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

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3.7 Marine Mammals

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

- Acoustics: Navy training and testing activities have the potential to expose marine mammals to multiple acoustic stressors. Exposure to sound-producing activities presents risks to marine mammals that could include temporary or permanent hearing threshold shift, auditory masking, physiological stress, or behavioral responses. Because individual animals would typically only experience a small number of behavioral responses or temporary hearing threshold shifts per year from exposure to acoustic stressors and are unlikely to incur substantive costs to the individual, population level effects are unlikely.
- Explosives: Explosions underwater or near the 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. Beyond the zone of injury, the impulsive, broadband noise introduced into the marine environment may cause temporary or permanent hearing threshold shift, auditory masking, physiological stress, or behavioral responses. Because most estimated impacts from explosions are behavioral responses or temporary threshold shifts (TTS) and because the number of marine mammals potentially impacted by explosives is small compared to each species' respective abundance, population level effects are unlikely.
- Energy: Navy training and testing activities have the potential to expose marine mammals to multiple energy stressors. The likelihood and magnitude of energy impacts depend on the proximity of marine mammals to energy stressors. 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 marine mammal migrating behaviors and navigational patterns are not anticipated. Potential impacts from high-energy lasers would only result for marine mammals directly struck by the laser beam. Statistical probability analyses demonstrate with a high level of certainty that no marine mammals would be struck by a high-energy laser. Energy stressors associated with Navy training and testing activities are temporary and localized in nature and, based on patchy distribution of animals, no impacts to individual marine mammals and marine mammal populations are anticipated.
- Physical Disturbance and Strike: Marine mammals would potentially be exposed to multiple physical disturbance and strike stressors associated with Navy training and testing activities. The potential for impacts relies heavily on the probability that marine mammals would be in close proximity to a physical disturbance and strike stressor (e.g., a vessel or a non-explosive munition). Historical data on Navy ship strike records demonstrate a low occurrence of interactions with marine mammals over the last 10 years. Since the Navy does not anticipate a change in the level of vessel use compared to the last decade, the potential for striking a marine mammal remains low. Physical disturbance due to vessel movement and in-water devices of

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- Physical Disturbance and Strike (continued): individual marine mammals may also occur, but any stress response of avoidance behavior would not be severe enough to have long-term fitness consequences for individual marine mammals. The use of in-water devices during Navy activities involves multiple types of vehicles or towed devices traveling on the water surface, through the water column, or along the seafloor, all of which having the potential to disturb or physically strike marine mammals. No recorded or reported instances of marine mammal strikes have resulted from in-water devices; therefore, impacts to individuals or long-term consequences to marine mammal populations are not anticipated. Potential physical disturbance and strike impacts from military expended materials and seafloor devices are determined through statistical probability analyses. Results for each of these physical disturbance and strike stressors suggest a very low potential for marine mammals to be struck by any of these items. Long-term consequences to marine mammal populations from physical disturbance and strike stressors associated with Navy training and testing activities are not anticipated.
- Entanglement: Marine mammals could be exposed to multiple entanglement stressors associated with Navy training and testing activities. The potential for impacts is dependent on the physical properties of the expended materials and the likelihood that a marine mammal would encounter a potential entanglement stressor and then become entangled in it. Physical characteristics of wires and cables, decelerators/parachutes, and biodegradable polymers combined with the sparse distribution of these items throughout the Study Area indicate a very low potential for marine mammals to encounter and become entangled in them. Long-term impacts to individual marine mammals and marine mammal populations from entanglement stressors associated with Navy training and testing activities are not anticipated.
- Ingestion: Navy training and testing activities have the potential to expose marine mammals to multiple ingestion stressors and associated impacts. The likelihood and magnitude of impacts depend on the physical properties of the military expended items, the feeding behaviors of marine mammals that occur in the Study Area, and the likelihood that a marine mammal would encounter and incidentally ingest the items. Adverse impacts from ingestion of military expended materials would be limited to the unlikely event that a marine mammal would be harmed by ingesting an item that becomes embedded in tissue or is too large to be passed through the digestive system. The likelihood that a marine mammal would encounter and subsequently ingest a military expended item associated with Navy training and testing activities is considered low. Long-term consequences to marine mammal populations from ingestion stressors associated with Navy training and testing activities are not anticipated.
- Secondary: Marine mammals could be exposed to multiple secondary stressors (indirect stressors to habitat or prey) associated with Navy training and testing activities in the Study Area. In-water explosions have the potential to injure or kill prey species that marine mammals feed on within a small area affected by the blast; however, impacts would not substantially impact prey availability for marine mammals. Explosion byproducts and unexploded munitions would have no meaningful effect on water or sediment quality; therefore, they are not

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- Secondary (continued): considered to be secondary stressors for marine mammals. Metals are introduced into the water and sediments from multiple types of military expended materials. Available research indicates metal contamination is very localized and that bioaccumulation resulting from munitions would not occur. Several Navy training and testing activities introduce chemicals into the marine environment that are potentially harmful in concentration; however, through rapid dilution, toxic concentrations are unlikely to be encountered by marine mammals. Furthermore, bioconcentration or bioaccumulation of chemicals introduced by Navy activities to levels that would significantly alter water quality and degrade marine mammal habitat has not been documented. The Navy's use of marine mammals is not likely to increase the risk of transmitting diseases or parasites to wild marine mammals. Secondary stressors from Navy training and testing activities in the Study Area are not expected to have short-term impacts on individual marine mammals or long-term impacts on marine mammal populations.

3.7.1 Introduction

In this Environmental Impact Statement (EIS)/Overseas EIS (OEIