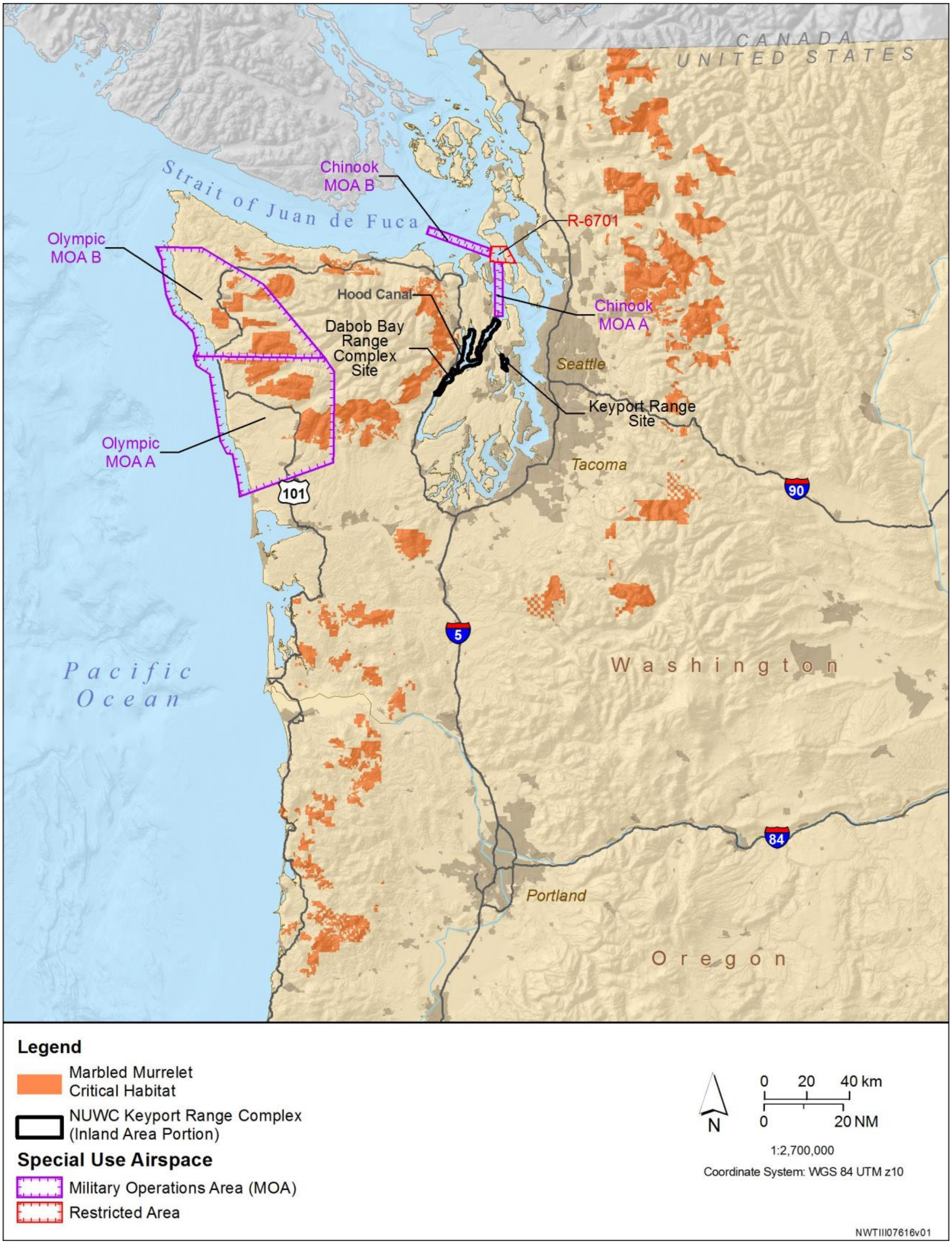

Figure 3.6-1: Critical Habitat for the Marbled Murrelet

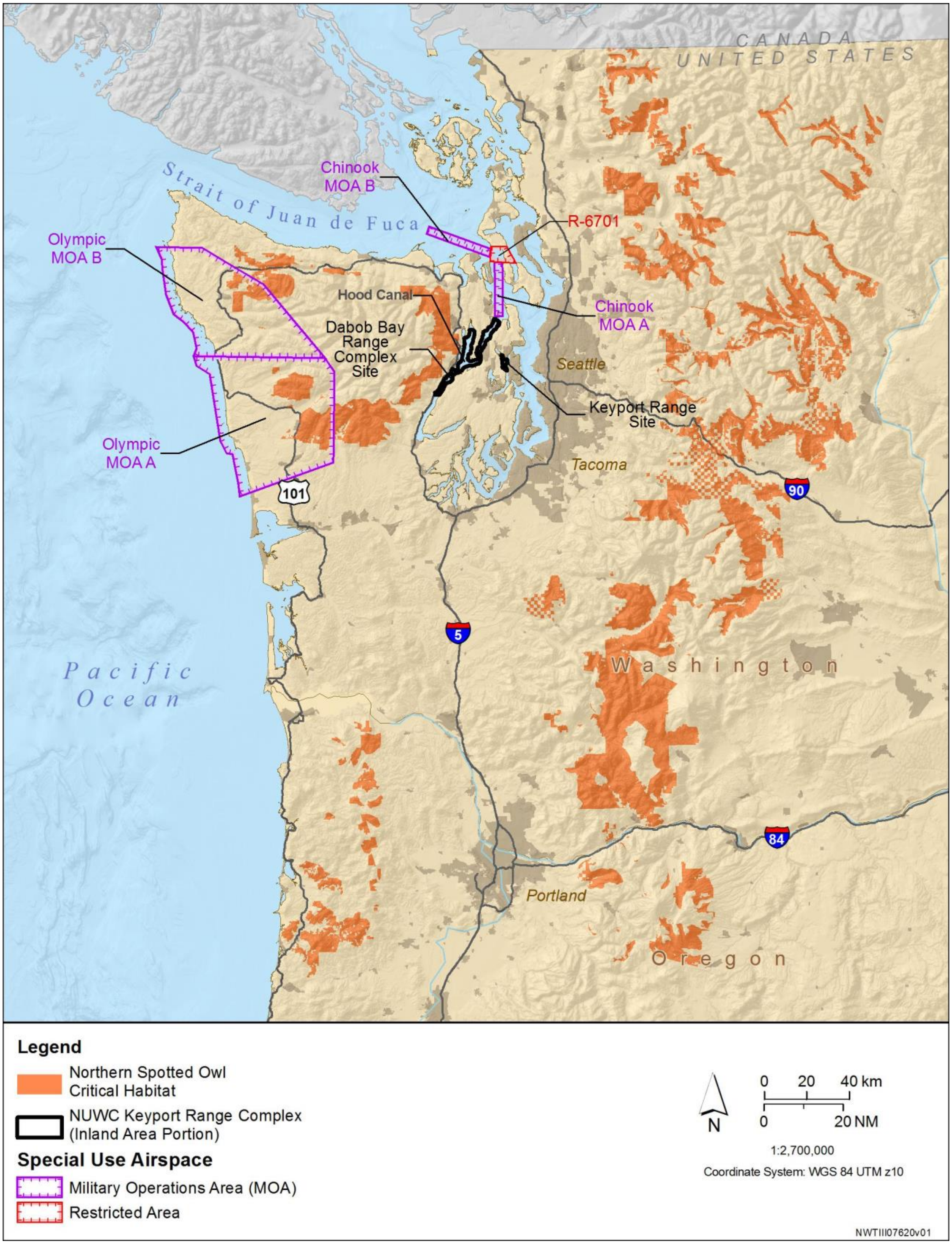

Figure 3.6-2: Critical Habitat for the Northern Spotted Owl

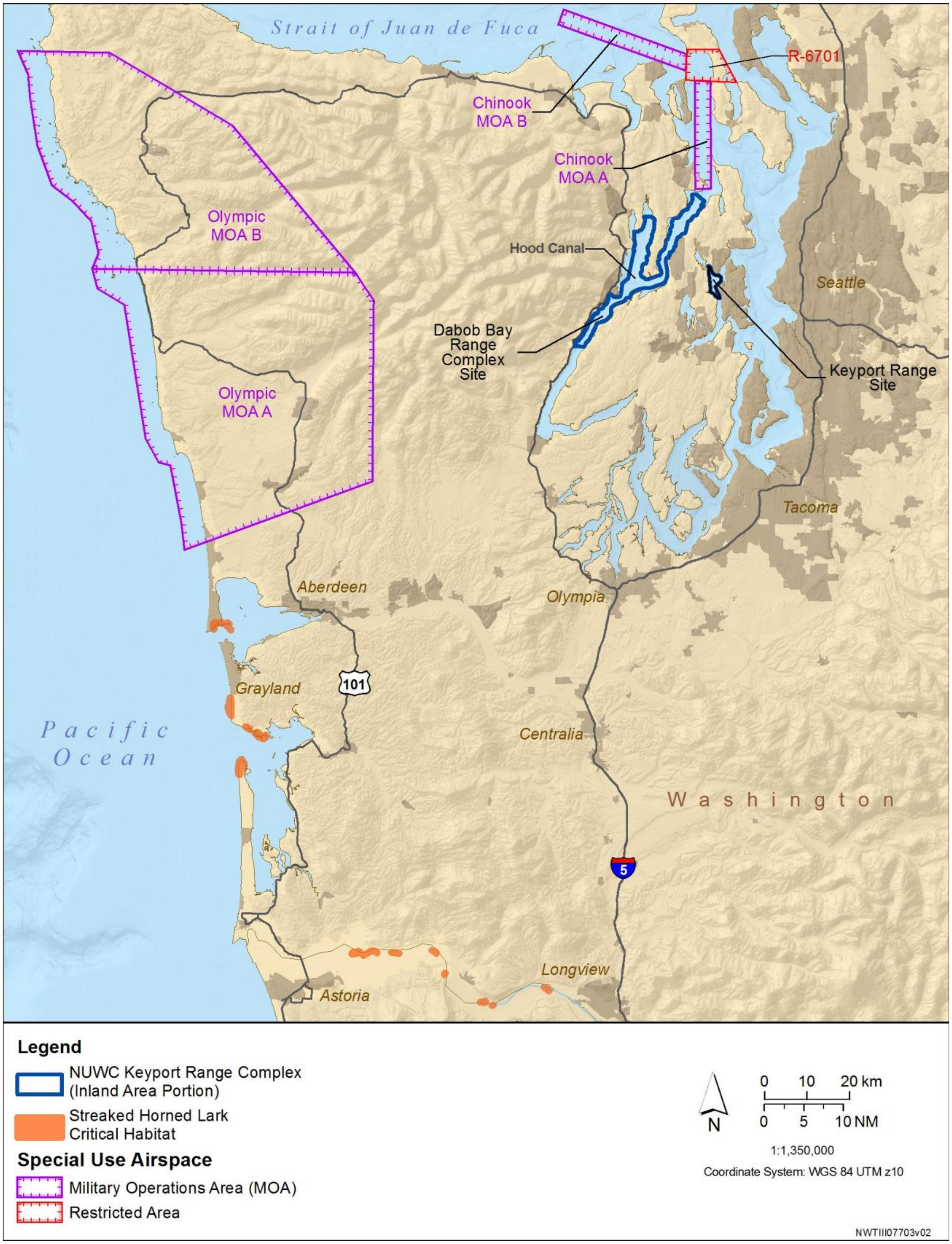

Figure 3.6-3: Critical Habitat for the Streaked Horned Lark

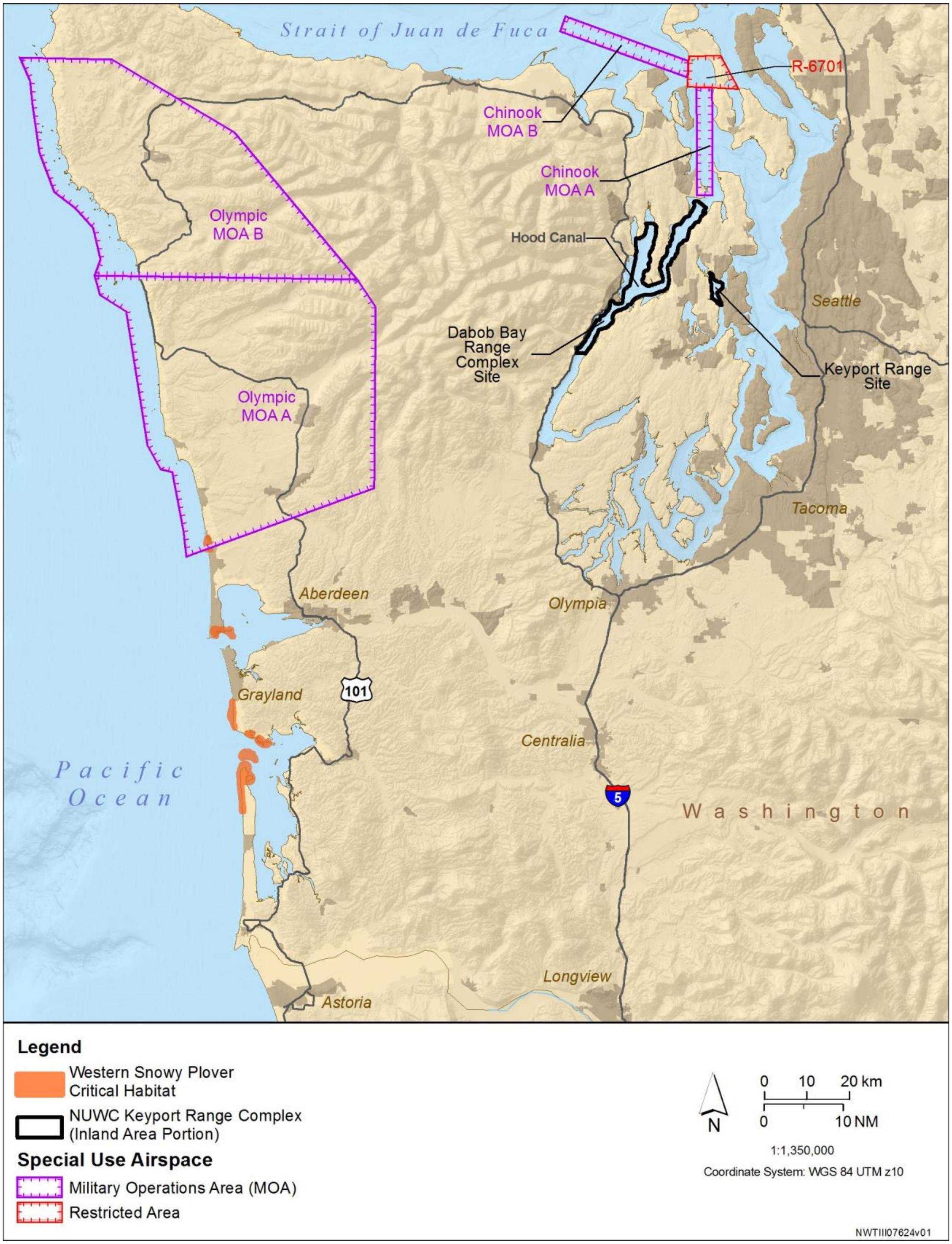

Figure 3.6-4: Critical Habitat for the Western Snowy Plover

3.6.2 Environmental Consequences

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. Because of new activities being proposed, two new stressors would be introduced that are analyzed for their potential effects on marine bird species: high-energy lasers (as an Energy stressor), as detailed in Section 3.0.3.3.2.2 (High-Energy Lasers), and biodegradable polymer (as an Entanglement stressor), as detailed in Section 3.0.3.5.3 (Biodegradable Polymer).

In the 2015 NWTT Final EIS/OEIS, the Navy considered all potential stressors associated with ongoing training and testing activities in the Offshore Area, Inland Waters, and the Western Behm Canal and then analyzed their potential impacts on birds 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 Navy has completed a literature review for information on birds 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 document will supplement the 2015 NWTT Final EIS/OEIS to support environmental compliance with applicable environmental statutes for birds.

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 ESA-listed species or populations of birds in the Study Area. Use of acoustic stressors (sonar and other transducers) and use of explosives have occurred since the 2015 completion of the NWTT Final EIS/OEIS Record of Decision and conclusion of the formal consultation process between the Navy and USFWS in 2016. See Chapter 2 (Description of Proposed Action and Alternatives) for a comparison of all alternatives and a comparison to activities proposed in the 2015 NWTT Final EIS/OEIS. There have been no known additional impacts on bird populations or bird habitats in terrestrial or marine environments that were not accounted for in the 2015 NWTT Final EIS/OEIS (U.S. Department of the Navy, 2015) or the USFWS Biological Opinion pursuant to ESA (U.S. Fish and Wildlife Service, 2016). In addition, the Navy will be including a number of measures and adjustments in activities that would reduce potential impacts on the marbled murrelet.

There has been no emergent science that would necessitate changes to conclusions reached by Navy in the 2015 NWTT Final EIS/OEIS regarding those other dismissed stressors as having a negligible and/or discountable impact on bird populations or species. The analysis presented in this section of this Supplemental also considers standard operating procedures that are described in Chapter 2 (Description of Proposed Action and Alternatives), mitigation measures that are described in Chapter 5 (Mitigation), and in Appendix K (Geographic Mitigation Assessment) which defines mitigation areas designed to avoid or reduce potential impacts on seabirds (e.g., distance from shore restrictions on high explosives for training activities [no closer than 50 NM from any shore]). The Navy would implement these measures to avoid potential impacts on birds from stressors associated with the proposed training and testing activities. Minimizing impacts on ESA-listed birds will be coordinated with USFWS through the ESA consultation process.

The potential stressors associated with the training and testing activities in the Study Area include the following, which will be analyzed for potential impacts on birds within the stressor categories below:

- **Acoustic** (sonar and other transducers, vessel noise, aircraft noise, weapons noise)
- **Explosives** (explosive shock wave and sound, explosive fragments)
- **Energy** (in-water electromagnetic devices, and high-energy lasers, radar)
- **Physical disturbance and strike** (vessels and in-water devices, aircraft and aerial targets, and military expended materials)
- **Entanglement** (wires and cables, decelerators/parachutes, biodegradable polymer)
- **Ingestion** (military expended materials other than munitions)
- **Secondary** (impacts on habitat; impacts on prey availability)

This section of this Supplemental evaluates how and to what degree potential impacts on birds from stressors described in Section 3.0.1 (Overall Approach to Analysis) may have changed since the analysis presented in the 2015 NWTT Final EIS/OEIS was completed. Tables 2.5-1, 2.5-2, and 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 described in the 2015 NWTT Final EIS/OEIS so that the proposed levels of training and testing under this supplemental can be easily compared.

3.6.2.1 Acoustic Stressors

Section 3.6.3.1 (Acoustic Stressors) in the 2015 NWTT Final EIS/OEIS provides an overview of seabird hearing, including an explanation of how birds can suffer injury, hearing loss, and physiological stress, as well as various behavioral reactions exhibited by birds when a noise event induces a response. Although it was assumed nesting colonial waterbirds would be more likely to flush or exhibit a mob response when disturbed, observations of nesting black skimmers and nesting least, gull-billed, and common terns showed they did not modify nesting behavior in response to military fixed-wing aircraft engaged in low-altitude tactical flights and rotary-wing overflights (Hillman et al., 2015). In addition, long-term consequences associated with noise-induced impacts are discussed in the 2015 NWTT Final EIS/OEIS in Section 3.6.3.1 (Acoustic Stressors).

3.6.2.1.1 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 birds potentially resulting from sound-producing Navy training and testing activities. Impacts on birds depends on the sound source and context of exposure. Possible impacts include auditory or non-auditory trauma; hearing loss resulting in temporary or permanent hearing threshold shift; auditory masking; physiological stress; or changes in behavior, including changing habitat use and activity patterns, increasing stress response, decreasing immune response, reducing reproductive success, increasing predation risk, and degrading communication (Larkin et al., 1996). Numerous studies have documented that birds and other wild animals respond to human-made noise (Bowles et al., 1994; Larkin et al., 1996; National Park Service, 1994). The manner in which birds respond to noise could depend on species' physiology life stage, characteristics of the noise source, loudness, onset rate, distance from the noise source, presence/absence of associated visual stimuli, and previous exposure. Noise may cause physiological or behavioral responses that reduce the animals' fitness or ability to grow, survive, and reproduce successfully.

The types of birds exposed to sound-producing activities depend on where training and testing activities occur. Birds in the study area can be divided into three groups based on breeding and foraging habitat: (1) those species such as albatrosses, petrels, frigatebirds, tropicbirds, boobies, alcids, skuas and jaegers, and some terns that forage over the ocean and nest on oceanic islands; (2) species such as pelicans, cormorants, gulls, and some terns that nest along the coast and forage in nearshore areas; and (3) those few species such as jaegers, Franklin's gull, Bonaparte's gulls, ring-billed gulls, black terns, and ducks and loons that nest and forage along the coast and inland habitats and come to the coastal areas during nonbreeding seasons. In addition, birds that are typically found inland, such as songbirds, may be present flying in large numbers over open ocean areas during annual spring and fall migration periods.

Birds could be exposed to sounds from a variety of sources. While above the water surface, birds may be exposed to airborne sources such as pile driving, weapons noise, vessel noise, and aircraft noise. While foraging and diving, birds may be exposed to underwater sources such as sonar, pile driving, air guns, and vessel noise. While foraging birds will be present near the water surface, migrating birds may fly at various altitudes.

Seabirds use a variety of foraging behaviors that could expose them to underwater sound. Most seabirds plunge-dive from the air into the water or perform aerial dipping (the act of taking food from the water surface in flight); others surface-dip (swimming and then dipping to pick up items below the surface) or jump-plunge (swimming, then jumping upward and diving underwater). Birds that feed at the surface by surface or aerial dipping with limited to no underwater exposure include petrels, jaegers, and phalaropes. Birds that plunge-dive are typically submerged for short durations, and any exposure to underwater sound would be very brief. Birds that plunge-dive include albatrosses, some tern species, masked boobies, gannets, shearwaters, and tropicbirds. Some birds, such as cormorants, seaducks, alcids, and loons pursue prey under the surface, swimming deeper and staying underwater longer than other plunge-divers. Some of these birds may stay underwater for up to several minutes and reach depths between 50 ft. (15 m) and 550 ft. (168 m) (Alderfer, 2003; Durant et al., 2003; Jones, 2001; Lin, 2002; Ronconi, 2001). Birds that forage near the surface would be exposed to underwater sound for shorter periods of time than those that forage below the surface. Exposures of birds that forage below the surface may be reduced by destructive interference of reflected sound waves near the water surface (see Appendix D, Acoustic and Explosive Concepts). Sounds generated underwater during training and testing would be more likely to impact birds that pursue prey under the surface, although as previously stated, little is known about seabird hearing ability underwater.

3.6.2.1.1.1 Injury

Auditory structures can be susceptible to direct mechanical injury due to high levels of impulsive sound. This could include tympanic membrane rupture, disarticulation of the middle ear ossicles, and trauma to the inner ear structures such as hair cells within the organ of Corti. Auditory trauma differs from auditory fatigue in that the latter involves the overstimulation of the auditory system, rather than direct mechanical damage, which may result in hearing loss (see Section 3.6.2.1.1.2, Hearing Loss). There are no data on damage to the middle ear structures of birds due to acoustic exposures. Because birds are known to regenerate auditory hair cells, studies have been conducted to purposely expose birds to very high sound exposure levels (SELs) in order to induce hair cell damage in the inner ear. Because damage can co-occur with fatiguing exposures at high SELs, effects to hair cells are discussed below in Section 3.6.2.1.1.2 (Hearing Loss).

Because there is no data on non-auditory injury to birds from intense non-explosive sound sources, it may be useful to consider information for other similar-sized vertebrates. The rapid large pressure changes near non-explosive impulsive underwater sound sources, such as some large air guns and pile driving, are thought to be potentially injurious to other small animals (fishes and sea turtles). While long-duration exposures (i.e., minutes to hours) to high sound levels of sonars are thought to be injurious to fishes, this has not been experimentally observed (see Popper et al., 2014). Potential for injury is generally attributed to compression and expansion of body gas cavities, either due to rapid onset of pressure changes or resonance (enhanced oscillation of a cavity at its natural frequency). Because water is considered incompressible and animal tissue is generally of similar density as water, animals would be more susceptible to injury from a high-amplitude sound source in water than in air since waves would pass directly through the body rather than being reflected. Proximal exposures to high-amplitude non-impulsive sounds underwater could be limited by a bird's surfacing response.

In air, the risk of barotrauma would be associated with high-amplitude impulses, such as from explosives (discussed in Section 3.6.2.2, Explosives Stressors). Unlike in water, most acoustic energy will reflect off the surface of an animal's body in air. Additionally, air is compressible whereas water is not, allowing energy to dissipate more rapidly. For these reasons, in-air non-explosive sound sources in this analysis are considered to pose little risk of non-auditory injury.

3.6.2.1.1.2 Hearing Loss

Exposure to intense sound may result in hearing loss that persists after cessation of the noise exposure. Hearing loss may be temporary or permanent, depending on factors such as the exposure frequency, received sound pressure level (SPL), temporal pattern, and duration. Hearing loss could impair a bird's ability to hear biologically important sounds within the affected frequency range. Biologically important sounds come from social groups, potential mates, offspring, or parents; environmental sounds; prey; or predators.

Because in-air measures of hearing loss and recovery in birds due to an acoustic exposure are limited (e.g., quail, budgerigars, canaries, and zebra finches (Ryals et al., 1999); budgerigar (Hashino et al., 1988); parakeet (Saunders & Dooling, 1974); quail (Niemiec et al., 1994)), and no studies exist of bird hearing loss due to underwater sound exposures, auditory threshold shift in birds is considered to be consistent with general knowledge about noise-induced hearing loss described in the Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities (see Section 3.0.3.7). The frequencies affected by hearing loss would vary depending on the exposure frequency. The limited data on hearing loss in birds shows that the frequency of exposure is the hearing frequency most likely to be affected (Saunders & Dooling, 1974).

Hearing loss can be due to biochemical (fatiguing) processes or tissue damage. Tissue damage can include damage to the auditory hair cells and their underlying support cells. Hair cell damage has been observed in birds exposed to long duration sounds that resulted in initial threshold shifts greater than 40 dB (Niemiec et al., 1994; Ryals et al., 1999). Unlike many other animals, birds have the ability to regenerate hair cells in the ear, usually resulting in considerable anatomical, physiological, and behavioral recovery within several weeks (Rubel et al., 2013; Ryals et al., 1999). Still, intense exposures are not always fully recoverable, even over periods up to a year after exposure, and damage and subsequent recovery vary significantly by species (Ryals et al., 1999). Birds may be able to protect themselves against damage from sustained sound exposures by reducing middle ear pressure, an ability that may protect ears while in flight (Ryals et al., 1999) and from injury due to pressure changes during diving (Dooling & Therrien, 2012).

Hearing loss is typically quantified in terms of threshold shift, which is the amount (in dB) that hearing thresholds at one or more specified frequencies are elevated, compared to their pre-exposure values, at some specific time after the noise exposure. The amount of threshold shift measured usually decreases with increasing recovery time, which is the amount of time that has elapsed since a noise exposure. If the threshold shift eventually returns to zero (i.e., the hearing threshold returns to the pre-exposure value), the threshold shift is called a temporary threshold shift (TTS). If the threshold shift does not completely recover (the threshold remains elevated compared to the pre-exposure value), the remaining threshold shift is called a permanent threshold shift (PTS). Figure 3.0-3 (Chapter 3, Section 3.0.3.7.2 – Hearing Loss) shows two hypothetical threshold shifts: one that completely recovers, a TTS, and one that does not completely recover, leaving some PTS. By definition, TTS is a function of the recovery time; therefore, comparing the severity of noise exposures based on the amount of induced TTS can only be done if the recovery times are also considered. For example, a 20 dB TTS measured 24 hours post-exposure indicates a more hazardous exposure than one producing 20 dB of TTS measured only two minutes after exposure. If the TTS is 20 dB after 24 hours, the TTS measured after two minutes would be much higher. Conversely, if 20 dB of TTS is measured after two minutes, the TTS measured after 24 hours would likely would likely be much smaller. Studies in mammals have revealed that noise exposures resulting in high levels of TTS (greater than 40 dB) may also result in neural injury without any permanent hearing loss (Kujawa & Liberman, 2009; Lin et al., 2011). It is unknown if a similar effect would be observed in birds.

Hearing Loss due to Non-Impulsive Sounds

Behavioral studies of threshold shift in birds within their frequencies of best hearing (between 2 and 4 kHz) due to long duration (30 minutes to 72 hours) continuous, non-impulsive, high-level sound exposures in air have shown that susceptibility to hearing loss varies substantially by species, even in species with similar auditory sensitivities, hearing ranges, and body size (Niemiec et al., 1994; Ryals et al., 1999; Saunders & Dooling, 1974). For example, Ryals et al. (1999) conducted the same exposure experiment on quail and budgerigars, which have very similar audiograms. A 12-hour exposure to a 2.86 kHz tone at 112 dB re 20 µPa SPL (cumulative SEL of 158 dB re 20 $\mu Pa^2 s$) resulted in a 70 dB threshold shift measured after 24 hours of recovery in quail, but a substantially lower 40 dB threshold shift measured after just 12 hours of recovery in budgerigars recovered to within 10 dB of baseline after three days and fully recovered by one month (Ryals et al., 1999). Although not directly comparable, this SPL would be perceived as extremely loud but just under the threshold of pain for humans per the American Speech-Language-Hearing Association. Whereas the 158 dB re 20 μPa^2-s SEL tonal exposure to quail discussed above caused 20 dB of PTS (Ryals et al., 1999), a shorter (four-hour) tonal exposure to quail with similar SEL (157 dB re 20 μPa^2-s) caused 65 dB of threshold shift that fully recovered within two weeks (Niemiec et al., 1994).

Data on threshold shift in birds due to relatively short-duration sound exposures that could be used to estimate the onset of threshold shift is limited. Saunders and Dooling (1974) provide the only threshold shift growth data measured for birds. Saunders and Dooling (1974) exposed young budgerigars to four levels of continuous 1/3-octave band noise (76, 86, 96, and 106 dB re 20 µPa) centered at 2.0 kHz and measured the threshold shift at various time intervals during the 72-hour exposure. The earliest measurement found 7 dB of threshold shift after approximately 20 minutes of exposure to the 96 dB re

20 µPa SPL noise (127 dB re 20 µPa^2-s SEL). Generally, onset of TTS in other species has been considered 6 dB above measured threshold (Finneran, 2015), which accounts for natural variability in auditory thresholds. The Saunders and Dooling (1974) budgerigar data is the only bird data showing low levels of threshold shift. Because of the observed variability of threshold shift susceptibility among bird species and the relatively long duration of sound exposure in Saunders and Dooling (1974), the observed onset level cannot be assumed to represent the SEL that would cause onset of TTS for other bird species or for shorter duration exposures (i.e., a higher SEL may be required to induce threshold shift for shorter duration exposures).

Since the goal of most bird hearing studies has been to induce hair cell damage to study regeneration and recovery, exposure durations were purposely long. Studies with other non-avian species have shown that long-duration exposures tend to produce more threshold shift than short-duration exposures with the same SEL [e.g., see Finneran (2015)]. The SELs that induced TTS and PTS in these studies likely over-estimate the potential for hearing loss due to any short-duration sound of comparable SEL that a bird could encounter outside of a controlled laboratory setting. In addition, these studies were not designed to determine the exposure levels associated with the onset of any threshold shift or to determine the lowest SEL that may result in PTS.

With insufficient data to determine PTS onset for birds due to a non-impulsive exposure, data from other taxa are considered. Studies of terrestrial mammals suggest that 40 dB of threshold shift is a reasonable estimate of where PTS onset may begin (see (Southall et al., 2007). Similar amounts of threshold shift have been observed in some bird studies with no subsequent PTS. Of the birds studied, the budgerigars showed intermediate susceptibility to threshold shift; they exhibited threshold shifts in the range of 40 dB–50 dB after 12-hour exposures to 112 dB and 118 dB re 20 µPa SPL tones at 2.86 kHz (158–164 dB re 20 µPa^2-s SEL), which recovered to within 10 dB of baseline after three days and fully recovered by one month (Ryals et al., 1999). These experimental SELs are a conservative estimate of the SEL above which PTS may be considered possible for birds.

All of the above studies were conducted in air. There are no studies of hearing loss to diving birds due to underwater exposures.

Hearing Loss due to Impulsive Sounds

The only measure of hearing loss in a bird due to an impulsive noise exposure was conducted by Hashino et al. (1988), in which budgerigars were exposed to the firing of a pistol with a received level of 169 dB re 20 µPa peak SPL (two gunshots per each ear); SELs were not provided. While the gunshot frequency power spectrum had its peak at 2.8 kHz, threshold shift was most extensive below 1 kHz. Threshold shift recovered at frequencies above 1 kHz, while a 24 dB PTS was sustained at frequencies below 1 kHz. Studies of hearing loss in diving birds exposed to impulsive sounds underwater do not exist.

Because there is only one study of hearing loss in birds due to an impulsive exposure, the few studies of hearing loss in birds due to exposures to non-impulsive sound are the only other avian data upon which to assess bird susceptibility to hearing loss from an impulsive sound source. Data from other taxa (U.S. Department of the Navy, 2017) indicate that, for the same SEL, impulsive exposures are more likely to result in hearing loss than non-impulsive exposures. This is due to the high peak pressures and rapid pressure rise times associated with impulsive exposures.

3.6.2.1.1.3 Masking

Masking occurs when one sound, distinguished as the "noise," interferes with the detection or recognition of another sound. The quantitative definition of masking is the amount in decibels an auditory detection or discrimination threshold is raised in the presence of a masker (Erbe et al., 2016). As discussed in the Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities (Section 3.0.3.7), masking can effectively limit the distance over which an animal can communicate and detect biologically relevant sounds. Masking only occurs in the presence of the masking noise and does not persist after the cessation of the noise.

Critical ratios are the lowest ratio of signal-to-noise at which a signal can be detected. When expressed in decibels, critical ratios can easily be calculated by subtracting the noise level (in dB re 1 $\mu Pa^2/Hz$) from the signal level (in dB re 1 μPa) at detection threshold. A signal must be received above the critical ratio at a given frequency to be detectable by an animal. Critical ratios have been determined for a variety of bird species (e.g., Dooling (1980), Noirot et al. (2011), Dooling and Popper (2000), and Crowell (2016)), and inter-species variability is evident. Some birds exhibit low critical ratios at certain vocal frequencies, perhaps indicating that hearing evolved to detect signals in noisy environments or over long distances (Dooling & Popper, 2000).

The effect of masking is to limit the distance over which a signal can be perceived. An animal may attempt to compensate in several ways, such as by increasing the source level of vocalizations (the Lombard effect), changing the frequency of vocalizations, or changing behavior (e.g., moving to another location, increasing visual display). Birds have been shown to shift song frequencies in the presence of a tone at a similar frequency (Goodwin & Podos, 2013), and in continuously noisy urban habitats, populations have been shown to have altered song duration and shifted to higher frequencies (Slabbekoorn & den Boer-Visser, 2006). Changes in vocalization may incur energetic costs and hinder communication with conspecifics, which, for example, could result in reduced mating opportunities. These effects are of long-term concern in constant noisy urban environments (Patricelli & Blickley, 2006) where masking conditions are prevalent.

3.6.2.1.1.4 Physiological Stress

Animals in the marine environment naturally experience stressors within their environment and as part of their life histories. Contributors to stress include 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. Anthropogenic sound-producing activities have the potential to provide additional stressors beyond those that naturally occur, as described in the Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities (see Section 3.0.3.7).

Chronic stress due to disturbance may compromise the general health and reproductive success of birds (Kight et al., 2012), but a physiological stress response is not necessarily indicative of negative consequences to individual birds or to populations (Larkin et al., 1996; National Park Service, 1994). The reported behavioral and physiological responses of birds to noise exposure can fall within the range of normal adaptive responses to external stimuli, such as predation, that birds face on a regular basis. These responses can include activation of the neural and endocrine systems, which can cause changes such as increased blood pressure, available glucose, and blood levels of corticosteroids (Manci et al., 1988). It is possible that individuals would return to normal almost immediately after short-term or transient exposure, and the individual's metabolism and energy budget would not be affected in the long term. Studies have also shown that birds can habituate to noise following frequent exposure and cease to respond behaviorally to the noise (Larkin et al., 1996; National Park Service, 1994; Plumpton, 2006). However, the likelihood of habituation is dependent upon a number of factors, including species of bird (Bowles et al., 1991) and frequency of and proximity to exposure. Although Andersen et al. (1990) did not evaluate noise specifically, they found evidence that anthropogenic disturbance is related to changes in home ranges; for example, raptors have been shown to shift their terrestrial home range when concentrated military training activity was introduced to the area. On the other hand, cardinals nesting in areas with high levels of military training activity (including gunfire, artillery, and explosives) were observed to have similar reproductive success and stress hormone levels as cardinals in areas of low activity (Barron et al., 2012).

While physiological responses such as increased heart rate or startle response can be difficult to measure in the field, they often accompany more easily measured reactions like behavioral responses. A startle is a reflex characterized by rapid increase in heart rate, shutdown of nonessential functions, and mobilization of glucose reserves. Habituation keeps animals from expending energy and attention on harmless stimuli, but the physiological component might not habituate completely (Bowles, 1995).

A strong and consistent behavioral or physiological response is not necessarily indicative of negative consequences to individuals or to populations (Bowles, 1995; Larkin et al., 1996; National Park Service, 1994). For example, many of the reported behavioral and physiological responses to noise are within the range of normal adaptive responses to external stimuli, such as predation, that wild animals face on a regular basis. In many cases, individuals would return to homeostasis or a stable equilibrium almost immediately after exposure. The individual's overall metabolism and energy budgets would not be affected if it had time to recover before being exposed again. If the individual does not recover before being exposed again, physiological responses could be cumulative and lead to reduced fitness. However, it is also possible that an individual would have an avoidance reaction (i.e., move away from the noise source) to repeated exposure or habituate to the noise when repeatedly exposed.

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

3.6.2.1.1.5 Behavioral Reactions

Numerous studies have documented that birds and other wild animals respond to human-made noise, including aircraft overflights, weapons firing, and explosions (Larkin et al., 1996; National Park Service, 1994; Plumpton, 2006). The manner in which an animal responds to noise could depend on several factors, including life history characteristics of the species, characteristics of the noise source, sound source intensity, onset rate, distance from the noise source, presence or absence of associated visual stimuli, food and habitat availability, and previous exposure (see Section 3.0.3.7, Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities). Researchers have documented a range of bird behavioral responses to noise, including no response, head turn, alert behavior, startle response, flying or swimming away, diving into the water, and increased vocalizations (Brown et al., 1999; Larkin et al., 1996; National Park Service, 1994; Plumpton, 2006; Pytte et al., 2003; Stalmaster & Kaiser, 1997). Some behavioral responses may be accompanied by physiological responses, such as increased heart rate or short-term changes in stress hormone levels (Partecke et al., 2006).

Behavioral responses may depend on the characteristics of the noise and whether the noise is similar to biologically relevant sounds such as alarm calls by other birds and predator sounds. For example, European starlings (*Sturnus vulgaris*) took significantly longer to habituate to repeated bird distress calls than white noise or pure tones (Johnson et al., 1985). Starlings may have been more likely to continue to respond to the distress because it is a more biologically meaningful sound. Starlings were also more likely to habituate in winter than summer, possibly meaning that food scarcity or seasonal physiological conditions may affect intensity of behavioral response (Johnson et al., 1985).

Behavioral Reactions to Impulsive Sound Sources

Studies regarding behavioral responses by non-nesting birds to impulsive sound sources are limited. Seismic surveys had no noticeable impacts on the movements or diving behavior of long-tailed ducks undergoing wing molt, a period in which flight is limited and food requirements are high (Lacroix et al., 2003). The birds may have tolerated the seismic survey noise to stay in preferred feeding areas.

Responses to aircraft sonic booms are informative of responses to single impulsive sounds. Responses to sonic booms are discussed below in Behavioral Reactions to Aircraft.

Behavioral Reactions to Sonar and Other Active Acoustic Sources

There are no studies of bird responses underwater to sonars, but the effect of pingers on fishing nets has been examined. Fewer common murres (*Uria aalge*) were entangled in gillnets when the gillnets were outfitted with 1.5 kHz pingers with a source level of 120 dB re 1 µPa; however, there was no significant reduction in rhinoceros auklet (*Cerorhinca monocerata*) bycatch in the same nets (Melvin et al., 1999; Melvin et al., 2011). It was unknown whether the pingers elicited a behavioral response by the birds or decreased prey availability.

Behavioral Reactions to Aircraft

There are multiple possible factors involved in behavioral responses to aircraft overflights, including the noise stimulus as well as the visual stimulus.

Observations of tern colonies responses to balloon overflights suggest that visual stimulus is likely to be an important component of disturbance from overflights (Brown, 1990). Although it was assumed nesting colonial waterbirds would be more likely to flush or exhibit a mob response when disturbed, observations of nesting black skimmers and nesting least, gull-billed, and common terns showed they did not modify nesting behavior in response to military fixed-wing aircraft engaged in low-altitude tactical flights and rotary-wing overflights (Hillman et al., 2015). Maximum behavioral responses by crested tern (*Sterna bergii*) to aircraft noise were observed at sound level exposures greater than 85 A-weighted decibels (dBA) re 20 µPa. However, herring gulls (*Larus argentatus*) significantly increased their aggressive interactions within the colony and their flights over the colony during overflights with received SPLs of 101–116 dBA re 20 µPa (Burger, 1981).

Raptors and wading birds have responded minimally to jet (110 dBA re 20 µPa) and propeller plane (92 dBA re 20 µPa) overflights, respectively (Ellis, 1981). Jet flights greater than 1,640 ft. (500 m) distance from raptors were observed to elicit no response (Ellis, 1981). The impacts of low-altitude military training flights on wading bird colonies in Florida were estimated using colony distributions and turnover rates. There were no demonstrated impacts of military activity on wading bird colony establishment or size (Black et al., 1984). Fixed-winged jet aircraft disturbance did not seem to adversely affect waterfowl observed during a study in coastal North Carolina (Conomy et al., 1998); however, harlequin ducks were observed to show increased agonistic behavior and reduced courtship behavior up to one to two hours after low-altitude military jet overflights (Goudie & Jones, 2004).

It is possible that birds could habituate and no longer exhibit behavioral responses to aircraft noise, as has been documented for some impulsive noise sources (Ellis, 1981; Russel et al., 1996) and aircraft noise (Conomy et al., 1998). Ellis (1981), found that raptors would typically exhibit a minor short-term startle response to simulated sonic booms, and no long-term effect to productivity was noted.

3.6.2.1.1.6 Long Term Consequences

Long term consequences to birds due to acoustic exposures are considered following the Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities (see Section 3.0.3.7).

Long-term consequences due to individual behavioral reactions and short-term instances of physiological stress are especially difficult to predict because individual experience over time can create complex contingencies. It is more likely that any long-term consequences to an individual would be a result of costs accumulated over a season, year, or life stage due to multiple behavioral or stress responses resulting from exposures to multiple stressors over significant periods of time. Conversely, some birds may habituate to or become tolerant of repeated acoustic exposures over time, learning to ignore a stimulus that in the past did not accompany any overt threat. Most research on long-term consequences to birds due to acoustic exposures has focused on breeding colonies or shore habitats, and does not address the brief exposures that may be encountered during migration or foraging at sea. More research is needed to better understand the long-term consequences of human-made noise on birds, although intermittent exposures are assumed to be less likely than prolonged exposures to have lasting consequences.

3.6.2.1.2 Impacts from Sonar and Other Transducers

Sonar and other transducers emit sound waves into the water to detect objects, safely navigate, and communicate. Use of sonar and other transducers would typically be transient and temporary. General categories of sonar systems are described in Section 3.0.3.1 (Acoustic Stressors).

Information regarding the impacts of sonar on birds is unavailable, and little is known about the ability of birds to hear underwater. The limited information (Johansen et al., 2016) and data from other species suggest the range of best hearing may shift to lower frequencies in water (Dooling & Therrien, 2012; Therrien, 2014) (see Section 3.6.1.5, Hearing and Vocalization). Because few birds can hear above 10 kHz in air, it is likely that the only sonar sources they may be able to detect are low and mid-frequency sources.

Other than pursuit diving species, the exposure to birds by these sounds is likely to be negligible because they spend only a very short time underwater (plunge-diving or surface-dipping) or forage only at the water surface. Pursuit divers may remain underwater for minutes, increasing the chance of underwater sound exposure.

In addition to diving behavior, the likelihood of a bird being exposed to underwater sound depends on factors such as duty cycle (defined as the percentage of the time during which a sound is generated over a total operational period), whether the source is moving or stationary, and other activities that might be occurring in the area. When used, continuously active sonars transmit more frequently (greater than 80 percent duty cycle) than traditional sonars, but at a substantially lower source level. However, it should be noted that active sonar is rarely used continuously throughout the listed activities, and many sources are mobile. For moving sources such as hull-mounted sonar, the likelihood of an individual bird being repeatedly exposed to an intense sound source over a short period of time is low because the training activities are transient and sonar use and bird diving are intermittent. The potential for birds to be exposed to intense sound associated with stationary sonar sources would likely be limited for some training and testing activities because other activities occurring in conjunction may cause them to leave the immediate area. For example, birds would likely react to helicopter noise during dipping sonar exercises by flushing from the immediate area, and would therefore not be exposed to underwater sonar.

Injury due to acoustic resonance of air space in the lungs from sonar and other transducers is unlikely in birds. Unlike mammals, birds have compact, rigid lungs with strong pulmonary capillaries that do not change much in diameter when exposed to extreme pressure changes (Baerwald et al., 2008), leading to resonant frequencies lower than the frequencies used for Navy sources.

A physiological impact, such as hearing loss, would likely only occur if a seabird were close to an intense sound source. An underwater sound exposure would have to be intense and of a sufficient duration to cause hearing loss. Avoiding the sound by returning to the surface would limit extended or multiple sound exposures underwater. Additionally, some diving birds may avoid interactions with large moving vessels upon which the most powerful sonars are operated (Schwemmer et al., 2011). In general, birds are less susceptible to both temporary and PTS than mammals (Saunders & Dooling, 1974). Diving birds have adaptations to protect the middle ear and tympanum from pressure changes during diving that may affect hearing (Dooling & Therrien, 2012). While some adaptions may exist to aid in underwater hearing, other adaptations to protect in-air hearing may limit aspects of underwater hearing (Hetherington, 2008). Because of these reasons, the likelihood of a diving bird experiencing an underwater exposure to sonar or other transducer that could result in an impact on hearing is considered low.

Because diving birds may rely more on vision for foraging and there is no evidence that diving birds rely on underwater acoustic communication for foraging (see Section 3.6.1.5, Hearing and Vocalization), the masking of important acoustic signals underwater by sonar or other transducers is unlikely.

There have been no studies documenting diving seabirds' reactions to sonar. However, given the information and adaptations discussed above, diving seabirds are not expected to detect high-frequency sources underwater and are only expected to detect mid- and low-frequency sources when in close proximity. A diving bird may not respond to an underwater source, or it may respond by altering its dive behavior, perhaps by reducing or ceasing a foraging bout. It is expected that any behavioral interruption would be temporary as the source or the bird changes location.

Some birds commonly follow vessels, including certain species of gulls, storm petrels, and albatrosses, as there is increased potential of foraging success as the prop wake brings prey to the surface (Hamilton, 1958; Hyrenbach, 2001, 2006; Melvin et al., 2001). Birds that approach vessels while foraging are the most likely to be exposed to underwater active acoustic sources, but only if the ship is engaged in anti-submarine warfare or mine warfare with active acoustic sources. However, hull-mounted sonar does not project sound aft of ships (behind the ship, opposite the direction of travel), so most birds diving in ship wakes would not be exposed to sonar. In addition, based on what is known about bird hearing capabilities in air, it is expected that diving birds may have limited or no ability to perceive high-frequency sounds, so they would likely not be impacted by high-frequency sources such as those used in mine warfare.

3.6.2.1.2.1 Impacts from Sonar and Other Transducers Under Alternative 1

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

Under Alternative 1 training activities, sonar and other transducers would not be regularly used in nearshore areas that could be used by foraging marine birds, except during maintenance and for navigation in areas around ports. 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).

The possibility of an ESA-listed bird species being exposed to sonar and other transducers depends on whether it submerges during foraging and whether it forages in areas where these sound sources may be used. Most sonar use occurs offshore, so the chance for an exposure would be low. Because impacts on individual birds, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Because some ESA-listed species (e.g., western snowy plover, streaked horned lark, northern spotted owl) would not be submerged in water, they would not be susceptible to impacts and will not be analyzed further. The marbled murrelet and short-tailed albatross are analyzed below for potential impacts associated with the use of sonar and other active acoustic stressors.

Marbled murrelet. Marbled murrelets regularly foraging in inland areas where sonar and other transducers are used may be exposed to underwater sound. Marbled murrelets may be exposed to underwater sound from training activities; however, for an exposure to occur, a murrelet would have to be submerged at the same time of sonar and other transducer use, and the murrelet would have to be sufficiently close to the sound source. A number of factors reduce the likelihood of exposure, such as the relatively short dive duration and the location where activities occur. Within the Inland Waters, marbled murrelets forage throughout Puget Sound and are known to occur at the Dabob Bay Range Complex (DBRC), Keyport Range site, Naval Station (NS) Everett, Naval Base Kitsap (NBK) Bangor and NBK Bremerton, but only these maintenance activities occurring in inland waters have sound sources within the hearing range of birds. The instances of murrelets occurring under water, coinciding at the time and location of maintenance activities, would be infrequent. Most other sonar use occurs farther offshore (e.g., greater than 3 NM from shore), so the chance for an exposure would decrease further from shore. Specifically, anti-submarine warfare activities would typically occur at distances that exceed foraging ranges for murrelets, particularly during the nesting season. Other sonars used for anti-mine warfare, communication, and navigation are outside of the known hearing range for birds. Therefore, exposures would be more likely to occur within winter (when murrelets may forage further offshore); however, instances of murrelets occurring under water, coinciding at the time and location of anti-submarine warfare training, would be infrequent.

The Navy has requested reinitiation of Section 7 consultation with the USFWS for activities described in this Supplemental for potential impacts on marbled murrelets from sonar and other transducers. As part of this consultation, the Navy will be presenting the most current information to estimate and model potential impacts on the marbled murrelet. This information will include new range to effects estimates not included in the previous consultation between the Navy and USFWS for activities described in the 2015 NWTT Final EIS/OEIS. The new range to effects estimates are based off of a revised modeling methodology and an increased understanding of underwater hearing abilities of marbled murrelets, and abundance estimations for off shore areas that overlap with activities using sonar and other transducers. These revised methods will provide the Navy and USFWS with a quantitative assessment of impacts for this acoustic substressor, and the Final Supplemental will be updated with the outcomes of the reinitiated Section 7 consultation.

Short-tailed albatross. Short-tailed albatrosses are rare vagrant migrants that forage in offshore, open ocean waters. Short-tailed albatross remain one of the world's most endangered birds (U.S. Fish and Wildlife Service, 2005a). Considering the rarity of this species in general and the infrequent sightings, chances for its potential interactions with training activities within the Study Area would be extremely low. The spatial and temporal variability of both the occurrence of a short-tailed albatross and the training activities conducted within offshore locations near foraging areas presents a negligible chance that a direct or indirect impact would occur to this species because of training and testing activities that use non-impulse sound sources. In USFWS's 2016 biological opinion, the potential for short-tailed albatross exposures were considered unlikely to result in injury because of the (1) mobility of sonar sources (with the exception of sonobuoys); (2) short-tailed albatross are mobile, are transported by currents, and only dive to shallow depths when foraging; and (3) the range to effects for sonobuoys is considered to be 0 m.

The Navy has requested reinitiation of Section 7 consultation with the USFWS for activities described in this Supplemental for potential impacts on the short-tailed albatross from sonar and other transducers and other acoustic substressors. As part of this consultation, the Navy will be presenting the most current information to estimate and model potential impacts on the short-tailed albatross. This information includes abundance estimations for off shore areas that overlap with activities using sonar and other transducers, as well as new range to effects estimates based on revised modeling methods (the range to effects for sonobuoys will continue to be considered 0 m). Although the quantitative estimates of impacts on short-tailed albatrosses may be revised during the reinitiated Section 7 consultation, the underlying conclusion reached by the Navy and USFWS during the Section 7 consultation for activities described in the Navy's 2015 NWTT Final EIS/OEIS are not expected to change—exposures to sonar and other transducers are unlikely to result in injury.

Pursuant to the ESA, acoustic stressors from the use of sonar and other transducers during training activities, as described under Alternative 1, would have no effect on the ESA-listed northern spotted owl, streaked horned lark, or the western snowy plover. The use of sonar and other transducers may affect the marbled murrelet and the short-tailed albatross. The Navy will consult with the USFWS, as required by Section 7(a)(2) of the ESA.

Under the MBTA regulations applicable to military readiness activities (50 Code of Federal Regulations [CFR] Part 21), the impacts from sonar and other transducers during training activities described under Alternative 1 would not result in a significant adverse effect on populations seabirds, shorebirds, and other birds protected under the MBTA.

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

Sonar and other transducers used in testing activities would occur in the Offshore Area, including the Quinault Range Site. Most of this range is more than 3 NM from shore (see Figure 2.2-2).

In inland waters, sonar and other transducers may be used for testing purposes in DBRC Site, the Keyport Range Site, NS Everett, NBK Bangor, and NBK Bremerton (see Table 2.5-2 and Figure 2.2-3).

Sonar and other transducers would be used during testing activities in Western Behm Canal, Alaska, under Alternative 1 for communications, range calibration, and position information for units operating submerged on the range (see Table 2.5-2 and Figure 2.2-4). Tactical mid-frequency active sonar would not be used in Western Behm Canal, Alaska. Low-frequency, mid-frequency, and high-frequency source classes would be used in Western Behm Canal during testing activities conducted under Alternative 1. High-frequency sources are generally outside the audible range of seabird hearing; therefore, the analysis focuses on low-frequency and mid-frequency sources.

The possibility of an ESA-listed bird species being exposed to sonar and other transducers depends on whether it submerges during foraging and whether it forages in areas where these sound sources may be used. Most sonar use occurs offshore, so the chance for an exposure would be low. Because impacts on individual birds, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Because some ESA-listed species (i.e., western snowy plover, streaked horned lark, northern spotted owl) would not be submerged in water, they would not be susceptible to impacts and will not be analyzed further. The marbled murrelet and short-tailed albatross are analyzed below for potential impacts associated with the use of sonar and other active acoustic stressors.

Marbled murrelet. Marbled murrelets regularly forage in areas where sonar and other transducers would be used for testing activities. Marbled murrelets may be exposed to underwater sound from testing activities; however, for an exposure to occur, a murrelet would have to be submerged at the same time of sonar and other transducer use, and the murrelet would have to be sufficiently close to the sound source. As with training activities, a number of factors reduce the likelihood of exposure, such as the relatively short dive duration and the location where activities occur. Most other sonar use occurs farther offshore, so the chance for an exposure would decrease further from shore. Within the Inland Waters, marbled murrelets forage throughout Puget Sound and are known to occur at the DBRC, Keyport Range site, NS Everett, NBK Bangor, and NBK Bremerton.

The Navy has requested reinitiation of Section 7 consultation with the USFWS for activities described in this Supplemental for potential impacts on marbled murrelets from sonar and other transducers used during testing activities. As part of this consultation, the Navy will be presenting the most current information to estimate and model potential impacts on the marbled murrelet. This new information includes range to effects data, increased understanding of underwater hearing abilities of marbled murrelets, and abundance estimations for off shore areas that overlap with activities using sonar and other transducers used during testing activities.

Short-tailed albatross. The spatial and temporal variability of both the occurrence of a short-tailed albatross and the testing activities conducted within offshore locations near foraging areas presents a negligible chance that a direct or indirect impact would occur to this species from sonar or other transducers. In USFWS's 2016 biological opinion, the potential for short-tailed albatross exposures were considered unlikely to result in injury because of the (1) mobility of sonar sources (with the exception of sonobuoys); (2) short-tailed albatross are mobile, are transported by currents, and only dive to shallow depths when foraging; and (3) the range to effects for sonobuoys is considered to be 0 m.

The Navy has requested reinitiation of Section 7 consultation with the USFWS for activities described in this Supplemental for potential impacts on the short-tailed albatross from sonar and other transducers during testing activities. As part of this consultation, the Navy will be presenting the most current information to estimate and model potential impacts on the short-tailed albatross. This new information includes abundance estimations for off shore areas that overlap with testing activities using sonar and other transducers.

Pursuant to the ESA, acoustic stressors from the use of sonar and other transducers during testing activities under Alternative 1 will have no effect on the ESA-listed northern spotted owl, streaked horned lark, or the western snowy plover. The use of sonar and other transducers may affect the ESA-listed marbled murrelet and short-tailed albatross. The Navy will consult with the USFWS, as required by Section 7(a)(2) of the ESA. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from sonar and other transducers during testing activities under Alternative 1 would not result in a significant adverse effect on migratory bird populations.

3.6.2.1.2.2 Impacts from Sonar and Other Transducers Under Alternative 2

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

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.

Marbled murrelet. Marbled murrelets regularly foraging in inland areas where sonar and other transducers are used may be exposed to underwater sound. Marbled murrelets may be exposed to underwater sound from training activities; however, for an exposure to occur, a murrelet would have to be submerged at the same time of sonar and other transducer use, and the murrelet would have to be sufficiently close to the sound source. A number of factors reduce the likelihood of exposure, such as the relatively short dive duration and the location where activities occur. Within the Inland Waters, marbled murrelets forage throughout Puget Sound and are known to occur at the DBRC, Keyport Range site, NS Everett, NBK Bangor, and NBK Bremerton, but only these maintenance activities occurring in inland waters have sound sources within the hearing range of birds. The instances of murrelets occurring under water, coinciding at the time and location of maintenance activities, would be infrequent. Most other sonar use occurs farther offshore (e.g., greater than 3 NM from shore), so the chance for an exposure would decrease further from shore. Specifically, anti-submarine warfare activities would typically occur at distances that exceed foraging ranges for murrelets, particularly during the nesting season. Other sonars used for anti-mine warfare, communication, and navigation are outside of the known hearing range for birds. Therefore, exposures would be more likely to occur within winter (when murrelets may forage further offshore); however, instances of murrelets occurring under water, coinciding at the time and location of anti-submarine warfare training, would be infrequent. Compared to Alternative 1, exposure to sonar and other transducers substressors would likely increase under Alternative 2.

Short-tailed albatross. Short-tailed albatrosses are rare vagrant migrants that forage in offshore, open ocean waters. Short-tailed albatross remain one of the world's most endangered birds (U.S. Fish and Wildlife Service, 2005a). Considering the rarity of this species in general and the infrequent sightings, chances for its potential interactions with training activities within the Study Area would be extremely low, even under Alternative 2 with a relative increase in the overall use of sonar and other transducers. The spatial and temporal variability of both the occurrence of a short-tailed albatross and the training activities conducted within offshore locations near foraging areas presents a negligible chance that a direct or indirect impact would occur to this species because of training and testing activities that use non-impulse sound sources. In USFWS's 2016 biological opinion, the potential for short-tailed albatross exposures were considered unlikely to result in injury because of the (1) mobility of sonar sources (with the exception of sonobuoys); (2) short-tailed albatross are mobile, are transported by currents, and only dive to shallow depths when foraging; and (3) the range to effects for sonobuoys is considered to be 0 m.

Pursuant to the ESA, acoustic stressors from the use of sonar and other transducers during training activities, as described under Alternative 2, would have no effect on the ESA-listed northern spotted owl, streaked horned lark, or the western snowy plover. The use of sonar and other transducers may affect the ESA-listed marbled murrelet and short-tailed albatross. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from sonar and other transducers during training activities described under Alternative 2 would not result in a significant adverse effect on populations seabirds, shorebirds, and other birds protected under the MBTA.

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

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. 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 Figures 2.4-1 and 2.4-2.

Under Alternative 2, testing activities using low-frequency sonar and other transducers will take place throughout the NWTT Study Area; however, these sources would occur more frequently in the NWTT Inland Waters.

Marbled murrelet. Marbled murrelets regularly forage in areas where sonar and other transducers would be used for testing activities. Marbled murrelets may be exposed to underwater sound from testing activities; however, for an exposure to occur, a murrelet would have to be submerged at the same time of sonar and other transducer use, and the murrelet would have to be sufficiently close to the sound source. As with training activities, a number of factors reduce the likelihood of exposure, such as the relatively short dive duration and the location where activities occur. Most other sonar use occurs farther offshore, so the chance for an exposure would decrease further from shore. Within the Inland Waters, marbled murrelets forage throughout Puget Sound and are known to occur at the DBRC, Keyport Range site, NS Everett, NBK Bangor, and NBK Bremerton. With the increase in the use of sonar and other transducers in inland waters under Alternative 2, more marbled murrelets would likely be exposed to this substressors while foraging in inland waters (particularly during the nesting season) compared to Alternative 1.

Short-tailed albatross. As with training activities, there is a negligible chance of short-tailed albatross exposure to sonar and other transducers. This conclusion is supported by the spatial and temporal variability of both the occurrence of a short-tailed albatross and the testing activities conducted within offshore locations near foraging areas. In USFWS's 2016 biological opinion, the potential for short-tailed albatross exposures were considered unlikely to result in injury because of the (1) mobility of sonar sources (with the exception of sonobuoys); (2) short-tailed albatross are mobile, are transported by currents, and only dive to shallow depths when foraging; and (3) the range to effects for sonobuoys is considered to be 0 m.

Pursuant to the ESA, acoustic stressors from the use of sonar and other transducers during testing activities, as described under Alternative 2, would have no effect on the ESA-listed northern spotted owl, streaked horned lark, or the western snowy plover. The use of sonar and other transducers may affect the ESA-listed marbled murrelet and short-tailed albatross. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from sonar and other transducers during testing activities described under Alternative 2 would not result in a significant adverse effect on populations seabirds, shorebirds, and other birds protected under the MBTA.

3.6.2.1.2.3 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. Other military activities not associated with this Proposed Action would continue to occur. Sonar and other transducers 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 acoustic 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 sonar and other transducers on individual birds, but would not measurably improve the status of bird populations.

3.6.2.1.3 Impacts from Vessel Noise

Section 3.6.3.1.4 (Impacts from Vessel Noise) of the 2015 NWTT Final EIS/OEIS discusses the different types of vessels and the noise they generate, along with a summary of potential responses marine birds may exhibit. Naval combat vessels are designed to be quiet to avoid detection; therefore, any disturbance to birds is expected to be due to visual, rather than acoustic, stressors. Other training and testing support vessels, such as rigid hull inflatable boats, use outboard engines that can produce substantially more noise even though they are much smaller than warships. Noise due to watercraft with outboard engines, or noise produced by larger vessels operating at high speeds, may briefly disturb some birds while foraging or resting at the water surface. However, the responses due to both acoustic and visual exposures are likely related and difficult to distinguish. Although loud, sudden noises can startle and flush birds, Navy vessels are not expected to result in major acoustic disturbance of seabirds in the Study Area. Noise from Navy vessels is similar to or less than those of the general maritime environment. Birds respond to the physical presence of a vessel, regardless of the associated noise. The potential is very low for noise generated by Navy vessels to impact seabirds, and such noise would not result in major impacts on seabird populations. Since the publication of the 2015 NWTT Final EIS/OEIS, no new information was identified during the Navy's literature review that would substantially alter the assessment of potential impacts on marine birds from vessel noise. Therefore, the information contained in Section 3.6.3.1.4 (Impacts from Vessel Noise) of the 2015 NWTT Final EIS/OEIS remains valid.

Pursuant to the ESA, vessel noise generated during training and testing activities, as described under Alternatives 1 and 2, would have no effect on the ESA-listed northern spotted owl, streaked horned lark, or the western snowy plover. Vessel noise may affect the marbled murrelet and the short-tailed albatross. The Navy will consult with the USFWS, as required by Section 7(a)(2) of the ESA. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from sonar and other transducers during training and testing activities described under Alternatives 1 and 2 would not result in a significant adverse effect on populations seabirds, shorebirds, and other land birds protected under the MBTA.

Under the No Action Alternative, the Navy would not conduct proposed at-sea training and testing activities in the NWTT Study Area. Other military activities not associated with this Proposed Action would continue to occur. Vessel noise from sources 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 less vessel noise 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 vessel noise impacts on individual birds and bird populations.

3.6.2.1.4 Impacts from Aircraft Noise

Section 3.6.3.1.5 (Impacts from Aircraft Noise) of the 2015 NWTT Final EIS/OEIS discuss the different types of aircraft and the noise they generate, along with a summary of potential responses birds may exhibit. Since the publication of the 2015 NWTT Final EIS/OEIS, no new information was identified during the Navy's literature review that would substantially alter the assessment of potential impacts on birds from aircraft noise. Aircraft restrictions (e.g., flight altitude restrictions, supersonic flights only allowed to occur greater than 30 NM from shore) would remain in place as analyzed in the 2015 NWTT Final EIS/OEIS. Therefore, the information contained in Section 3.6.3.1.5 (Impacts from Aircraft Noise) of the 2015 NWTT Final EIS/OEIS remains valid. A summary of noise sources and potential bird responses is provided below for fixed-wing aircraft and helicopters.

- **Fixed-wing aircraft** (manned and unmanned). Common behavioral responses to aircraft noise include no response or stationary alert behavior (Johnson & Reynolds, 2002), startle response, flying away, and increased vocalizations (Bowles, 1995; Larkin et al., 1996; National Park Service, 1994). In some instances, behavioral responses could interfere with foraging, habitat use, and physiological energy budgets, particularly when an animal continues to respond to repeated exposures. The potential for masking of calls in air is possible if a bird remains in the area; however, due to the transitory nature of aircraft overflights, the duration of masking would be limited. Supersonic flights are only authorized when the aircraft is at least 30 NM from shore and clear of islands and vessels. In such circumstances, some air combat maneuver training would involve high-altitude, supersonic flight which would produce sonic booms, but such airspeeds would be infrequent and are typically conducted at high altitudes and far from shore, limiting the areas where birds could be exposed. When sonic booms do occur, boom duration is generally less than 300 milliseconds. Sonic booms would cause seabirds to startle, but the exposure would be brief, and any reactions are expected to be short-term. Startle impacts range from altering behavior (e.g., stop feeding or preening), minor behavioral changes (e.g., head turning), or at worst, a flight response. Because most fixed-wing flights are not supersonic and both birds and aircraft are transient in any area, exposure of birds in the open ocean to sonic booms would be infrequent. It is unlikely that individual birds would be repeatedly exposed to sonic booms in the open ocean.

- **Helicopters**. Exposure from helicopter noise may be as brief as fixed-wing aircraft, but lower altitude and hovering or slow-moving helicopters could prolong the exposure, eliciting different responses and resulting in more severe impacts. Helicopter activities at lower altitudes increase the likelihood that birds would respond to noise from overflights with reactions such as flushing (Stalmaster & Kaiser, 1997), although a large portion of birds may exhibit no reaction to nearby helicopters (Grubb et al., 2010). Helicopter flights are generally limited to the inland water areas, unless deployed onboard ships. Helicopter flights, therefore, are more likely to impact the greater numbers of birds that forage in coastal areas than those that forage in open ocean areas. Nearshore areas of the coast are the primary foraging habitat for many bird species. The presence of dense aggregations of sea ducks, other seabirds, and migrating land birds is a potential concern during low-altitude helicopter activities. Although birds may be more likely to react to helicopters than to fixed-wing aircraft, Navy helicopter pilots avoid large flocks of birds to protect aircrews and equipment, thereby reducing disturbance to birds as well. Noise from low-altitude helicopter overflights would only be expected to elicit short-term behavioral or physiological responses in exposed birds.

Birds in areas that may experience repeated exposure often habituate and do not respond behaviorally (Larkin et al., 1996; National Park Service, 1994; Plumpton, 2006). Throughout the Study Area, repeated exposure of individual birds or groups of birds is unlikely based on the dispersed nature of the overflights and the capability of birds to avoid or rapidly vacate an area of disturbance. Therefore, the general health of individual birds would not be compromised. Occasional startle or alert reactions to aircraft noise are not likely to disrupt major behavior patterns (such as migrating, breeding, feeding, and sheltering) or to result in serious injury to any birds.

3.6.2.1.4.1 Impacts from Aircraft Noise Under Alternative 1

Impacts from Aircraft Noise Under Alternative 1 for Training Activities

Under Alternative 1, the number of proposed training activities involving aircraft is shown in Table 3.0-11 of this Supplemental. Airborne noise levels for aircraft used during training activities, along with airborne noise levels at various stages of flight (e.g., takeoff, under afterburner for aircraft) are provided by Bousman and Kufeld (2005) for helicopters (e.g., H-60), U.S. Naval Research Advisory Committee (2009) for F/A-18C/D and F-35A, U.S. Department of the Air Force (2016) for F-35A at takeoff, U.S. Department of the Navy (2012) for EA-18G aircraft (see Table 3.0-4 of this Supplemental). The activities would occur in the same locations and in a similar manner as were analyzed previously. Therefore, the impacts on birds would be the same.

Aircraft training activities conducted under Alternative 1 in inland waters would be limited to low altitude helicopter overflights, primarily at Crescent Harbor and Restricted Area 6701, and fixed-wing overflights within the Olympic MOA and transit corridor flights between Whidbey Island to the MOAs, which would occur no lower than 6,000 ft. above sea level (including cruising altitude once an aircraft departs from Whidbey Island). Unlike fixed-wing aircraft, helicopters typically operate below 1,000 ft. altitude and often occur as low as 75–100 ft. altitude. This low altitude increases the likelihood that birds would respond to noise from helicopter overflights. Helicopters travel at slower speeds (less than 100 knots), which increases durations of noise exposure compared to fixed-wing aircraft. In addition, some studies have suggested that birds respond more to noise from helicopters than from fixed-wing aircraft (Larkin et al., 1996; National Park Service, 1994). The noise level from a hovering SH-60 helicopter at 50 ft. is approximately 90 A-weighted decibels (dBA). Noise from low-altitude helicopter overflights would be expected to elicit short-term behavioral or physiological responses in exposed birds. Birds foraging or loafing on the water's surface or nesting in adjacent areas could flush in response to the noise, vibration, downwash, or visual cues associated with a helicopter. This could result in energetic costs to individuals from lost foraging time. However, birds are also likely to habituate to disturbance from helicopters (Black et al., 1984; Conomy et al., 1998; Nedelec et al., 2016). Habituation is a simple form of learning, in which an animal, after a period of exposure to a stimulus, stops responding. Navy jets flying over land areas within the Olympic MOAs would potentially expose land bird species to various levels of aircraft noise, ranging from low-intensity, ambient-level sounds from distant overflights to high amplitude sounds associated with low altitude flights (specific impacts on northern spotted owls resulting from aircraft overflights within the Olympic MOAs are discussed below).

All five of the ESA-listed bird species within the Study Area (western snowy plover, streaked horned lark, northern spotted owl, marbled murrelet, and short-tailed albatross) are analyzed for potential impacts resulting from aircraft noise. Aircraft noise will impact these bird species differently based on where these species occur and the flight altitude restrictions that overlie their habitats. The coastal areas where western snowy plover and streaked horned lark critical habitat has been designated also underlies extensive commercial air traffic routes with the same altitude restrictions as military aircraft (see Section 3.12, Socioeconomic Resources).

Marbled murrelet. Foraging or loafing murrelets could exhibit short-term behavioral and physiological responses to helicopter overflights but would be expected to resume normal behavior shortly after the helicopter leaves the area. In their 2016 Biological Opinion, the USFWS concluded that murrelets are likely to habituate to in-air sound fields. Some murrelets may have no previous exposure to these sound fields and may have a stronger behavioral response initially, but they are not likely to abort foraging as a result of encountering a sound field (U.S. Fish and Wildlife Service, 2016). Habituation has likely already occurred in many murrelets because helicopters have been used in Navy training exercises within Puget Sound for decades. Marbled murrelet nesting habitats surrounding Puget Sound and foraging habitats within Puget Sound underlie extensive commercial air traffic routes (see Section 3.12, Socioeconomic Resources), which also likely contributes to habituation to noise by murrelets. Potential marbled murrelet responses to disturbance can range from minor behavioral responses, such as scanning or head-turning, or increased vigilance for short periods, to more severe responses such as flushing. In the 2016 USFWS Biological Opinion, the criteria used to assess potential risk was Aircraft noise exceeding 92 dB SEL at an active nest site, or aircraft approach within a distance of 110 yards. This criteria was based on Delaney's et al. (1999) study that found Mexican spotted owls exposed to helicopter noise did not flush from their roosts until the noise from helicopters exceeded 92 dBA SEL and the helicopters were within a distance of 105 m. It should be noted that no jet aircraft would be within 110 yards of a murrelet, even in flight. In addition, no helicopter training activities occur within the MOAs; therefore, there is no chance for an aircraft to occur within the distance (110 yards) where behavioral responses were noted by the Delaney et al. (1999) study. Most studies of avian responses to aircraft have been limited to raptors and waterfowl. Even within these groups, responses have differed widely, depending on reproductive state, activity, age, exposure frequency, and species. Given the range of responses observed in various bird species, the USFWS expected the combined auditory and visual stimuli of low altitude jet flights to pose a risk of disturbance to marbled murrelets. Navy aircraft (including Navy jet aircraft and helicopters) would fly over Olympic MOAs at altitudes not less than 6,000 ft. above sea level. Because marbled murrelet nesting, roosting, and foraging habitat in the action area ranges in elevation from 0 to 4,000 ft., the closest approach of an aircraft over marbled murrelet habitat would be 2,000 ft. above ground level. In summary, the proposed aircraft overflights are likely to affect marbled murrelets through intermittent exposures to aircraft noise throughout the year, including during the nesting season. However, because Navy aircraft would maintain minimum flight altitudes well above the distances at which any significant behavioral responses by affected marbled murrelets are likely to occur, the effects to marbled murrelets by these aircraft overflights should be considered insignificant. Critical habitat for the marbled murrelet occurs below the MOA; however, none of the primary constituent elements of the critical habitat designation would be impacted by aircraft overflights. Therefore, there would be no effect on designated critical habitat for the marbled murrelet from training activities.

Short-tailed albatross. Given the proposed timing, location, and frequency of training in the Offshore Area and the small number of short-tailed albatross that are likely to occur in the Offshore Area at any given time, it is extremely unlikely that individual albatross would co-occur with aircraft noise. Therefore, any adverse effects of aircraft noise on short-tailed albatross would be discountable.

Northern spotted owl. No published studies have evaluated the effects of aircraft overflights on the northern spotted owl. However, there have been studies on the Mexican spotted owl (*Strix occidentalis lucida*), a closely related subspecies to the northern spotted owl. Johnson and Reynolds (2002) found that the behavior of Mexican spotted owls in Colorado to fixed-wing military aircraft (F-16 jets) overflights during a 25-second fly-by period ranged from “no response” to “intermediate response” (sudden movement of head, wing, or body) while roosting. The overflights were less than 1,500 ft. above ground level. The sound levels that they were exposed to were reported as ranging from 78 to 95 dBA. None of the Mexican spotted owls flushed from their roosts in response to the aircraft overflights (Johnson & Reynolds, 2002). Because jet aircraft fly at high rates of speed (≥ 250 km/hour), the onset of exposure to loud noise from a jet overflight can be rapid –i.e., in some situations a jet can be flying so fast that a person or animal on the ground will not hear the jet approaching until the jet is passing directly overhead. The rapid onset of the sound would likely induce startling reactions, and the intense and sudden auditory stimuli coupled with visual stimuli of a low altitude jet overflight have the potential to disturb or disrupt spotted owl nesting behaviors. Given the range of responses observed in individual spotted owls to aircraft discussed in (Johnson & Reynolds, 2002), low altitude jet flights pose a risk of minor disturbance to spotted owls by eliciting sub-flight defensive behaviors (i.e., vocalizing, moving). Northern spotted owls would have limited exposures to aircraft noise for the following reasons:

- The flight floor for the Olympic MOA is 6,000 ft. above sea level, which would restrict most flights to an altitude above ground level at 4,000 ft.
- Because spotted owl nesting, roosting, and foraging habitat in the action area ranges in ground elevation from 0 to 4,000 ft., the closest approach of an aircraft over spotted owl habitat would be 2,000 ft. above ground level.
- Approximately 1 percent of the Olympic MOA area is above a ground elevation of 4,500 ft., which means the lowest possible flight elevation would be 1,500 ft. above ground level in this upper elevation zone of the Olympic MOA.

- Approximately 5 percent of military aircraft flights would occur under 10,000 ft. above mean sea level.

Because Navy aircraft would maintain minimum flight altitudes well above the distances at which any significant behavioral responses by affected spotted owls are likely to occur, the effects to spotted owls by these aircraft overflights should be considered insignificant. Critical habitat for the northern spotted owl occurs below the MOA; however, none of the primary constituent elements of the critical habitat designation would be impacted by aircraft overflights. Therefore, there would be no effect on designated critical habitat for the northern spotted owl from training activities.

Streaked horned lark. Given the high flight altitudes of military overflights that would potentially occur over streaked horned lark nesting locations along the Washington coast, and the relatively small number of streaked horned larks anticipated to be in these locations during training activities, it is extremely unlikely that individual streaked horned larks would be disturbed by aircraft noise from military training activities. Therefore, the effects to streaked horned larks by these aircraft overflights should be considered insignificant. Critical habitat for the streaked horned lark does not occur under the MOAs; therefore, there would be no effect on designated critical habitat for the streaked horned lark from training activities.

Western snowy plover. Given the high flight altitudes of military overflights that would potentially occur over western snowy plover nesting locations along the Washington coast, and the relatively small number of plovers anticipated to be in these locations during training activities, it is extremely unlikely that individual western snowy plovers would be disturbed by aircraft noise from military training activities. Therefore, the effects to western snowy plover by these aircraft overflights should be considered insignificant. Critical habitat for the western snowy plover is designated along some coastal nesting sites that underlie the MOAs along the Washington coast; however, there is no pathway for military training activities to affect the physical and biological factors that comprise the critical habitat designation for the western snowy plover. Therefore, training activities that involve overflights would have no effect on western snowy plover critical habitat (Stinson, 2016b).

Pursuant to the ESA, acoustic stressors from aircraft noise during training activities, as described under Alternative 1, may affect the marbled murrelet, short-tailed albatross, northern spotted owl, streaked horned lark, and western snowy plover. The Navy will consult with the USFWS, as required by Section 7(a)(2) of the ESA. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from aircraft noise during training activities described under Alternative 1 would not result in a significant adverse effect on populations seabirds, shorebirds, and other birds protected under the MBTA.

Impacts from Aircraft Noise Under Alternative 1 for Testing Activities

Under Alternative 1, the number of proposed testing activities involving aircraft is shown in Table 3.0-11 of this Supplemental. Compared to ongoing activities, the number of aircraft overflights would increase in the Offshore, remain the same in the Western Behm Canal portions of the Study Area, but decrease in Inland Waters. Although the additional number of aircraft flights would increase the frequencies of overflights on land and at sea, impacts on birds are likely minimal because (1) flight restrictions minimizing exposures to birds on land and at sea (discussed above), and (2) the brief duration of exposure.

Marbled murrelet. Foraging or loafing murrelets could exhibit short-term behavioral and physiological responses to aircraft overflights but would be expected to resume normal behavior shortly after the aircraft leaves the area. In their 2010 Biological Opinion for the Northwest Training Range Complex, the USFWS concluded that murrelets are likely to habituate to in-air sound fields. Some murrelets may have no previous exposure to these sound fields and may have a stronger behavioral response initially, but they are not likely to abort foraging as a result of encountering a sound field (U.S. Fish and Wildlife Service, 2010). Within the Quinault Range, aircraft overflights that test mine countermeasures using UAS may occur from 0 to 3 NM from the shore, with a nominal altitude of 3,000 ft. These flights could occur over foraging habitats of murrelets. Navy aircraft would fly over Olympic MOAs at altitudes not less than 6,000 ft. above sea level. Because marbled murrelet nesting, roosting, and foraging habitat in the action area ranges in elevation from 0 to 4,000 ft., the closest approach of an aircraft over marbled murrelet habitat would be 2,000 ft. above ground level. In summary, the proposed aircraft overflights are likely to affect marbled murrelets through intermittent exposures to aircraft noise throughout the year, including during the nesting season. However, because Navy aircraft would maintain minimum flight altitudes well above the distances at which any significant behavioral responses by affected marbled murrelets are likely to occur, the effects to marbled murrelets by these aircraft overflights during testing activities should be considered insignificant. Critical habitat for the marbled murrelet occurs below the MOA; however, none of the primary constituent elements of the critical habitat designation would be impacted by aircraft overflights. Therefore, there would be no effect on designated critical habitat for the northern spotted owl from testing activities.

Short-tailed albatross. Given the proposed timing, location, and frequency of testing activities in the Offshore Area and the small number of short-tailed albatross that are likely to occur in the Offshore Area at any given time, it is extremely unlikely that individual albatross would co-occur with aircraft noise. Therefore, the effects of aircraft noise on short-tailed albatross would be discountable.

Northern spotted owl. Given the range of responses observed in individual spotted owls to aircraft discussed previously under training activities, low altitude jet flights pose a risk of minor disturbance to spotted owls by eliciting sub-flight defensive behaviors (i.e., vocalizing, moving). Within the Quinault Range, aircraft overflights that test mine countermeasures using UAS may occur from 0 to 3 NM from the shore, with a nominal altitude of 3,000 ft. These flights would not occur over owl habitats. Navy aircraft would fly over Olympic MOAs at altitudes not less than 6,000 ft. above sea level. Because spotted owl nesting, roosting, and foraging habitat in the action area ranges in elevation from 0 to 4,000 ft., the closest approach of an aircraft over spotted owl habitat would be 2,000 ft. above ground level. Northern spotted owls nesting within the eastern portion of the Olympic Peninsula under the Olympic MOAs would likely be intermittently exposed to high-level aircraft noise, multiple times each year from testing activities. Because Navy aircraft would maintain minimum flight altitudes well above the distances at which any significant behavioral responses by affected spotted owls are likely to occur, the effects to spotted owls by these aircraft overflights should be considered insignificant. Critical habitat for the northern spotted owl occurs below the MOA; however, none of the primary constituent elements of the critical habitat designation would be impacted by aircraft overflights. Therefore, there would be no effect on designated critical habitat for the marbled murrelet from testing activities.

Streaked horned lark. Given the high flight altitudes of military overflights that would potentially occur over streaked horned lark nesting locations along the Washington coast, and the relatively small number of streaked horned larks anticipated to be in these locations during testing activities, it is extremely unlikely that individual streaked horned larks would be disturbed by aircraft noise from military testing activities. Therefore, the effects to streaked horned larks by these aircraft overflights should be considered insignificant. Critical habitat for the streaked horned lark does not occur under the MOAs; therefore, there would be no effect on designated critical habitat for the streaked horned lark from testing activities.

Western snowy plover. Given the high flight altitudes of military overflights that would potentially occur over western snowy plover nesting locations along the Washington coast, and the relatively small number of plovers anticipated to be in these locations during testing activities, it is extremely unlikely that individual western snowy plovers would be disturbed by aircraft noise from military testing activities. Therefore, the effects to western snowy plover by these aircraft overflights should be considered insignificant. Critical habitat for the western snowy plover is designated along some coastal nesting sites that underlie the MOAs along the Washington coast; however, there is no pathway for military testing activities to affect the physical and biological factors that comprise the critical habitat designation for the western snowy plover. Therefore, testing activities that involve overflights would have no effect on western snowy plover critical habitat.

Pursuant to the ESA, acoustic stressors from aircraft noise during testing activities, as described under Alternative 1, may affect the marbled murrelet, short-tailed albatross, northern spotted owl, streaked horned lark, and western snowy plover. The Navy will consult with the USFWS, as required by Section 7(a)(2) of the ESA. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from aircraft noise during testing activities described under Alternative 1 would not result in a significant adverse effect on populations seabirds, shorebirds, and other birds protected under the MBTA.

3.6.2.1.4.2 Impacts from Aircraft Noise Under Alternative 2

Impacts from Aircraft Noise Under Alternative 2 for Training Activities

Under Alternative 2, the number of proposed training activities would increase, decrease, or stay the same compared to the number of activities proposed in the 2015 NWTT Final EIS/OEIS (see Table 2.5-1). Increases and decreases shown in Table 2.5-1 for activities proposed under Alternative 2 do not appreciably change the impact conclusions presented in the 2015 NWTT Final EIS/OEIS. As with Alternative 1, exposures under Alternative 2 to most seabirds would be infrequent, based on the brief duration and dispersed nature of the aircraft activities. Impacts from aircraft noise training activities would be the same as those discussed under Alternative 1.

Pursuant to the ESA, acoustic stressors from aircraft noise during training activities, as described under Alternative 2, may affect the marbled murrelet, short-tailed albatross, northern spotted owl, streaked horned lark, and western snowy plover. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from aircraft noise during training activities described under Alternative 2 would not result in a significant adverse effect on populations seabirds, shorebirds, and other birds protected under the MBTA.

Impacts from Aircraft Noise Under Alternative 2 for Testing Activities

Under Alternative 2, the number of proposed testing activities involving aircraft is shown in Table 3.0-11. Compared to Alternative 1, the number of aircraft overflights would increase in the

Offshore portions of the Study Area, but stay the same in the Inland Waters and Western Behm Canal portions. Increases and decreases shown in Tables 2.5-2 and 2.5-3 for activities proposed under Alternative 2 do not appreciably change the impact conclusions presented in the 2015 NWTT Final EIS/OEIS. As with Alternative 1, exposures under Alternative 2 to most seabirds would be infrequent, based on the brief duration and dispersed nature of the aircraft activities. Impacts from aircraft noise testing activities would be the same as those discussed under Alternative 1.

Pursuant to the ESA, acoustic stressors from aircraft noise during testing activities, as described under Alternative 2, may affect the marbled murrelet, short-tailed albatross, northern spotted owl, streaked horned lark, and western snowy plover. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from aircraft noise during testing activities described under Alternative 2 would not result in a significant adverse effect on populations seabirds, shorebirds, and other birds protected under the MBTA.

3.6.2.1.4.3 Impacts from Aircraft Noise 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. Other military activities not associated with this Proposed Action would continue to occur. Aircraft noise from sources as listed above would not be introduced into the marine environment or areas over land. 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 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 aircraft noise on individual birds, but would not measurably improve the status of bird populations.

3.6.2.1.5 Impacts from Weapons Noise

Sounds produced by weapons firing (muzzle blast), launch boosters, and projectile travel are potential stressors to birds and are discussed as impulsive noise under Section 3.6.3.1.3 (Impacts from Weapons Firing, Launch, and Water-Surface Impact Noise) in the 2015 NWTT Final EIS/OEIS. Since the publication of the 2015 NWTT Final EIS/OEIS, no new information was identified during the Navy's literature review that would substantially alter the assessment of potential impacts on marine birds from weapons noise.

Chapter 5 (Mitigation) of this Supplemental includes procedural mitigation to avoid or reduce potential impacts on birds from weapon noise (see Table 5.3-3 for a list of lookout procedures, mitigation zones, and activity delays if seabirds are present within mitigation zones).

3.6.2.1.5.1 Impacts from Weapon Noise Under Alternative 1

Impacts from Weapons Noise Under Alternative 1 for Training Activities

Under Alternative 1, the number of proposed training activities would increase, decrease, or stay the same compared to the number of activities proposed in the 2015 NWTT Final EIS/OEIS (see Table 2.5-1). These activities would only occur offshore (not in inshore waters). Most activities involving large-caliber naval gunfire or the launching of targets, missiles, bombs, or other munitions are conducted more than 3 NM from shore. Most sounds would be brief, lasting from less than a second for a blast or inert impact to a few seconds for other launch and object travel sounds. Most incidents of impulsive sounds produced by weapons firing, launch, or inert object impacts would be single events, with the exception of gunfire activities. Variants of the Long Range Acoustic Device are used both on vessels and on piers. These devices communicate voice, tones, or prerecorded tracks within the range of human hearing and may reach birds within 3,000 m of the device. Birds have the potential to be briefly startled or temporarily displaced during training with this device.

Increases and decreases shown in Table 2.5-1 for activities proposed under Alternative 1 do not appreciably change the impact conclusions presented in the 2015 NWTT Final EIS/OEIS. A bird in the open ocean could be exposed to weapons noise if not already displaced by the visual or noise disturbance of a vessel supporting weapons firing exercises. Birds foraging or migrating through a training area in the open ocean may respond by avoiding areas where weapons firing exercises occur. Exposures to most seabirds would be infrequent, based on the brief duration and dispersed nature of the vessels, and the brief duration of the weapons firing noise. If a bird responds to weapons noise, only short-term behavioral responses such as startle responses, head turning, or avoidance responses would be expected.

Marbled murrelet. As discussed above, murrelets in nesting seasons tend to be greatest in nearshore waters to reduce flight times between foraging locations and nests; however, in winter, marbled murrelets may range further out to sea. Most marbled murrelets in Offshore Areas would be expected to occur within about 1 NM of the coastline, which corresponds to the seaward boundary of the murrelet conservation zones. Large-caliber weapons and other large platform systems use occurs more than 12 NM from shore. Inland waters and some nearshore coastal areas may use small- and medium-caliber weapons, which produce less noise (per firing event) but would happen more frequently. In general, it is reasonable to assume that although some murrelets may be exposed to large-caliber weapons noise during at-sea activities, most murrelets would likely be exposed to small- and medium-caliber weapons noise. Anticipated reactions, if any, would be behavioral, eliciting short-term responses (cessation of foraging activities, flushing while loafing on water, or diverting flight direction away from the sound source).

The Navy has requested reinitiation of Section 7 consultation with the USFWS for activities described in this Supplemental for potential impacts on marbled murrelets from weapons firing noise during training activities. As part of this consultation, the Navy will be presenting the most current information to estimate and model potential impacts on the marbled murrelet. This new information includes range to effects data and abundance estimations for off shore areas that overlap with weapons firing activities.

Short-tailed albatross. Given the proposed timing, location, and frequency of training in the Offshore Area and the small number of short-tailed albatross that are likely to occur in Offshore Area at any given time, it is extremely unlikely that individual albatross would co-occur with weapons firing, launch, and non-explosive impact noise. Therefore, the effects of weapons firing, launch, and non-explosive impact noise on short-tailed albatross would be discountable.

The Navy has requested reinitiation of Section 7 consultation with the USFWS for activities described in this Supplemental for potential impacts on the short-tailed albatross from weapons firing noise during testing activities. As part of this consultation, the Navy will be presenting the most current information to estimate and model potential impacts on the short-tailed albatross. This new information includes abundance estimations for off shore areas that overlap with weapons firing activities.

Pursuant to the ESA, acoustic stressors from weapons noise during training activities, as described under Alternative 1, would have no effect on the ESA-listed northern spotted owl, streaked horned lark, or the *western snowy plover. Weapons noise may affect the marbled murrelet and the short-tailed albatross. The Navy will consult with the USFWS, as required by Section 7(a)(2) of the ESA. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.*

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from weapons noise during training activities described under Alternative 1 would not result in a significant adverse effect on populations seabirds, shorebirds, and other land birds protected under the MBTA.

Impacts from Weapons Noise Under Alternative 1 for Testing Activities

Under Alternative 1 testing activities, additional testing activities not previously analyzed would occur in the Offshore Area. This section considers the kinetic energy weapons testing that would occur in the Offshore Area greater than 50 NM from the shore. At this distance, it is reasonable to expect decreased marine bird densities, and therefore fewer exposures than activities generating weapons firing noise closer to shore. General characteristics of kinetic energy weapons testing are provided in Section 3.0.3.1.4 (Weapons Noise) and summarized here to consider potential impacts of noise generated from these systems on marine birds.

Supersonic projectiles, which would be similar in size to shells fired from 5 in./54 guns, would travel at approximately 2,600 ft./second, creating a bow shock wave. Pater et al. (2009) measured the characteristics of a bow shock wave from a 5 in. projectile and found that the shock wave ranged from 40 to 147 dB re 20 µPa SPL peak taken at the ground surface at 1,100 m from the firing location and 190 m perpendicular from the trajectory (for safety reasons). Shells fired from a kinetic energy weapon are considered hypersonic, and would travel at about 6,500 ft./second, and peak pressures would be expected to be several dB higher than for shell velocities described by Pater et al. (2009). By definition, bow shock waves, regardless of shell velocity, would travel at the speed of sound in air. Marine birds would be exposed to this type of noise for a very brief period of time (a few seconds), and would likely cause brief and temporary behavioral reactions described previously for other in-air noise disturbances.

As shown in Table 3.0-14, testing activities under Alternative 1 would include 80 hypersonic firing testing events. Because of the distance from shore (greater than 50 NM), lower densities of marine birds, the temporary nature of the impact, the chances of adverse impacts on individual marine birds is remote and no population level impacts are expected to occur.

Marbled murrelet. As discussed above, murrelets may occur, albeit at lower densities, in areas where kinetic energy weapons are tested. While the summer distribution of murrelets is well documented as occurring primarily in the nearshore waters, the winter distribution of murrelets is poorly documented but does include a few observations of murrelets in offshore areas. Exposure of marbled murrelets to bow shock wave noise from hypersonic shells traveling through the air would not be expected to occur because of the wide dispersal of activities, the low number of murrelets that could be in the area where they would be exposed to noise, and the infrequent number of kinetic energy weapons testing activities. If any marbled murrelets were exposed to bow shock waves, the exposure would be very brief, and with normal activities quickly resuming after behavioral reactions. Anticipated reactions, if any, would be behavioral, eliciting short-term responses (cessation of foraging activities, flushing while loafing on water, or diverting flight direction away from the sound source).

The Navy has requested reinitiation of Section 7 consultation with the USFWS for activities described in this Supplemental for potential impacts on marbled murrelets from new testing activities involving bow shock wave generation from kinetic energy weapons testing. As part of this consultation, the Navy will be presenting the most current information to estimate and model potential impacts on the marbled murrelet. This new information includes range to effects data and abundance estimations for off shore areas that overlap with weapons firing activities.

Short-tailed albatross. Given the proposed timing, location, and frequency of training in the Offshore Area and the small number of short-tailed albatross that are likely to occur in Offshore Area at any given time, it is extremely unlikely that individual albatross would co-occur with kinetic energy weapons testing. If any short-tailed albatrosses were exposed to bow shock waves, the exposure would be very brief, and with normal activities quickly resuming after behavioral reactions. Anticipated reactions, if any, would be behavioral, eliciting short-term responses (cessation of foraging activities or diverting flight direction away from the sound source).

The Navy has requested reinitiation of Section 7 consultation with the USFWS for activities described in this Supplemental for potential impacts on short-tailed albatross from new testing activities involving bow shock wave generation from kinetic energy weapons testing. As part of this consultation, the Navy will be presenting the most current information to estimate and model potential impacts on the short-tailed albatross. This new information includes range to effects data and abundance estimations for off shore areas that overlap with weapons firing activities.

Pursuant to the ESA, acoustic stressors from weapons noise during testing activities, as described under Alternative 1, would have no effect on the ESA-listed northern spotted owl, streaked horned lark, or the western snowy plover. Weapons noise may affect the marbled murrelet and the short-tailed albatross. The Navy will consult with the USFWS, as required by Section 7(a)(2) of the ESA. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from weapons noise during testing activities described under Alternative 1 would not result in a significant adverse effect on populations seabirds, shorebirds, and other birds protected under the MBTA.

3.6.2.1.5.2 Impacts from Weapons Noise Under Alternative 2

Impacts from Weapons Noise Under Alternative 2 for Training Activities

Under Alternative 2, the number of proposed training activities would increase, decrease, or stay the same compared to the number of activities proposed in the 2015 NWTT Final EIS/OEIS (see Table 2.5-1). Increases and decreases shown in Table 2.5-1 for activities proposed under Alternative 2 do not appreciably change the impact conclusions presented in the 2015 NWTT Final EIS/OEIS. The analysis of stressors discussed under Alternative 1, would be the same for Alternative 2. Therefore, conclusions would be the same.

Pursuant to the ESA, acoustic stressors from weapons noise during training activities, as described under Alternative 2, would have no effect on ESA-listed the northern spotted owl, streaked horned lark, or the western snowy plover. Acoustic stressors from weapons noise may affect the marbled murrelet and the short-tailed albatross. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from weapons noise during training and testing activities described under Alternative 2 would not result in a significant adverse effect on populations seabirds, shorebirds, and other birds protected under the MBTA.

Impacts from Weapons Noise Under Alternative 2 for Testing Activities

Under Alternative 2, the number and type of testing activities generating weapons noise are the same as discussed under Alternative 1. Therefore, the analysis of stressors discussed under Alternative 1, would be the same for Alternative 2. Therefore, conclusions would be the same.

Pursuant to the ESA, acoustic stressors from weapons noise during testing activities, as described under Alternative 2, would have no effect on ESA-listed the northern spotted owl, streaked horned lark, or the western snowy plover. Weapons noise may affect the marbled murrelet and the short-tailed albatross. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from weapons noise during testing activities described under Alternative 2 would not result in a significant adverse effect on populations seabirds, shorebirds, and other birds protected under the MBTA.

3.6.2.1.5.3 Impacts from Weapons Noise 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. Other military activities not associated with this Proposed Action would continue to occur. Weapons noise from sources 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 acoustic 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 weapons noise on individual birds, but would not measurably improve the status of bird populations.

3.6.2.2 Explosives Stressors

Section 3.6.3.1.2 (Impacts from Explosives) in the 2015 NWTT Final EIS/OEIS discusses the sources and potential impacts of in-water and in-air explosives noise on marine birds (e.g., injury, hearing loss, physiological stress, masking, and long-term consequences of exposures). This Supplemental includes new explosive testing activities not previously analyzed in the 2015 NWTT Final EIS/OEIS. These new activities using explosives would occur only in the Offshore Area. Explosive training and testing activities in inland waters would either decrease or not change compared to levels analyzed in the 2015 NWTT Final EIS/OEIS (see Table 3.0-7 in this Supplemental for comparisons between the number and types of events proposed in this Supplemental to the 2015 NWTT Final EIS/OEIS).

Explosions in the water, near the water surface, and in the air can introduce loud, impulsive, broadband sounds into the marine environment. But, unlike other acoustic stressors, explosives release energy at a high rate producing a shock wave that can be injurious and even deadly. Therefore, explosive impacts on birds are discussed separately from other acoustic stressors, even though the analysis of explosive impacts will rely on data for bird 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 birds in Section 3.6.2.1.1 (Background). Studies of the effects of sound and energy from explosives on birds are limited, therefore, where necessary, knowledge of impacts on other species from explosives is used to assess impacts on birds.

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 birds potentially resulting from Navy training and testing activities. A range of impacts could occur to a bird 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.

3.6.2.2.1 Impacts from Explosives (In-Air and In-Water Explosions)

3.6.2.2.1.1 Injury

If a bird is close to an explosive detonation, the exposure to high pressure levels and sound impulse can cause barotrauma. Barotrauma is physical injury due to a difference in pressure between an air space inside the body and the surrounding air or water. Sudden very high pressures can also cause damage at tissue interfaces due to the way pressure waves travel differently through tissues with different material properties. Damage could also occur to the structure of the ear, considered to be the body part most susceptible to pressure damage.

Detonations that occur underwater could injure, kill, or disturb diving birds, particularly pursuit divers that spend more time underwater than other foraging birds (Danil & St Leger, 2011). Studies show that birds are more susceptible to underwater explosions when they are submerged versus partially submerged on the surface. Two species of duck were exposed to explosive blasts while submerged 0.61 m and while sitting on the water surface. Onset of mortality (LD_1) was predicted to occur at an impulse exposure of 248 pascal seconds (Pa-s) (36 pounds per square inch per millisecond [psi-ms]) for birds underwater and 690 Pa-s (100 psi-ms) for birds at the water surface (Yelverton & Richmond, 1981). No injuries would be expected for birds underwater at blast pressures below 41 Pa-s (6 psi-ms) and for birds on the surface at blast pressures below 207 Pa-s (30 psi-ms) (Yelverton & Richmond, 1981). Tests of underwater explosive exposures to other taxa (fish, mammals) have shown that susceptibility to injury is related to animal mass, with smaller animals being more susceptible to injury (Yelverton & Richmond, 1981). It is reasonable to assume that this relationship would apply to birds as well. The range to these thresholds would be based on several factors including charge size, depth of the detonation, and how far the bird is beneath the water surface.

Detonations in air or at the water surface could also injure birds while either in flight or at the water surface. Experiments that exposed small, medium, and large birds to blast waves in air were conducted to determine the exposure levels that would be injurious (Damon et al., 1974). Birds were assessed for internal injuries to air sacs, organs, and vasculature, as well as injury to the auditory tympanum, but internal auditory damage was not assessed. Results indicated that peak pressure exposure of 5 psi would be expected to produce no blast injuries, 10 psi would produce slight to extensive injuries, and 20 psi would produce 50 percent mortality. These results also suggested that birds with higher mass may be less susceptible to injury. In addition to the risk of direct blast injury, exposure to an explosion in air may cause physical displacement of a bird that could be injurious if the animal impacts a surface. The same study examined displacement injuries to birds (Damon et al., 1974). Results indicated that impulse exposures below 5 psi-ms would not be expected to result in injuries.

One experiment was conducted with birds in flight, showing how birds can withstand relatively close exposures to in-air explosions (Damon et al., 1974). Flying pigeons were exposed to a 64-pound (lb.) net explosive weight explosion. Birds at 44 to 126 ft. from the blast exhibited no signs of injury, while serious injuries were sustained at ranges less than 40 ft. The no injury zone in this experiment was also for exposures less than 5 psi-ms impulse, similar to the results of the displacement injury study.

Ranges to the no injury threshold for a range of in-air explosives are shown in Table 3.6-3.

Table 3.6-3: Range to No Blast Injury for Birds Exposed to Aerial Explosives

Net explosive weight	*Range to 5 psi*
5 pounds (lb.)	21 feet (ft.)
10 lb.	26 ft.
100 lb.	57 ft.

Note: Ranges calculated using the methods in Swisdak (1978); Swisdak and Montanaro (1992a).

Another risk of explosions in air is exposure to explosive fragmentation, in which pieces of the casing of a cased explosive are ejected at supersonic speeds from the explosion. The risk of direct strike by fragmentation would decrease exponentially with distance from the explosion, as the worst case for strike at any distance is the surface area of the casing fragments, which ultimately would decrease their outward velocity under the influence of drag. It is reasonable to assume that a direct strike in air or at the water surface would be lethal. Once in water, the drag on any fragments would quickly reduce their velocity to non-hazardous levels (Swisdak & Montanaro, 1992b).

The initial detonation in a series of detonations may deter birds from subsequent exposures via an avoidance response, however, birds have been observed taking interest in surface objects related to detonation events and subsequently being killed following detonation [Stemp, R. in Greene et al. (1985)].

3.6.2.2.1.2 Hearing Loss

Exposure to intense sound may result in hearing loss which persists after cessation of the noise exposure. There are no data on hearing loss in birds specifically due to explosives; therefore, the limited data on hearing loss due to impulsive sounds, described for acoustic stressors in Section 3.6.2.1.1.2 (Hearing Loss), apply to explosive exposures.

3.6.2.2.1.3 Physiological Stress

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. Exposures to explosives have the potential to provide additional stressors beyond those that naturally occur, as described in the Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities (see Section 3.0.3.7).

There are no data on physiological stress in birds specifically due to explosives; therefore, the limited data on physiological stress due to impulsive sounds, described for acoustic stressors in Section 3.6.2.1.1.4 (Physiological Stress), apply to explosive exposures.

3.6.2.2.1.4 Masking

Masking occurs when one sound, distinguished as the 'noise,' interferes with the detection or recognition of another sound. Exposure to explosives may result in masking. There are no data on masking in birds specifically due to explosives; therefore, the limited data on masking due to impulsive sounds, described for acoustic stressors in Section 3.6.2.1.1.3 (Masking), apply to explosive exposures. Due to the very brief duration of an explosive sound, any masking would be brief during an explosive activity.

3.6.2.2.1.5 Behavioral Reactions

Numerous studies have documented that birds and other wild animals respond to human-made noise, including aircraft overflights, weapons firing, and explosions (Larkin et al., 1996; National Park Service, 1994; Plumpton, 2006). The limited data on behavioral reactions due to impulsive sounds, described for acoustic stressors in Section 3.6.2.1.1.5 (Behavioral Reactions), apply to explosive exposures.

Because data on behavioral responses by birds to explosions is limited, information on bird responses to other impulsive sounds may be informative. Seismic surveys had no noticeable impacts on the movements or diving behavior of long-tailed ducks undergoing wing molt, a period in which flight is limited and food requirements are high (Lacroix et al., 2003). The birds may have tolerated the seismic survey noise to stay in preferred feeding areas. The sensitivity of birds to disturbance may also vary during different stages of the nesting cycle. Similar noise levels may be more likely to cause nest abandonment during incubation of eggs than during brooding of chicks because birds have invested less time and energy and have a greater chance of re-nesting (Knight & Temple, 1986).

3.6.2.2.1.6 Long-term Consequences

Long term consequences to birds due to explosive exposures are considered following the Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities (see Section 3.0.3.7).

Long-term consequences to a population are determined by examining changes in the population growth rate. Physical effects that could lead to a reduction in the population growth rate include mortality or injury, which could remove animals from the reproductive pool, and permanent hearing impairment, which could impact foraging and communication. The long-term consequences due to individual behavioral reactions and short-term instances of physiological stress are especially difficult to predict because individual experience over time can create complex contingencies. It is more likely that any long-term consequences to an individual would be a result of costs accumulated over a season, year, or life stage due to multiple behavioral or stress responses resulting from exposures to multiple stressors over significant periods of time. Conversely, some birds may habituate to or become tolerant of repeated acoustic exposures over time, learning to ignore a stimulus that in the past did not accompany any overt threat. More research is needed to better understand the long-term consequences of anthropogenic stressors, although intermittent exposures to explosive noise are assumed to be less likely to have lasting consequences.

3.6.2.2.1.7 Impacts from Explosives Under Alternative 1

<u>Impacts from Explosives Under Alternative 1 for Training Activities</u>

As shown in Table 3.0-7, the number of explosions would increase for E1, E2, and E5 explosives but decrease for E1 explosives. E3 explosives would remain the same as what was analyzed previously under the NWTT 2015 Final EIS/OEIS. Sound and energy generated by most small underwater explosions are unlikely to disturb birds above the water surface. If a detonation is sufficiently large or is near the water surface, however, pressure will be released at the air-water interface. Birds above this pressure release could be injured or killed. Explosives detonated at or just above the water surface, such as those used in anti-surface warfare, would create blast waves that would propagate through both the water and air. Detonations in air could also injure birds while either in flight or at the water surface. Detonations in air during anti-air warfare training would typically occur at much higher altitudes (greater than 3,000 ft. [914 m] above sea level) where seabirds and migrating birds are less likely to be present, although some events target incoming threats at lower altitudes. Detonations of bombs with larger net explosive weights, any event employing static targets, or multiple detonations could be more likely to cause seabird mortalities or injuries. If prey species, such as fish, are killed or injured as a result of detonations, some birds may continue to forage close to the area, or may be attracted to the area, and be exposed to subsequent detonations in the same area within a single event, such as gunnery exercises, which involves firing multiple high-explosive 5 in. rounds at a target area; bombing exercises, which could involve multiple bomb drops separated by several minutes; or underwater detonations, such as multiple explosive munitions disposal charges. However, a fleeing response to an initial explosion may reduce seabird exposure to any additional explosions that occur within a short timeframe. Detonations either in air or underwater have the potential to cause a permanent or temporary threshold shift, which could affect the ability of a bird to communicate with conspecifics or detect biologically relevant sounds.

An explosive detonation would likely cause a startle reaction, as the exposure would be brief and any reactions are expected to be short-term. Startle impacts range from altering behavior (e.g., stop feeding or preening), minor behavioral changes (e.g., head turning), or a flight response. The range of impacts could depend on the charge size, distance from the charge, and the animal's behavior at the time of the exposure. Any impacts related to startle reactions, displacement from a preferred area, or reduced foraging success in offshore waters would likely be short-term and infrequent.

Nearshore waters are the primary foraging habitat for many seabird species. Any small detonations close to shore could have a short-term adverse impact on nesting and nearshore foraging species. Larger detonations would typically occur near areas with the potential for relatively high concentrations of seabirds (upwelling areas associated with the Pacific Current; productive live/hard bottom habitats; and large algal mats); therefore, any impacts on seabirds are likely to be greater in these areas.

Offshore training activities involving explosions would typically be conducted in existing training areas, with detonations and explosive munitions typically occurring 50 NM or more from shore. Explosions would occur in inland waters within the Crescent Harbor EOD Training Range and Hood Canal EOD Training Range. Unlike offshore training areas where explosives are used, detonations in Crescent Harbor would occur in the same general location that measures approximately 1,200 m wide and 2,400 m long (2.88 km^2). As shown in Table 3.0-7 of this Supplemental, the number of E3 detonations would remain at six per year and the number of 1 oz. size charges would remain the same; therefore, birds in Inland Waters would be exposed to the same number of detonations as was analyzed in the 2015 NWTT Final EIS/OEIS.

The Navy will implement mitigation for seabirds during applicable explosive mine warfare activities in the Study Area. The mitigation will help avoid or minimize potential impacts on concentrations of foraging birds, as discussed in Section 5.3.3 (Explosive Stressors) (see Table 5.3-6 for a list of procedures, including the establishment of 200-yard exclusion zones around the intended target, lookout procedures, and activity delays if seabirds are within the mitigation zone). In addition, high-explosives use would not occur within 50 NM of shore, which reduces the likelihood of exposure, particularly in breeding periods when murrelets are known to forage in waters in close proximity to nest sites.

Marbled murrelet. As discussed previously, marbled murrelet ranges in breeding periods are closer to breeding habitats, which suggests that no murrelets would be exposed to high explosives (as these activities occur greater than 50 NM from shore). All research, to date, indicates that marbled murrelet occurrence beyond 12 km offshore is extremely unlikely, even during the winter months (Adams et al., 2014; Falxa & Raphael, 2016; Lorenz et al., 2016; Raphael et al., 2007; U.S. Fish and Wildlife Service, 2016). Therefore, exposures to explosive training activities are not likely to occur. In Inland Waters, marbled murrelets have an increased likelihood of exposure. Marbled murrelets exposed to underwater explosions may be subject to lethal or non-lethal injuries. Non-lethal injuries may include scarred or ruptured eardrums, or gastrointestinal tract lesions. Marbled murrelets may survive their exposure to in-air and in-water explosions and associated stressors; however, these individuals would have reduced levels of fitness and reproductive success, and higher risk of predation by reducing their ability to detect and/or evade predators. Lethal injuries may include direct mortality, lung hemorrhaging, ruptured liver, hemorrhaged kidney, ruptured air sacs, and/or coronary air embolisms. For individual marbled murrelets that are exposed to in-air and in-water explosions but not injured or killed, responses would likely include startle responses, flushing, or avoidance behaviors (i.e., diving, or leaving the area). In uninjured individuals, these responses would be short term with no significant disruptions to their normal behavior that would create a likelihood of injury. For in-water explosions, the Navy no longer uses detonation techniques where the detonation is delayed between the time of pre-detonation survey and the detonation in inland waters. This allows the Navy to detonate on command once the pre-detonation surveys have been completed. This may reduce the window of opportunity for birds to enter into the area where injury may occur after the surveys have been completed (U.S. Fish and Wildlife Service, 2016).

The Navy has requested reinitiation of Section 7 consultation with the USFWS for training activities described in this Supplemental for potential impacts on marbled murrelets from explosive stressors. As part of this consultation, the Navy will be presenting the most current information to estimate and model potential impacts on the marbled murrelet. This information will include new range to effects estimates not included in the previous consultation between the Navy and USFWS for activities described in the 2015 NWTT Final EIS/OEIS. The new range to effects estimates are based off of a revised modeling methodology and in-air explosives criteria, as well as an increased understanding of underwater hearing abilities of marbled murrelets and abundance estimations for areas that overlap with activities using explosives of different types and sizes. These revised methods will provide the Navy and USFWS with a quantitative assessment of impacts for potential explosives impacts, and the Final Supplemental will be updated with the outcomes of the reinitiated Section 7 consultation.

Short-tailed albatross. Short-tailed albatross pelagic range overlaps with areas that include detonations as part of training activities in the Offshore Area portion of the NWTT Study Area. If a short-tailed albatross were within the range to effects for a particular detonation, mortality and injury may occur, or various behavioral responses. Due to the small range to effects distance and widely dispersed activities within the Offshore Area of the Study Area, and the expected low numbers of short-tailed albatrosses at sea where training activities would occur, short-tailed albatrosses would have a low potential for any exposures from explosives use during training activities. Minimization measures and avoidance procedures are in place whereby explosives are not discharged if flocks of birds or rafts of floating vegetation are observed.

The Navy has requested reinitiation of Section 7 consultation with the USFWS for training activities described in this Supplemental for potential impacts on short-tailed albatrosses from explosive stressors. As part of this consultation, the Navy will be presenting the most current information to estimate and model potential impacts on the short-tailed albatross. This information will include new range to effects estimates not included in the previous consultation between the Navy and USFWS for activities described in the 2015 NWTT Final EIS/OEIS, as well as revised in-air explosive criteria. These revised modeling methods will provide the Navy and USFWS with a quantitative assessment of impacts for explosives, and the Final Supplemental will be updated with the outcomes of the reinitiated Section 7 consultation.

Pursuant to the ESA, explosives used during training activities as described under Alternative 1 would have no effect on the northern spotted owl, western snowy plover, and streaked horned lark. Explosives used during training activities may affect the marbled murrelet and the short-tailed albatross. The Navy will consult with the USFWS, as required by Section 7(a)(2) of the ESA. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from explosives stressors during training activities using explosives described under Alternative 1 would not result in a significant adverse effect on populations seabirds, shorebirds, and other birds protected under the MBTA.

Impacts from Explosives Under Alternative 1 for Testing Activities

For a summary of general impacts on marine birds from explosive testing activities, see the discussion above under training activities. As shown in Table 3.0-7, the number of explosions in the Offshore Area would increase for E1, E7, and E11 explosives, but decreases for E4 explosives compared to activities previously analyzed in the 2015 NWTT Final EIS/OEIS. The number of activities using explosions in Inland Waters remains the same under Alternative 1 testing activities.

Marbled murrelet. Marbled murrelets would be exposed to explosives during mine countermeasure and neutralization testing proposed in the Offshore Area, and existing mine warfare areas in Inland Waters (i.e., Crescent Harbor and Hood Canal Explosive Ordnance Disposal Training Ranges). Exposures to explosions during other testing activities, if any, would likely occur when murrelets extend their pelagic ranges in winter (non-breeding) periods. All research to date indicates that such pelagic environments are rarely or never used by marbled murrelets (Adams et al., 2014; Falxa & Raphael, 2016; Lorenz et al., 2016; Raphael et al., 2007; U.S. Fish and Wildlife Service, 2016). In Inland Waters, marbled murrelets have an increased likelihood of exposure. Marbled murrelets exposed to underwater explosions may be subject to lethal or non-lethal injuries. Non-lethal injuries may include scarred or ruptured eardrums, or gastrointestinal tract lesions. Marbled murrelets may survive their exposure to in-air and in-water explosions and associated stressors; however, these individuals to have reduced levels of fitness and reproductive success, and higher risk of predation by reducing their ability to detect and/or evade predators. Lethal injuries may include direct mortality, lung hemorrhaging, ruptured liver, hemorrhaged kidney, ruptured air sacs, and/or coronary air embolisms. For individual marbled murrelets that are exposed to in-air and in-water explosions but not injured or killed, responses would likely include expect a startle response, flushing, or avoidance (i.e., diving, or leaving the area). In uninjured individuals, these responses would be short term with no significant disruptions to their normal behavior that would create a likelihood of injury. For in-water explosions, the Navy no longer uses detonation techniques where the detonation is delayed between the time of pre-detonation survey and the detonation in inland waters. This allows the Navy to detonate on command once the pre-detonation surveys have been completed. This may reduce the window of opportunity for birds to enter into the area where injury may occur after the surveys have been completed (U.S. Fish and Wildlife Service, 2016).

The Navy has requested reinitiation of Section 7 consultation with the USFWS for testing activities under Alternative 1 for potential impacts on marbled murrelets from explosive stressors. As part of this consultation, the Navy will be presenting the most current information to estimate and model potential impacts on the marbled murrelet. This information will include new range to effects estimates not included in the previous consultation between the Navy and USFWS for activities described in the 2015 NWTT Final EIS/OEIS. The new range to effects estimates are based off of a revised modeling methodology and in-air explosives criteria, as well as an increased understanding of underwater hearing abilities of marbled murrelets and abundance estimations for areas that overlap with activities using explosives of different types and sizes. These revised methods will provide the Navy and USFWS with a quantitative assessment of impacts for potential explosives impacts, and the Final Supplemental will be updated with the outcomes of the reinitiated Section 7 consultation.

Short-tailed albatross. Short-tailed albatross pelagic range overlaps with areas that include detonations as part of testing activities in the Offshore Area portion of the NWTT Study Area. If a short-tailed albatross were within the range to effects for a particular detonation, mortality and injury may occur, or various behavioral responses. Due to the small range to effects distance and widely dispersed activities within the Offshore Area of the Study Area, and the expected low numbers of short-tailed albatrosses at sea where testing activities would occur, short-tailed albatrosses would have a low potential for any exposures from explosives use during testing activities. Minimization measures and avoidance procedures are in place whereby explosives are not discharged if flocks of birds or rafts of floating vegetation are observed.

The Navy has requested reinitiation of Section 7 consultation with the USFWS for testing activities under Alternative 1 for potential impacts on short-tailed albatrosses from explosive stressors. As part of this consultation, the Navy will be presenting the most current information to estimate and model potential impacts on the short-tailed albatross. This information will include new range to effects estimates not included in the previous consultation between the Navy and USFWS for activities described in the 2015 NWTT Final EIS/OEIS, as well as revised in-air explosive criteria. These revised modeling methods will provide the Navy and USFWS with a quantitative assessment of impacts for explosives, and the Final Supplemental will be updated with the outcomes of the reinitiated Section 7 consultation.

Pursuant to the ESA, explosives used during testing activities as described under Alternative 1 would have no effect on the northern spotted owl, western snowy plover, and streaked horned lark. Explosives used during training activities may affect the marbled murrelet and the short-tailed albatross. The Navy will consult with the USFWS, as required by Section 7(a)(2) of the ESA. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from explosives stressors during testing activities using explosives described under Alternative 1 would not result in a significant adverse effect on populations seabirds, shorebirds, and other birds protected under the MBTA.

3.6.2.2.1.8 Impacts from Explosives Under Alternative 2

Impacts from Explosives Under Alternative 2 for Training Activities

For a summary of general impacts on marine birds from explosive testing activities, see the discussion above under Alternative 1 training activities. As shown in Table 3.0-7, the number of explosions in the Offshore Area would increase for 1 oz. charges, E1, E2, E3, E5, E10, and E11 explosives (in locations greater than 50 NM from shore). In Inland Waters, the number of E3 explosions would decrease.

Marbled murrelet. As discussed under Alternative 1, marbled murrelet ranges in breeding periods are closer to breeding habitats, which suggests that no murrelets would be exposed to high explosives (as these activities occur greater than 50 NM from shore). Exposures, if any, would likely occur when murrelets extend their pelagic ranges in winter (non-breeding) periods. All research to date indicates that such pelagic environments are rarely or never used by marbled murrelets (Adams et al., 2014; Falxa & Raphael, 2016; Lorenz et al., 2016; Raphael et al., 2007; U.S. Fish and Wildlife Service, 2016). The potential impacts on marbled murrelets from explosive stressors under Alternative 2 training activities are the same as discussed previously under Alternative 1 training activities. For in-water explosions, the Navy no longer uses detonation techniques where the detonation is delayed between the time of pre-detonation survey and the detonation in inland waters. This allows the Navy to detonate on command once the pre-detonation surveys have been completed. This may reduce the window of opportunity for birds to enter into the area where injury may occur after the surveys have been completed (U.S. Fish and Wildlife Service, 2016).

Short-tailed albatross. Short-tailed albatross pelagic range overlaps with areas that include detonations as part of training activities in the Offshore Area portion of the NWTT Study Area. If a short-tailed albatross were within the range to effects for a particular detonation, mortality and injury may occur, or various behavioral responses. Due to the small range to effects distance and widely dispersed activities within the Offshore Area of the Study Area, and the expected low numbers of short-tailed albatrosses at sea where training activities would occur, short-tailed albatrosses would have a low potential for any exposures from explosives use during training activities. Minimization measures and avoidance procedures are in place whereby explosives are not discharged if flocks of birds or rafts of floating vegetation are observed.

Pursuant to the ESA, explosives used during training activities as described under Alternative 2 would have no effect on the northern spotted owl, western snowy plover, and streaked horned lark. Explosives used during training activities may affect the marbled murrelet and the short-tailed albatross. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from explosives stressors during training activities using explosives described under Alternative 2 would not result in a significant adverse effect on populations seabirds, shorebirds, and other birds protected under the MBTA.

Impacts from Explosives Under Alternative 2 for Testing Activities

For a summary of general impacts on marine birds from explosive testing activities, see the discussion above under Alternative 1 training activities. As shown in Table 3.0-7, the number of explosions in the Offshore Area would increase for E1, E7, E8, and E11 explosives, but decreases for E4 explosives compared to activities previously analyzed in the 2015 NWTT Final EIS/OEIS. The number of activities using explosions in Inland Waters remains the same under Alternative 2 testing activities. Alternative 2 would use the same number and type of explosions, as well as in the same locations, as proposed under Alternative 1.

Marbled murrelets. Marbled murrelets would be exposed to explosives during mine countermeasure and neutralization testing proposed in the Offshore Area, and existing mine warfare areas in Inland Waters (i.e., Crescent Harbor and Hood Canal Explosive Ordnance Disposal Training Ranges). Exposures to explosions during other testing activities, if any, would likely occur when murrelets extend their pelagic ranges in winter (non-breeding) periods. All research to date indicates that such pelagic environments are rarely or never used by marbled murrelets (Adams et al., 2014; Falxa & Raphael, 2016; Lorenz et al., 2016; Raphael et al., 2007; U.S. Fish and Wildlife Service, 2016). The potential impacts on marbled murrelets from explosive stressors under Alternative 2 testing activities are the same as discussed previously under Alternative 1 testing activities. For in-water explosions, the Navy no longer uses detonation techniques where the detonation is delayed between the time of pre-detonation survey and the detonation in inland waters. This allows the Navy to detonate on command once the pre-detonation surveys have been completed. This may reduce the window of opportunity for birds to enter into the area where injury may occur after the surveys have been completed (U.S. Fish and Wildlife Service, 2016).

Short-tailed albatross. Short-tailed albatross pelagic range overlaps with areas that include detonations as part of testing activities in the Offshore Area portion of the NWTT Study Area. If a short-tailed albatross were to be within an area considered to be within the range to effects for a particular detonation, mortality and injury may occur, or various behavioral responses. Due to the small range to effects distance and widely dispersed activities within the Offshore Area of the Study Area, and the expected low numbers of short-tailed albatrosses at sea where testing activities would occur, short-tailed albatrosses would have a low potential for any exposures from explosives use during testing activities. Minimization measures and avoidance procedures are in place whereby explosives are not discharged if flocks of birds or rafts of floating vegetation are observed.

Pursuant to the ESA, explosives used during testing activities as described under Alternative 2 would have no effect on the northern spotted owl, western snowy plover, and streaked horned lark. Explosives used during training activities may affect the marbled murrelet and the short-tailed albatross. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from explosives stressors during testing activities using explosives described under Alternative 2 would not result in a significant adverse effect on populations seabirds, shorebirds, and other birds protected under the MBTA.

3.6.2.2.2 No Action Alternative

Under the No Action Alternative, the Navy would not conduct proposed at-sea training and testing activities in the Study Area. Other military activities not associated with this Proposed Action would continue to occur. Explosives stressors from sources 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 explosive 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 explosives on individual birds, but would not measurably improve the status of bird populations.

3.6.2.3 Energy Stressors

The energy stressors that may impact marine birds include in-water electromagnetic devices, in-air electromagnetic devices, and high-energy lasers. Only one new energy stressor (high-energy lasers) used in testing activities differs from the energy stressors that were previously analyzed in the 2015 NWTT Final EIS/OEIS. Use of low-energy lasers was analyzed and dismissed as an energy stressor in the 2015 NWTT Final EIS/OEIS in Section 3.0.5.3.2.2 (Lasers). However, at that time high-energy laser weapons were not part of the proposed action for the Study Area.

3.6.2.3.1 Impacts from In-Water Electromagnetic Devices

In-water electromagnetic devices were described in Section 3.0.5.3.2.1 (Electromagnetic) of the 2015 NWTT Final EIS/OEIS; however, they were not analyzed for potential impacts on birds. This Supplemental provides an update to the 2015 NWTT Final EIS/OEIS with an analysis of potential impacts on birds from the use of in-water electromagnetic devices. For a description of in-water electromagnetic devices, see Section 3.0.3.3.1.2 (In-Water Electromagnetic Devices) and Table 3.0-9 in this Supplemental.

3.6.2.3.1.1 Impacts from In-Water Electromagnetic Devices Under Alternative 1

Impacts from In-Water Electromagnetic Devices Under Alternative 1 Training Activities

Under Alternative 1 training activities, the number of proposed training activities involving the use of in-water electromagnetic devices would remain the same as those proposed in the 2015 NWTT Final EIS/OEIS (Table 3.0-9).

Exposure of birds would be limited to those foraging at or below the surface (e.g., cormorants, loons, alcids, petrels, grebes) because that is where the devices are used. Birds that forage inshore could be exposed to these in-water electromagnetic stressors because their habitat overlaps with some of the activities that occur in the nearshore portions within the Study Area. However, the in-water electromagnetic fields generated would be distributed over time and location near mine warfare ranges and harbors, and any influence on the surrounding environment would be temporary and localized. More importantly, the in-water electromagnetic devices used are typically towed by a helicopter, surface ship, or unmanned vehicle. It is likely that any birds in the vicinity approaching a vehicle towing an in-water electromagnetic device would be dispersed by the noise and disturbance generated by the vehicles (Section 3.6.2.1.4, Impacts from Aircraft Noise) and therefore move away from the vehicle and device before any exposure could occur.

Impacts on birds from potential exposure to in-water electromagnetic devices would be temporary and inconsequential based on the (1) relatively low intensity of the magnetic fields generated (0.2 microtesla at 200 m from the source), (2) very localized potential impact area, (3) temporary duration of the activities (hours), (4) occurrence only underwater, and (5) the likelihood that any birds in the vicinity of the approaching vehicles towing an in-water electromagnetic devices would move away from the vehicle and device before any exposure could occur. No long-term or population-level impacts are expected.

Impacts on prey availability (fishes) would also likely be negligible. For an analysis of in-water electromagnetic devices on prey species for marine birds, see Section 3.6.2.3.1 (Impacts from In-Water

Electromagnetic Devices). Some fishes could have a detectable response to electromagnetic exposure, but any impacts would be temporary and would not impact the animal's fitness, which refers to changes in an individual's growth, survival, annual reproductive success, or lifetime reproductive success. Electromagnetic exposure of eggs and larvae of sensitive bony fishes would be low relative to their total ichthyoplankton biomass (Able & Fahay, 1998). Therefore, potential impacts on marine bird prey species recruitment are not be expected.

Pursuant to the ESA, use of in-water electromagnetic devices used during training activities as described under Alternative 1 would have no effect on the northern spotted owl, western snowy plover, or streaked horned lark. Activities that use In-water electromagnetic devices may affect the marbled murrelet and the short-tailed albatross. The Navy will consult with the USFWS, as required by section 7(a)(2) of the ESA. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from in-water electromagnetic devices during training activities described under Alternatives 1 would not result in a significant adverse effect on populations seabirds, shorebirds, and other birds protected under the MBTA.

Impacts from In-Water Electromagnetic Devices Under Alternative 1 Testing Activities

No in-water electromagnetic devices are proposed for testing activities under Alternative 1.

3.6.2.3.1.2 Impacts from In-Water Electromagnetic Devices Under Alternative 2

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

Under Alternative 2, the number of proposed training activities involving the use of in-water electromagnetic devices would remain the same as those proposed in the 2015 NWTT Final EIS/OEIS (Table 3.0-9). The activities would occur in the same locations and in a similar manner as were analyzed previously. Therefore, the impacts on birds would be the same. As described above for Alternative 1, some birds may be exposed to in-water electromagnetic devices during training activities. The impact of these stressors on marine birds under Alternative 2 would be inconsequential because (1) the area exposed to the stressor is extremely small relative to most birds' ranges; (2) birds would only be exposed to electromagnetic energy when submerged; (3) the number of activities involving the stressor is low; (4) exposures would be localized, temporary, and would cease with the conclusion of the activity; and (5) even for susceptible birds (e.g., diving birds), the consequences of exposure are limited to temporary disruptions to navigation and orientation under Alternative 2.

Pursuant to the ESA, use of in-water electromagnetic devices used during training activities as described under Alternative 2 would have no effect on the northern spotted owl, western snowy plover, or streaked horned lark. Activities that use In-water electromagnetic devices may affect the marbled murrelet and the short-tailed albatross. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from in-water electromagnetic devices during training activities described under Alternatives 1 would not result in a significant adverse effect on populations seabirds, shorebirds, and other birds protected under the MBTA.

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

No in-water electromagnetic devices are proposed for testing activities under Alternative 2.

3.6.2.3.1.3 Impacts from In-Water Electromagnetic Devices 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. Other military activities not associated with this Proposed Action would continue to occur. In-water electromagnetic devices 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 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 in-water electromagnetic devices on individual marine birds and their prey items, but would not measurably improve the status of bird populations or subpopulations.

3.6.2.3.2 Impacts from In-Air Electromagnetic Devices

In-air electromagnetic devices were described as Airborne Electromagnetic Energy in Section 3.0.5.3.2.1 (Electromagnetic) of the 2015 NWTT Final EIS/OEIS; however, they were not analyzed for potential impacts on birds. Sources of electromagnetic energy in the air include communications transmitters, radars, and electronic countermeasures transmitters. Electromagnetic devices on Navy platforms operate across a wide range of frequencies and power. On a single ship the source frequencies may range from 2 megahertz (MHz) to 14,500 MHz, and transmitter maximum average power may range from 0.25 watts to 1,280,00 watts. It is assumed that most Navy platforms associated with the training and testing activities will be transmitting from a variety of in-air electromagnetic devices at all times that they are underway, with very limited exceptions. Most of these transmissions (e.g., for routine surveillance, communications, and navigation) will be at low power. High-power settings are used for a small number of activities including ballistic missile defense training, missile and rocket testing, radar and other system testing, and signature analysis operations. The number of Navy vessels or aircraft in the Study Area at any given time varies and is dependent on local training or testing requirements. Therefore, in-air electromagnetic energy as part of training and testing activities would be widely dispersed throughout the Study Area, but more concentrated in portions of the Study Area near ports, naval installations, and range complexes.

This Supplemental provides an update to the 2015 NWTT Final EIS/OEIS with an analysis of potential impacts on birds from the use of in-water electromagnetic devices. For a description of in-water electromagnetic devices, see Section 3.0.3.3.1.2 (In-Air Electromagnetic Devices) and Table 3.0-9 in this Supplemental.

3.6.2.3.2.1 Impacts from In-Air Electromagnetic Devices Under Alternative 1 and Alternative 2

Impacts from In-Air Electromagnetic Devices Under Alternative 1 and 2 for Training and Testing Activities

Studies conducted on in-air electromagnetic sensitivity in birds have typically been associated with land, and little information exists specifically on seabird response to in-air electromagnetic changes at sea. Based on these studies, in-air electromagnetic effects can be categorized as thermal (i.e., capable of causing damage by heating tissue) or non-thermal. Thermal effects are most likely to occur when near high-power systems. Should such effects occur, they would likely cause birds to temporarily avoid the area receiving the electromagnetic radiation until the stressor ceases (Manville, 2016). Currently, questions exist about far-field, non-thermal effects from low-power, in-air electromagnetic devices. Manville (2016) performed a literature review of this topic. Although findings are not always consistent, Manville (2016) reported that several peer-reviewed studies have shown non-thermal effects can include (1) affecting behavior by preventing birds from using their magnetic compass, which may in turn affect migration; (2) fragmenting the DNA of reproductive cells, decreasing the reproductive capacity of living organisms; (3) increasing the permeability of the blood-brain barrier; (4) other behavioral effects; (5) other molecular, cellular, and metabolic changes; and (6) increasing cancer risk.

Many bird species return to the same stopover, wintering, and breeding areas every year and often follow the exact same or very similar migration routes (Akesson & Hedenstrom, 2007). However, ample evidence exists that displaced birds can successfully reorient and find their way when one or more cues are removed. For example, Haftorn et al. (1988) found that after removal from their nests and release into a different area, snow petrels (*Pagodrama nivea*) were able to successfully navigate back to their nests even when their ability to smell was removed. Furthermore, Wiltschko et al. (2011) and Wiltschko and Wiltschko (2005) report that electromagnetic pulses administered to birds during an experimental study on orientation do not deactivate the magnetite-based receptor mechanism in the upper beak altogether but instead cause the receptors to provide altered information, which in turn causes birds to orient in different directions. However, these impacts were temporary, and the ability of the birds to correctly orient themselves eventually returned.

Given the dispersed nature of Navy testing and training activities at sea and the relatively low-level and dispersed use of these systems at sea, the following conclusions are reached:

- The chance that in-air electromagnetic devices would cause thermal damage to an individual bird is extremely low;
- It is possible, although unlikely, that some birds would be exposed to levels of electromagnetic radiation that would cause discomfort, in which case they would likely avoid the immediate vicinity of testing and training activities;
- The strength of any avoidance response would decrease with increasing distance from the in-air electromagnetic device; and
- No long-term or population-level impacts would occur.

The western snowy plover, streaked horned lark, marbled murrelet, and short-tailed albatross would not likely be exposed to in-air electromagnetic radiation because these species would not be close to vessel or aircraft-based radar systems to receive any measurable amount of electromagnetic field. The USFWS examined the potential for land-based radar systems and their potential effects on the northern spotted owl and marbled murrelet in the terrestrial environment. In their biological opinion, the USFWS determined that there were several aspects of the electronic warfare training that limit exposures of wildlife to EMR. These factors include antenna configurations of mobile emitters that limit exposure to birds. For example, emitter antennas extend 14 ft. above the mobile emitter vehicles and the directional beams produced by the emitters are aimed to allow unobstructed signal transmission (taking advantage of clear lines of sight) so that there is little or no potential for wildlife on the ground or in the tree canopy to be exposed to the signal (U.S. Fish and Wildlife Service, 2016). Therefore, only birds in flight over the forest canopy have the potential to intersect beams and become exposed to electromagnetic energy from training and testing activities.

Northern spotted owl. Spotted owls are not likely to be exposed to electromagnetic energy due to their close affinity to closed-canopy forest cover. Although spotted owls do occasionally disperse across open areas, they usually avoid crossing such areas by traveling through corridors of forested habitat (Forsman et al., 1984). Physical effects, such as tissue heating, are considered insignificant because an exposure of one or two seconds during flight would be too brief to manifest a measurable effect. Potential exposure could occur if a spotted owl flew through the energy field from the emitter. Bruderer et al. (1999) aimed a 9 GHz tracking radar emitter at birds in flight to observe behavioral responses. The researchers found that the radar provoked no measurable changes in the behavior of the birds in terms of flight direction or vertical speed. The best available information indicates that the effects of brief exposure to birds in flight in the range of frequencies proposed for use by the Navy are likely to be insignificant (i.e., not measurable or detectable).

Marbled murrelet. A marbled murrelet would be exposed to electromagnetic energy when their flight paths intersect with a radar beam. The radar emitters are energized intermittently and produce EMR with frequencies between 4 and 8 GHz. The best-available commercial and scientific information indicates that the effects of brief, intermittent exposures to radar frequencies in the range of 4 to 8 GHz are likely to be insignificant to birds in flight, including the marbled murrelet (Manville, 2016). Physical effects, such as tissue heating or burns, are considered to be discountable, because an exposure lasting a few seconds (as is the case with a bird in flight) would be too brief to manifest these effects.

Pursuant to the ESA, use of in-air electromagnetic devices used during training and testing activities as described under Alternatives 1 and 2 would have no effect on the western snowy plover, streaked horned lark, or short-tailed albatross. Activities that use In-air electromagnetic devices may affect the northern spotted owl and marbled murrelet. The Navy will consult with the USFWS, as required by section 7(a)(2) of the ESA. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from in-air electromagnetic devices during training and testing activities described under Alternatives 1 and 2 would not result in a significant adverse effect on populations seabirds, shorebirds, and other birds protected under the MBTA.

3.6.2.3.2.2 Impacts from In-Air Electromagnetic Devices 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. Other military activities not associated with this Proposed Action would continue to occur. In-air electromagnetic devices as listed above would not be introduced into the marine environment or areas over land. 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 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 in-air electromagnetic devices on individual birds, but would not measurably improve the status of bird populations or subpopulations.

3.6.2.3.3 Impacts from High-Energy Lasers

Use of low-energy lasers were covered in the 2015 NWTT Final EIS/OEIS in Section 3.0.5.3.2.2 (Lasers), but high-energy laser weapons were not part of the proposed action in the 2015 NWTT Final EIS/OEIS.

The use of high-energy lasers represent a new substressor used in an existing activity in this Supplemental. As discussed in this Supplemental, Section 3.0.3.3.2.2 (High-Energy Lasers), high-energy lasers are designed to disable surface targets, rendering them immobile. High-energy laser weapons testing activities involve evaluating the effectiveness of a high-energy laser deployed from a surface ship or helicopter to create small but critical failures in potential targets from short ranges. The primary concern is the potential for a marine bird to be struck with the laser beam at or near the water's surface, where extended exposure could result in injury or death due to traumatic burns from the beam.

Marine birds could be exposed to a laser only if the beam missed the target or flew between the source and the target. Should the laser strike the sea surface, individual birds at or near the surface could be exposed. Because laser platforms are typically helicopters and ships, marine birds at sea would likely transit away or submerge in response to other stressors, such as ship or aircraft noise, although some marine birds may not exhibit a response to an oncoming vessel or aircraft, increasing the risk of contact with the laser beam. High-energy laser activities would only occur in open ocean locations (not close to land areas).

3.6.2.3.3.1 Impacts from High-Energy Lasers Under Alternative 1

Impacts from High-Energy Lasers Under Alternative 1 Training Activities

No high-energy lasers are proposed for training activities under Alternative 1.

Impacts from High-Energy Lasers Under Alternative 1 Testing Activities

Under Alternative 1, high-energy laser weapons would be used for testing activities in the Offshore Area portion of the Study Area. Birds in the open ocean are unlikely to be exposed to high-energy lasers based on (1) the relatively low number of events (54 per year throughout the entire Offshore portion of the Study Area), (2) the very localized potential impact area of the laser beam, (3) the temporary duration of potential impact (seconds), (4) the low probability of a bird at or near the surface at the exact time and place a laser misses its target, (5) the low probability of a bird transiting the area between the source and target and travel through the beam's path, and (6) the low probability of a laser missing its target. A direct strike of a marine bird at the water's surface or within the beam path is extremely unlikely, and potential impacts on the marbled murrelet and short-tailed albatross are discountable (adverse effects are unlikely to occur).

Pursuant to the ESA, use of high-energy lasers during testing activities as described under Alternative 1 would have no effect on the western snowy plover, streaked horned lark, or northern spotted owl. High-energy lasers may affect the marbled murrelet and short-tailed albatross. The Navy will consult with the USFWS, as required by section 7(a)(2) of the ESA. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from high-energy lasers during testing activities described under Alternative 1 would not result in a significant adverse effect on populations seabirds, shorebirds, and other birds protected under the MBTA.

3.6.2.3.3.2 Impacts from High-Energy Lasers Under Alternatives 2

Impacts from High-Energy Lasers Under Alternative 2 Training Activities

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

Impacts from High-Energy Lasers Under Alternative 2 Testing Activities

As shown in Table 3.0-10, 54 testing activities involving the use of high-energy lasers are proposed to be conducted in the Offshore Area under Alternative 2, the same as under Alternative 1. Therefore, the impacts would be the same as described under Alternative 1.

Pursuant to the ESA, use of high-energy lasers during testing activities as described under Alternative 2 would have no effect on the western snowy plover, streaked horned lark, or northern spotted owl. High-energy lasers may affect the marbled murrelet and short-tailed albatross. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from high-energy lasers during testing activities described under Alternative 2 would not result in a significant adverse effect on populations seabirds, shorebirds, and other birds protected under the MBTA.

3.6.2.3.3.3 Impacts from High-Energy Lasers 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. Other military activities not associated with this Proposed Action would continue to occur. High-energy lasers 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 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 remove the potential for impacts from high-energy lasers on individual marine birds, but would not measurably improve the status of bird populations.

3.6.2.4 Physical Disturbance and Strike Stressors

The physical disturbance and strike stressors that may impact birds include (1) aircraft and aerial targets, (2) vessels and in-water devices, and (3) military expended materials. The annual number of activities including aircraft and aerial targets, vessels and in-water devices, and the annual number of military expended materials are shown in Tables 3.0-11 through 3.0-17. Section 3.6.3.2 (Impacts from Physical Disturbance and Strike Stressors) of the 2015 NWTT Final EIS/OEIS discusses the potential impacts on birds by aircraft and aerial target strikes, vessels and in-water devices (disturbance and strike), and military expended material strike. For the purposes of this Supplemental, only activities that have changed since the publication of the 2015 NWTT Final EIS/OEIS are discussed in this section.

Physical disturbances may elicit short-term behavioral or physiological responses such as alert response, startle response, cessation of feeding, fleeing the immediate area, and a temporary increase in heart rate. Birds are unlikely to be struck by aircraft and aerial target strikes, vessels and in-water devices, or military expended material strike. Activities that use these platforms or expend materials typically generate other stressors (e.g., noise) or birds can avoid collision, particularly with vessels and in-water devices, by avoiding the approach of a vessel or in-water device. When strikes do occur, they often result in bird mortality or severe injury, particularly with aircraft strikes.

The Navy will implement procedural mitigation measures for seabirds to avoid or minimize impacts on seabirds from physical and strike stressors. The mitigation will help avoid or minimize potential impacts on concentrations of foraging birds, as discussed in Section 5.3.4 (Physical Disturbance and Strike Stressors) (refer to Chapter 5, Mitigation, Table 5.3-13 for a list of procedures, including the establishment of 200-yard exclusion zones around the intended target, lookout procedures, and activity delays if seabirds are within the mitigation zone). Refer to Appendix K (Geographic Mitigation Assessment, Table K-2) for offshore mitigation areas that restrict explosive munitions use to areas beyond 50 NM from the coast.

3.6.2.4.1 Impacts from Aircraft and Aerial Target Strikes

Aircraft and aerial targets were described in Section 3.0.5.3.3.5 (Aircraft Strikes) in the 2015 NWTT Final EIS/OEIS. Table 3.0-11 shows the number of ongoing activities (from the 2015 NWTT Final EIS/OEIS) and the number of activities proposed in this Supplemental that include the use of aircraft for both training and testing activities. Bird-aircraft strikes are a grave concern for the Navy because they can harm aircrews. Bird-aircraft strikes can also damage equipment and injure or kill birds (Bies et al., 2006). In the FAA's analysis of aircraft bird strikes from 1990 to 2015, waterfowl, gulls, and raptors are the species groups of birds with the most damaging strikes on aircraft, with most strikes occurring at or after takeoff or landing (Federal Aviation Administration, 2015). Pfeiffer et al. (2018) further analyzed strike risk for specific species and military aircraft using Navy and Air Force strike data. The Navy data covered 27 years (1990–2017) and contained 21,661 wildlife strike records. The Air Force dataset spanned 23 years (1994–2017) and contained 104,129 wildlife strike records. The most hazardous species to military aircraft was the snow goose (*Anser caerulescens*), followed by the common loon (*Gavia immer*), Canada goose (*Branta canadensis*), and black vulture (*Coragyps atratus*) (Pfeiffer et al., 2018). A general overview of flight height characteristics for birds is provided in this Supplemental in Section 3.6.1.3 (Flight Altitudes).

3.6.2.4.1.1 Impacts from Aircraft and Aerial Target Strikes Under Alternative 1

Impacts from Aircraft and Aerial Target Strikes Under Alternative 1 for Training Activities

As shown in Table 3.0-11, the number of activities including aircraft movements under Alternative 1 would increase slightly in the Offshore Area. Within the Offshore Area, birds are least likely to be struck because of the flight altitudes of birds (generally lower for seabirds over open water), and flight altitudes of aircraft. Within inland waters, the number of training activities involving aircraft under Alternative 1 would also increase. As with the 2015 NWTT Final EIS/OEIS, there would be no aircraft activity as part of training activities under Alternative 1 within the Western Behm Canal.

In general, bird populations consist of hundreds or thousands, ranging across a large geographical area. In this context, the loss of several or even dozens of birds due to physical strikes may not constitute a population-level effect, although some species gather in large flocks. Bird exposure to strike potential would be relatively brief, as an aircraft quickly passes overhead. Seabirds actively avoid interaction with aircraft; however, disturbances of various seabird species may occur from aviation operations on a site-specific basis. As a standard operating procedure, aircraft avoid large flocks of birds to minimize the safety risk involved with a potential bird strike.

Air combat maneuver (in W-237 and the Olympic MOA), and electronic warfare training (W-237 and the Olympic MOA) activities were analyzed in the 2015 NWTT Final EIS/OEIS and the USFWS 2016 Biological Opinion.

For streaked horned larks and western snowy plovers, it is extremely unlikely that individuals would be exposed to aircraft strikes under Alternative 1. If any of these birds were present, the vertical separation between the bird and aircraft would be at least 6,000 ft. based on the floor of the Olympic MOAs. It is extremely unlikely that overflights at these altitudes would result in strikes, and the effects would be considered discountable (adverse effects are unlikely to occur).

The USFWS concluded in their biological opinion that aircraft strikes of marbled murrelets and northern spotted owls by aircraft over land to be discountable (adverse effects are unlikely to occur) for the following reasons: (1) all aircraft flights occur at altitudes that exceed 6,000 ft. above mean sea level; (2) because murrelets and northern spotted owls use forests to 4,000 ft. elevation contours, the closest approach to nesting habitat would be 2,000 ft.; (3) murrelets typically fly at 1,000 ft. above ground level; (4) most aircraft flights would occur higher than 10,000 ft. above mean sea level; and (5) the low densities of murrelets and spotted owls that occur throughout the Olympic MOAs. Similarly, the USFWS discounted aircraft strike in their 2016 biological opinion of marbled murrelets and short-tailed albatrosses for the following reasons: (1) short-tailed albatrosses and marbled murrelets typically fly over the ocean within a few meters of the water surface; (2) both species will be in very low densities and spending the majority of their time on or near the surface of the water; and (3) although aircraft may fly at low altitudes (no less than 3,000 ft.) over the water surface, birds are expected to exhibit behaviors that will separate the birds from the altitudes used by the great majority of the aircraft.

Pursuant to the ESA, activities involving aircraft flights and aerial targets during training activities as described under Alternative 1 may affect the marbled murrelet, short-tailed albatross, northern spotted owl, streaked horned lark, and western snowy plover. The Navy will consult with the USFWS, as required by section 7(a)(2) of the ESA. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts of aircraft and aerial targets during training activities described under Alternative 1 would not result in a significant adverse effect on populations seabirds, shorebirds, and other birds protected under the MBTA.

Impacts from Aircraft and Aerial Target Strikes Under Alternative 1 for Testing Activities

As shown in Table 3.0-11, the number of testing activities including aircraft movements under Alternative 1 would increase in the Offshore Area. Alternative 1 includes new testing activities not previously analyzed in the NWTT 2015 Final EIS/OEIS. These activities include Mine Countermeasure and Neutralization Testing, Kinetic Energy Weapons testing (when using aerial targets), radar and other systems testing, and simulant testing (when using fixed-wing and rotary-wing aircraft). Within the Offshore Area, birds are least likely to be struck because of the flight altitudes of birds (generally lower for seabirds over open water), and flight altitudes of aircraft. Despite increases in the number of testing activities involving aircraft and aerial targets in the Offshore Area under Alternative 1, birds are at low risk for aircraft or aerial target strike for the same reasons as described above under training activities. Under Alternative 1, the number of aircraft activities in the Western Behm Canal would not change from what was previously analyzed in the 2015 NWTT Final EIS/OEIS. Within inland waters, the number of activities involving aircraft under Alternative 1 testing activities would decrease. These flights generally occur at lower altitudes, which may elevate the risk of strike for birds; however, these aircraft are primarily rotor wing aircraft and birds are expected to respond to other stimulus and avoid the helicopter, reducing the potential for strike. Therefore, the potential for strike of marbled murrelets within inshore waters is discountable, a conclusion supported in the USFWS 2016 Biological Opinion (U.S. Fish and Wildlife Service, 2016).

Mine Countermeasures and Neutralization Testing may occur within the surf zone in the nearshore and coastal portion of the Quinault Range. Typically, shorebirds when in flight in coastal areas fly within a few meters of the water or land surface and are not susceptible to strike. Although streaked horned larks and western snowy plovers may occur within the coastal portion of the Quinault Range, the vertical separation of aircraft flights and the birds presents a very low risk for strikes. Accordingly, the risk of aircraft strikes for streaked horned larks and western snowy plovers should be considered discountable (adverse effects are unlikely to occur). Critical habitat for these two species is outside of the area used for testing overflights; therefore, there would be no impacts on critical habitats for these two species.

Pursuant to the ESA, activities involving aircraft flights and aerial targets during testing activities as described under Alternative 1 may affect the marbled murrelet, short-tailed albatross, northern spotted owl, streaked horned lark, and western snowy plover. The Navy will consult with the USFWS, as required by section 7(a)(2) of the ESA. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts of aircraft and aerial targets during testing activities described under Alternative 1 would not result in a significant adverse effect on populations seabirds, shorebirds, and other birds protected under the MBTA.

3.6.2.4.1.2 Impacts from Aircraft and Aerial Targets Under Alternative 2

Impacts from Aircraft and Aerial Targets Under Alternative 2 for Training Activities

As shown in Table 3.0-11, the number of training activities including aircraft movements under Alternative 2 would increase in the Offshore Area compared to what was analyzed previously in the 2015 NWTT Final EIS/OEIS and to what is proposed under Alternative 1. Activities proposed under Alternative 2 in Inland Waters would increase from what was previously analyzed in the 2015 NWTT Final EIS/OEIS and what is proposed under Alternative 1. As with the 2015 NWTT Final EIS/OEIS and Alternative 1, there would be no aircraft activity as part of training activities under Alternative 2 within the Western Behm Canal.

In general, bird populations consist of hundreds or thousands, ranging across a large geographical area. In this context, the loss of several or even dozens of birds due to physical strikes may not constitute a population-level effect. Bird exposure to strike potential would be relatively brief, as an aircraft quickly passes overhead. Seabirds actively avoid interaction with aircraft; however, disturbances of various seabird species may occur from aviation operations on a site-specific basis. As a standard operating procedure, aircraft avoid large flocks of birds to minimize the safety risk involved with a potential bird strike. As stated previously, birds are least at risk from aircraft or aerial target strike in the Offshore Area, primarily because of the different altitudes birds and aircraft typically occupy over the open ocean, the dispersed number of activities, and the relatively lower abundance of birds in the Offshore Area. Within inland waters, aircraft movements would generally occur at lower altitudes, which may elevate the risk of strike for birds. These aircraft, however, are primarily rotor-wing aircraft. Birds are expected to respond to other stimulus and avoid the helicopter, thus reducing the potential for strike. Therefore, the potential for strike of marbled murrelets within inshore waters is discountable, a conclusion supported in the USFWS 2016 Biological Opinion (U.S. Fish and Wildlife Service, 2016). The conclusions for aircraft strike under Alternative 2 training activities is the same as for Alternative 1.

Pursuant to the ESA, activities involving aircraft flights and aerial targets during training activities as described under Alternative 2 may affect the marbled murrelet, short-tailed albatross, northern spotted owl, streaked horned lark, and western snowy plover. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts of aircraft and aerial targets during training activities described under Alternative 2 would not result in a significant adverse effect on populations seabirds, shorebirds, and other birds protected under the MBTA.

Impacts from Aircraft and Aerial Targets Under Alternative 2 for Testing Activities

As shown in Table 3.0-11, the number of testing activities including aircraft movements under Alternative 2 would increase in the Offshore Area compared to what was analyzed previously in the 2015 NWTT Final EIS/OEIS and slightly increase compared to what is analyzed under Alternative 1. These increases would occur in the Offshore Area, with decreases in the Inland Waters portion of the Study Area; there would be no change within Western Behm Canal.

In general, bird populations consist of hundreds or thousands, ranging across a large geographical area. In this context, the loss of several or even dozens of birds due to physical strikes may not constitute a population-level effect. Bird exposure to strike potential would be relatively brief, as an aircraft quickly passes overhead. Seabirds actively avoid interaction with aircraft; however, disturbances of various seabird species may occur from aviation operations on a site-specific basis. As a standard operating procedure, aircraft avoid large flocks of birds to minimize the safety risk involved with a potential bird strike. As stated previously, birds are least at risk from aircraft or aerial target strike in the Offshore Area, primarily because of the different altitudes birds and aircraft typically occupy over the open ocean, the dispersed number of activities, and the relatively lower abundance of birds in the Offshore Area. Within inland waters, aircraft movements would generally occur at lower altitudes, which may elevate the risk of strike for birds. These aircraft, however, are primarily rotor-wing aircraft. Birds are expected to respond to other stimulus and avoid the helicopter, thus reducing the potential for strike. Therefore, the potential for strike of marbled murrelets within inshore waters is discountable, a conclusion supported in the USFWS 2016 Biological Opinion (U.S. Fish and Wildlife Service, 2016). The conclusions for aircraft strike under Alternative 2 testing activities is the same as for Alternative 1.

Pursuant to the ESA, activities involving aircraft flights and aerial targets during testing activities as described under Alternative 2 may affect the marbled murrelet, short-tailed albatross, northern spotted owl, streaked horned lark, and western snowy plover. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts of aircraft and aerial targets during testing activities described under Alternative 2 would not result in a significant adverse effect on populations seabirds, shorebirds, and other birds protected under the MBTA.

3.6.2.4.1.3 Impacts from Aircraft and Aerial Targets 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. Other military activities not associated with this Proposed Action would continue to occur. Aircraft and aerial targets as listed above would not be introduced into the affected marine environment or areas over land. 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 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 aircraft and aerial targets on individual birds, but would not measurably improve the status of bird populations.

3.6.2.4.2 Impacts from Vessels and In-Water Devices

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. 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 10,300 commercial vessel transits in 2017 associated with visits to just those ports (The Northwest Seaport Alliance, 2018; Vancouver Fraser Port Authority, 2017). This information is summarized in Chapter 4 (Cumulative Impacts) of this Supplemental.

3.6.2.4.2.1 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 number of proposed training activities involving the movement of vessels or the use of in-water devices would remain generally consistent with those proposed in the 2015 NWTT Final EIS/OEIS (these comparisons are shown in Table 3.0-12 and Table 3.0-13 of this Supplemental). Vessel movement would decrease in the Offshore Area and decrease in Inland Waters, resulting in a small net decrease in activities in the Study Area. No vessel movements would occur as part of training activities within the Western Behm Canal. 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. The increases under Alternative 1 would occur in the Offshore Area and Inland Waters portions of the Study Area, with no use of in-water devices proposed under Alternative 1 occurring in the Western Behm Canal.

While some potential exists for birds to be struck by vessels or in-water devices as they are foraging, resting, or flying near the water surface, most birds would be expected to see or hear an oncoming vessel or device and to fly or swim away to avoid a potentially harmful encounter. Injury or mortality could occur if a bird were struck, but most bird encounters with vessels or in-water devices would be expected to result in a brief behavioral and physiological response, such as alert response, startle response, or fleeing the immediate area. Birds would be expected to resume normal behavior soon after the vessel or in-water device passed through the area and the fitness of individual birds would not be compromised. There could be a slightly increased risk of impacts during the winter or during fall/spring migrations when migratory birds are concentrated in coastal areas. Despite this concentration, most birds would still be able to avoid collisions.

Shorebirds and inland birds (streaked horned lark, western snowy plover, and northern spotted owls) are not analyzed for potential impacts resulting from vessels and in-water devices because these species are not expected to be over water where vessels would transit. Marbled murrelets and short-tailed albatrosses, however, are analyzed for potential impacts resulting from vessels and in-water devices.

Marbled murrelet. Marbled murrelets could encounter vessels or in-water devices during training and testing activities, but strikes are extremely unlikely. Murrelets' responses to vessel operation could include diving, swimming away from a vessel, or abandoning a foraging area. However, the potential for behavioral effects from Navy vessel movements are low because the training and testing events are transitory in time, with few vessels moving over large areas. In addition, if behavioral disruptions result from the vessel operation, they are expected to be temporary. Murrelets are expected to resume their resting, breeding, and foraging bouts with minimal disruption. Therefore, effects are expected to be insignificant.

Short-tailed-albatross. Given the proposed timing, location, and frequency of training in the Offshore Area, and the small number of short-tailed albatross that are likely to occur in the Offshore Area at any given time, it is extremely unlikely that individual albatross would co-occur with Navy vessels or in-water devices. Therefore, the effects of vessel and in-water device strikes on short-tailed albatross would be discountable.

Pursuant to the ESA, training activities that use vessels and in-water devices, as described under Alternative 1, would have no effect on the northern spotted owl, streaked horned lark, or western snowy plover. Vessel and in-water device strikes from training activities under Alternative 1 may affect the ESA-listed marbled murrelet or short-tailed albatross. The Navy will consult with the USFWS, as required by section 7(a)(2) of the ESA. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from vessels and in-water devices during training activities described under Alternative 1 would not result in a significant adverse effect on migratory bird populations.

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

Under Alternative 1, the number of proposed testing activities involving the movement of vessels or the use of in-water devices would increase compared to those proposed in the 2015 NWTT Final EIS/OEIS (see Table 3.0-12 and Table 3.0-13 for a comparison of what was analyzed in the 2015 NWTT Final EIS/OEIS to what is proposed in this Supplemental). While vessel movement would increase significantly in the Offshore Area (from 181 to 283 annual activities), it would increase in both Inland Waters (from 916 to 918) and Western Behm Canal (63 to 77), resulting in a net increase in the Study Area. There is also an overall increase in the use of in-water devices (Table 3.0-13). 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). This small increase in testing activity numbers would not appreciably change the analysis included in the 2015 NWTT Final EIS/OEIS, with the impact descriptions the same as described under Alternative 1 training activities.

Pursuant to the ESA, testing activities that use vessels and in-water devices, as described under Alternative 1, would have no effect on the northern spotted owl, streaked horned lark, or western snowy plover. Vessel and in-water device strikes from testing activities under Alternative 1 may affect the ESA-listed marbled murrelet or short-tailed albatross. The Navy will consult with the USFWS, as required by section 7(a)(2) of the ESA. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from vessels and in-water devices during testing activities described under Alternative 1 would not result in a significant adverse effect on migratory bird populations.

3.6.2.4.2.2 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 number of proposed training activities involving the movement of vessels or the use of in-water devices would remain generally consistent with those proposed in the 2015 NWTT Final EIS/OEIS (see Table 3.0-12 and Table 3.0-13 for a comparison of what was analyzed in the 2015 NWTT Final EIS/OEIS to what is proposed in this Supplemental). Vessel movement would decrease slightly in the Study Area (Table 3.0-12), and there is an overall increase in the use of in-water devices (Table 3.0-13). Compared to Alternative 1, Alternative 2 would slightly increase vessel and in-water device use.

As with Alternative 1, the activities described under Alternative 2 in this Supplemental would not be sufficient to modify the vessel and in-water device strike conclusions for seabird species provided in the 2015 NWTT Final EIS/OEIS. Therefore, the conclusions for ESA-listed seabird species and other seabird species protected by the MBTA that were included in the 2015 NWTT Final EIS/OEIS remain valid. During Section 7 ESA consultation between the Navy and USFWS, the Navy determined that the activities described in the 2015 NWTT Final EIS/OEIS may affect, but are not likely to adversely affect the marbled murrelet or short-tailed albatross, and would have no effect on the northern spotted owl, streaked horned lark, or western snowy plover.

Pursuant to the ESA, training activities that use vessels and in-water devices, as described under Alternative 2, would have no effect on the northern spotted owl, streaked horned lark, or western snowy plover. Vessel and in-water device strikes from training activities under Alternative 2 may affect the ESA-listed marbled murrelet or short-tailed albatross. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from vessels and in-water devices during training activities described under Alternative 2 would not result in a significant adverse effect on migratory bird populations.

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

Under Alternative 2, the number of proposed testing activities involving the movement of vessels or the use of in-water devices would increase compared to those proposed in the 2015 NWTT Final EIS/OEIS (see Table 3.0-12 and Table 3.0-13 for a comparison of what was analyzed in the 2015 NWTT Final EIS/OEIS to what is proposed in this Supplemental). Compared to the previous 2015 analysis, vessel movement under Alternative 2 would increase in the Offshore Area (from 181 to 285 annual activities), increase in the Inland Waters (from 916 to 1,028), and increase in the Western Behm Canal (from 60 to 77), resulting in an increase in the Study Area. There is also an overall increase in the use of in-water devices (Table 3.0-13). Compared to Alternative 1, Alterative 2 would slightly increase vessel and in-water device use.

As with Alternative 1, the testing activities described under Alternative 2 in this Supplemental would not be sufficient to modify the vessel and in-water device strike conclusions for bird species provided in the

2015 NWTT Final EIS/OEIS. Therefore, the conclusions for ESA-listed seabird species and other seabird species protected by the MBTA that were included in the 2015 NWTT Final EIS/OEIS remain valid.

Pursuant to the ESA, testing activities that use vessels and in-water devices, as described under Alternative 2, would have no effect on the northern spotted owl, streaked horned lark, or western snowy plover. Vessel and in-water device strikes from testing activities under Alternative 2 may affect the ESA-listed marbled murrelet or short-tailed albatross. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from vessels and in-water devices during testing activities described under Alternative 2 would not result in a significant adverse effect on migratory bird populations.

3.6.2.4.2.3 Impacts from Vessels and In-Water Devices 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. Other military activities not associated with this Proposed Action would continue to occur. Vessels and in-water devices 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 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 vessels and in-water devices on individual birds, but would not measurably improve the status of bird populations.

3.6.2.4.3 Impacts from Military Expended Materials

For the analysis of impacts from military expended material as physical disturbance stressors, see Section 3.6.3.2.3 (Impacts from Military Expended Materials) in 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 impacts from military expended material as presented in the 2015 analyses. There have been no known instances of physical disturbance or strike to any marine bird 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.

3.6.2.4.3.1 Impacts from Military Expended Materials Under Alternative 1

Impacts from Military Expended Materials Under Alternative 1 for Training Activities

Under Alternative 1, 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 3.0-16) are combined, the number of items proposed to be expended under Alternative 1 decreases compared to ongoing activities (from a total of 187,016 to 170,754 items). The activities that expend military materials would occur in the same locations and in a similar manner as were analyzed previously. For example, Table 5.3-13 includes lookout-based procedural mitigation measures that establishes a 200--yard mitigation zone around the intended impact location, pre-activity observations for seabirds, observations of seabirds during the activity, and procedures that allow a sighted seabird to leave the area prior to beginning or recommencing a firing activity. While the number of training activities using military expended material would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS and the USFWS Biological Opinion for the 2015 NWTT Final EIS/OEIS (U.S. Fish and Wildlife Service, 2016) remain valid; physical disturbance and strike impacts on birds resulting from military expended materials are not anticipated.

Pursuant to the ESA, training activities that release military expended materials, as described under Alternative 1, would have no effect on the northern spotted owl, streaked horned lark, or western snowy plover. Release of military expended materials during training activities under Alternative 1 may affect the ESA-listed marbled murrelet or short-tailed albatross. The Navy will consult with the USFWS, as required by section 7(a)(2) of the ESA. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from military expended materials during training activities described under Alternative 1 would not result in a significant adverse effect on migratory bird populations.

Impacts from Military Expended Materials Under Alternative 1 for Testing Activities

Under Alternative 1, the number of military materials that would be expended during testing 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 Table 3.0-14 through Table 3.0-16 in this Supplemental are combined, the number of items proposed to be expended under Alternative 1 increases compared to ongoing activities (from a total of 8,130 to 10,710 items). The activities that expend military materials would occur in the same locations and in a similar manner as were analyzed previously. While the number of testing activities using military expended material would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS and the USFWS Biological Opinion for the 2015 NWTT Final EIS/OEIS (U.S. Fish and Wildlife Service, 2016) remain valid; physical disturbance and strike impacts on marine birds resulting from military expended materials are not expected.

Pursuant to the ESA, testing activities that release military expended materials, as described under Alternative 1, would have no effect on the northern spotted owl, streaked horned lark, or western snowy plover. Release of military expended materials during testing activities under Alternative 1 may affect the ESA-listed marbled murrelet or short-tailed albatross. The Navy will consult with the USFWS, as required by section 7(a)(2) of the ESA. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from military expended materials during testing activities described under Alternative 1 would not result in a significant adverse effect on migratory bird populations.

3.6.2.4.3.2 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 Table 3.0-14 through Table 3.0-16 of this Supplemental are combined, the number of items proposed to be expended under Alternative 2 increases compared to ongoing activities (from a total of 187,016 to 196,629 items). Compared to Alternative 1, there would be an overall increase in the number of items expended under Alternative 2. While the number of testing activities using military expended material would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS and the USFWS Biological Opinion for the 2015 NWTT Final EIS/OEIS (U.S. Fish and Wildlife Service, 2016) remain valid; physical disturbance and strike impacts on birds resulting from military expended materials are not expected.

Pursuant to the ESA, training activities that release military expended materials, as described under Alternative 2, would have no effect on the northern spotted owl, streaked horned lark, or western snowy plover. Release of military expended materials during training activities under Alternative 2 may affect the ESA-listed marbled murrelet or short-tailed albatross. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from military expended materials during training activities described under Alternative 2 would not result in a significant adverse effect on migratory bird populations.

Impacts from Military Expended Materials Under Alternative 2 for Testing Activities

Under Alternative 2, the number of military materials that would be expended during testing 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 Table 3.0-14 through Table 3.0-16 are combined, the number of items proposed to be expended under Alternative 2 increases compared to ongoing activities and would increase compared to what is proposed under Alternative 1 (by approximately 3,000 total items).

While the number of testing activities using military expended material would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS and the USFWS Biological Opinion for the 2015 NWTT Final EIS/OEIS (U.S. Fish and Wildlife Service, 2016) remain valid; physical disturbance and strike impacts on birds resulting from military expended materials are not expected.

Pursuant to the ESA, testing activities that release military expended materials, as described under Alternative 2, would have no effect on the northern spotted owl, streaked horned lark, or western snowy plover. Release of military expended materials during testing activities under Alternative 2 may affect the ESA-listed marbled murrelet or short-tailed albatross. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from military expended materials during testing activities described under Alternative 2 would not result in a significant adverse effect on migratory bird populations.

3.6.2.4.3.3 Impacts from Military Expended Materials 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. Other military activities not associated with this Proposed Action would continue to occur. Military expended materials 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 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 military expended materials on individual birds, but would not measurably improve the status of bird populations.

3.6.2.4.4 Entanglement Stressors

In the 2015 NWTT Final EIS/OEIS, the Navy did not analyze potential impacts on birds from entanglement stressors. The USFWS, however, decided the analysis of entanglement stressors was warranted and included this analysis in the 2016 Biological Opinion. Entanglement stressors were not analyzed in the 2015 NWTT EIS/OEIS because wires and cables and decelerators/parachutes (the types materials analyzed for potential entanglement of other marine animals) were determined to be an extremely low risk for marine birds. Certain activities and their associated stressors take place in specific locations or depth zones within the Study Area outside the range or foraging abilities of most birds. The USFWS analyzed the potential for entanglement of expended materials during training and testing activities and determined that the risk was discountable for marbled murrelets and short-tailed albatross for the following reasons: (1) guidance wires and fiber optic cables would rapidly sink in the water column; (2) decelerators and parachutes have weights and metal clips attached to them that facilitate their descent to the seafloor and minimize the time when entanglement could occur; and (3) items at risk for entanglement of murrelets and albatrosses are expended from moving objects (e.g., torpedoes, unmanned underwater vehicles), which are likely avoided by birds).

Since the publication of the 2015 NWTT Final EIS/OEIS, a new type of expended material is used during the existing countermeasure testing activity that involves the use of biodegradable polymers. The biodegradable polymers that the Navy uses are designed to temporarily interact with the propeller(s) of a target craft, rendering it ineffective. Based on the constituents of the biodegradable polymer the Navy proposes to use, it is anticipated that the material will breakdown into small pieces within a few days to weeks. This will breakdown further and dissolve into the water column within weeks to a few months. The final products which are all environmentally benign will be dispersed quickly to undetectable concentrations. Unlike other entanglement stressors, biodegradable polymers only retain their strength for a relatively short period of time, therefore the potential for entanglement by a marine bird would be limited. Furthermore, the longer the biodegradable polymer remains in the water, the weaker it becomes making it more brittle and likely to break. A marine bird would have to encounter the biodegradable polymer immediately after it was expended for it to be a potential entanglement risk. If an animal were to encounter the polymer a few hours after it was expended, it is very likely that it would break easily and would no longer be an entanglement stressor. The use of biodegradable polymers is included as a new testing activity in this Supplemental and is analyzed in the following sections.

3.6.2.4.4.1 Impacts from Biodegradable Polymers Under Alternative 1

Impacts from Military Expended Materials Under Alternative 1 for Training Activities

There are no training activities under Alternative 1 that use biodegradable polymers.

Impacts from Military Expended Materials Under Alternative 1 for Testing Activities

As shown in Table 3.0-21, four testing activities involving the use of biodegradable polymers are proposed to be conducted in the Inland Waters under Alternative 1 in the DBRC and the Keyport Range. The impact of biodegradable polymers on marine birds would be inconsequential because biodegradable polymers only retain their strength for a relatively short period of time, and a marine bird would have to encounter the biodegradable polymer immediately after it was expended for it to be a potential entanglement risk. It is possible for any marine bird species inhabiting the Inland Waters portion of the Study Area to be at either of those two locations.

Pursuant to the ESA, testing activities that release biodegradable polymers, as described under Alternative 1, would have no effect on the northern spotted owl, streaked horned lark, western snowy plover, or short-tailed albatross. Release of biodegradable polymers during testing activities under Alternative 1 may affect the ESA-listed marbled murrelet. The Navy will consult with the USFWS, as required by section 7(a)(2) of the ESA. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from biodegradable polymers released during testing activities described under Alternative 1 would not result in a significant adverse effect on migratory bird populations.

The number of proposed testing activities involving biodegradable polymers in the Inland Waters is relatively low. Based on this limited number of annual activities, the concentration of biodegradable polymers within the two Inland Waters locations of the Study Area would likewise be low, and the Navy does not anticipate that any marine birds would become entangled by biodegradable polymers.

3.6.2.4.4.2 Impacts from Biodegradable Polymers Under Alternative 2

Impacts from Military Expended Materials Under Alternative 2 for Training Activities

There are no training activities under Alternative 2 that use biodegradable polymers.

Impacts from Military Expended Materials Under Alternative 2 for Testing Activities

Biodegradable polymers were not part of the proposed action analyzed in the 2015 NWTT Final EIS/OEIS. The proposed use of biodegradable polymers under Alternative 2 in this Supplemental is the same as under Alternative 1 (see Table 3.0-21 for a comparison of what was analyzed in the 2015 NWTT Final EIS/OEIS to what is proposed in this Supplemental). As a result, the expected impacts are the same between the two alternatives and as described in detail above under Alternative 1; Navy does not anticipate that any marine birds would become entangled by biodegradable polymers.

Pursuant to the ESA, testing activities that release biodegradable polymers, as described under Alternative 2, would have no effect on the northern spotted owl, streaked horned lark, western snowy plover, or short-tailed albatross. Release of biodegradable polymers during testing activities under Alternative 2 may affect the ESA-listed marbled murrelet. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from biodegradable polymers released during testing activities described under Alternative 2 would not result in a significant adverse effect on migratory bird populations.

3.6.2.4.4.3 Impacts from Biodegradable Polymers Under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, proposed training and testing activities would not occur. Other military activities not associated with this Proposed Action would continue to occur. Biodegradable polymers 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 training and testing activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would lessen the potential for entanglement on individual marine birds, but would not measurably improve the status of bird populations.

3.6.2.4.5 Ingestion Stressors

As discussed in Section 3.6.3.3 (Ingestion Stressors) of the 2015 NWTT Final EIS/OEIS, a variety of ingestible materials may be released into the marine environment by Navy training and testing activities. Unrecovered materials from the Navy's training and testing activities that that could float at or below the surface include chaff fibers, plastic end caps and pistons from flares, plastic end caps and pistons from chaff cartridges, fragments of missiles (rubber, carbon, or Kevlar fibers), and fragments of targets. Plastic end caps and pistons from flares and chaff cartridges may float for some period of time. The ingestions stressor that may impact marine birds is a broad category of military expended materials other than munitions, that includes fragments from targets, chaff and flare components, and biodegradable polymers) as detailed in Section 3.0.3.6 (Ingestion Stressors) in this Supplemental.

The 2015 NWTT Final EIS/OEIS discounted the potential of military expended materials from munitions (non-explosive practice munitions and fragments from high-explosives) as a potential ingestion stressor because military expended material from munitions is not expected to occur because the solid metal and heavy plastic objects from these ordnances sink rapidly to the seafloor, beyond the foraging depth range of most birds. The analysis for potential ingestion stressors in the 2015 NWTT Final EIS/OEIS also discounted decelerator/parachutes as an ingestion stressor because these items likely remain on the surface, but sink rapidly because of metal components attached to the decelerator/parachute. In the USFWS 2016 Biological Opinion, the USFWS agreed with the Navy in discounting military expended materials from munitions and decelerator/parachutes and determined that potential impacts on marbled murrelets would be discountable (unlikely to occur) from ingestion stressors. The USFWS, however, determined in their 2016 biological opinion that short-tailed albatrosses would likely experience adverse effects from potentially ingestible military expended materials other than munitions (U.S. Fish and Wildlife Service, 2016).

3.6.2.4.5.1 Impacts from Ingestion Stressors (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 (see Table 3.0-15, 3.0-17, Table 3.0-20, Table 3.0-21, and Table 3.0-22 for a comparison of what was analyzed in the 2015 NWTT Final EIS/OEIS to what is proposed in this Supplemental). When the amount of military expended materials other than munitions (fragments from targets, chaff and flare components, and biodegradable polymers) 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 would change under this Supplemental, the analysis presented in Section 3.6.3.3 (Ingestion Stressors) in the 2015 NWTT Final EIS/OEIS and the USFWS Biological Opinion for the 2015 NWTT Final EIS/OEIS (U.S. Fish and Wildlife Service, 2016) would not change. The USFWS determined that potential impacts on marbled murrelets from ingestion stressors would be discountable (unlikely to occur), and that the short-tailed albatross would likely experience adverse effects through the introduction of plastic debris in the action area.

Pursuant to the ESA, training activities that release military expended materials – other than munitions, as described under Alternative 1, would have no effect on the northern spotted owl, streaked horned lark, or western snowy plover. Release of military expended materials – other than munitions during training activities under Alternative 1 may affect the ESA-listed marbled murrelet and short-tailed albatross. The Navy will consult with the USFWS, as required by section 7(a)(2) of the ESA. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from military expended materials – other than munitions released during training activities described under Alternative 1 would not result in a significant adverse effect on migratory bird populations.

Impacts from Military Expended Materials, Other Than Munitions, Under Alternative 1 for Testing Activities

Under Alternative 1 and as presented in Section 3.0 (Introduction, see Table 3.0-15, Table 3.0-17, Table 3.0-20, Table 3.0-21, and Table 3.0-22 for a comparison of what was analyzed in the 2015 NWTT Final EIS/OEIS to what is proposed in this Supplemental), testing use of military expended materials – other than munitions will increase in comparison to ongoing activities and as discussed in the 2015 NWTT Final EIS/OEIS. This includes testing activities that use biodegradable polymers, which are proposed to be conducted in the DBRC, Keyport Range, and Hood Canal. The number of proposed testing activities involving biodegradable polymers is relatively low (a maximum of four times annually), as shown in Section 3.0.3.5.3 (Biodegradable Polymer), Table 3.0-21. As stated previously, biodegradable polymers would be used in some testing activities and were not analyzed in the 2015 document. Biodegradable polymers could theoretically be ingested by birds; however, the likelihood is low because testing activities that use biodegradable polymers would only occur in Hood Canal, Keyport Range, and Dabob Bay (only birds foraging in these waters would potentially ingest biodegradable polymers), the material would persist only until the polymer degrades, generally within days to weeks of deployment. Because the final products of the breakdown are all environmentally benign, the Navy does not expect the use biodegradable polymer to have any negative impacts for marine birds.

While testing use of military expended material would change under this Supplemental, the analysis presented in Section 3.6.3.3 (Ingestion Stressors) in the 2015 NWTT Final EIS/OEIS and the USFWS Biological Opinion for the 2015 NWTT Final EIS/OEIS (U.S. Fish and Wildlife Service, 2016) would not change. The USFWS determined that potential impacts on marbled murrelets from ingestion stressors would be discountable (unlikely to occur), and that the short-tailed albatross would likely experience adverse effects through the introduction of plastic debris in the action area. Because biodegradable polymers would only be expended in Inland Waters, only the marbled murrelet would be potentially exposed to biodegradable polymers as an ingestion stressor.

Pursuant to the ESA, testing activities that release military expended materials – other than munitions, as described under Alternative 1, would have no effect on the northern spotted owl, streaked horned lark, or western snowy plover. Biodegradable polymers (a new testing activity) would have no effect on the short-tailed albatross. Release of military expended materials – other than munitions during testing activities under Alternative 1 may affect the ESA-listed marbled murrelet and short-tailed albatross. The Navy will consult with the USFWS, as required by section 7(a)(2) of the ESA. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from military expended materials – other than munitions released during testing activities described under Alternative 1 would not result in a significant adverse effect on migratory bird populations.

3.6.2.4.5.2 Impacts 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, see Table 3.0-15, Table 3.0-17, Table 3.0-20, Table 3.0-21, and Table 3.0-22 for a comparison of what was analyzed in the 2015 NWTT Final EIS/OEIS to what is proposed in this Supplemental), training use of military expended materials – other than munitions increases in comparison to ongoing activities and Alternative 1. The new biodegradable polymers ingestion sub stressor would not be used during training activities under Alternative 2. While training use of military expended material would change under this Supplemental, the analysis presented in Section 3.6.3.3 (Ingestion Stressors) in the 2015 NWTT Final EIS/OEIS and the USFWS Biological Opinion for the 2015 NWTT Final EIS/OEIS (U.S. Fish and Wildlife Service, 2016) would not change. The USFWS determined that potential impacts on marbled murrelets from ingestion stressors would be discountable (unlikely to occur), and that the short-tailed albatross would likely experience adverse effects through the introduction of plastic debris in the action area.

Pursuant to the ESA, training activities that release military expended materials – other than munitions, as described under Alternative 2, would have no effect on the northern spotted owl, streaked horned lark, or western snowy plover. Release of military expended materials – other than munitions during training activities under Alternative 2 may affect the ESA-listed marbled murrelet and short-tailed albatross. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from military expended materials – other than munitions released during training activities described under Alternative 2 would not result in a significant adverse effect on migratory bird populations.

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, see Table 3.0-15, Table 3.0-17, Table 3.0-20, Table 3.0-21, and Table 3.0-22 for a comparison of what was analyzed in the 2015 NWTT Final EIS/OEIS to what is proposed in this Supplemental), testing use of military expended materials – other than munitions will increase in comparison to ongoing activities and are the same as proposed under Alternative 1 in this Supplemental. Given the alternatives are the same and as presented above for Alternative 1 for testing, the conclusions are the same. Impacts from ingestion stressors from the use of military expended materials – other than munitions are not expected.

Pursuant to the ESA, testing activities that release military expended materials – other than munitions, as described under Alternative 2, would have no effect on the northern spotted owl, streaked horned lark, or western snowy plover. Release of military expended materials – other than munitions during testing activities under Alternative 2 may affect the ESA-listed marbled murrelet and short-tailed albatross. There would be no effect on critical habitat designations for the marbled murrelet, northern spotted owl, streaked horned lark, or western snowy plover.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from military expended materials – other than munitions released during testing activities described under Alternative 2 would not result in a significant adverse effect on migratory bird populations.

3.6.2.4.6 Impacts from Military Expended Materials – Other Than Munitions 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. Other military activities not associated with this Proposed Action would continue to occur. Military expended materials –other than munitions 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 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 military expended materials on individual birds, but would not measurably improve the status of bird populations.

3.6.2.5 Secondary Stressors (Impacts on Habitat; Impacts on Prey Availability)

Stressors from training and testing activities could pose secondary or indirect impacts on birds via habitat, sediment, and water quality. These include (1) impacts on habitats for birds, and (2) impacts on prey availability.

While the number of training and testing activities would change under this supplement, the analysis presented in the 2015 NWTT Final EIS/OEIS, Section 3.6.3.4 (Secondary Stressors) remains valid. The changes in training and testing activities are not substantial and would not result in an overall change to existing environmental conditions or an increase in the level or intensity of secondary stressors within the Study Area.

As stated in the 2015 NWTT Final EIS/OEIS, indirect impacts of explosives and unexploded ordnance on birds via water could not only cause physical impacts, but prey items (e.g., fishes) might also have behavioral reactions to underwater sound. For example, the sound from underwater explosions might induce startle reactions and temporary dispersal of schooling fishes if they are within close proximity. The abundances of fish and invertebrate prey species near the detonation point could be diminished for a short period of time before being repopulated by animals from adjacent waters. Secondary impacts from underwater explosions would be temporary, and no lasting impact on prey availability or the pelagic food web would be expected. Indirect impacts of underwater detonations and explosive ordnance use under the proposed action would not result in a decrease in the quantity or quality of bird populations or habitats, or prey species and habitats, in the Study Area.

Certain metals are harmful to prey items at concentrations above background levels (e.g., cadmium, chromium, lead, mercury, zinc, copper, manganese, and many others) (Wang & Rainbow, 2008). Metals are introduced into seawater and sediments as a result of Navy training and testing activities involving vessel hulks, targets, ordnance, munitions, and other military expended materials. Indirect impacts of metals on birds consuming prey items through the food chain involve concentrations that are several orders of magnitude lower than concentrations achieved via bioaccumulation. Fishes may be exposed by contact with the metal, contact with contaminants in the sediment or water, and ingestion of contaminated sediments. Concentrations of metals in sea water are orders of magnitude lower than concentrations in marine sediments. It is extremely unlikely that birds would be indirectly impacted by toxic metals via the water.

Any effects to birds are not anticipated to be harmful or severe because of (1) the temporary nature of impacts on water or air quality, (2) the distribution of temporary water or air quality impacts, (3) the wide distribution of birds in the Study Area, and (4) the dispersed spatial and temporal nature of the training and testing activities that may have temporary water or air quality impacts. No long-term or population-level impacts are expected.

Pursuant to the ESA, secondary impacts on prey availability during training or testing activities as described under Alternative 1 and Alternative 2 would have no effect on the northern spotted owl, streaked horned lark, or western snowy plover. Secondary impacts may affect the marbled murrelet and short-tailed albatross. The Navy will consult with the USFWS, as required by section 7(a)(2) of the ESA for secondary stressors under Alternative 1.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from secondary stressors would not result in a significant adverse effect on migratory bird populations.

3.6.2.6 Critical Habitat Determinations

The 2015 NWTT Final EIS/OEIS contained critical habitat determinations. Critical habitat has not changed for any of the species considered, and as stated in the analysis above, no activities have increased, decreased, or changed significantly enough to alter the conclusions from the 2015 NWTT Final EIS/OEIS; therefore, those conclusions remain valid for this Supplemental. The Navy has determined that the Alternatives 1 and 2 would have no effect on designated critical habitat for the marbled murrelet, northern spotted owl, streaked horned lark, or the western snowy plover. Critical habitat has not been designated or proposed for the short-tailed albatross.

3.6.2.7 Migratory Bird Treaty Act Determinations

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from stressors introduced during training and testing activities would not result in a significant adverse effect on migratory bird populations.

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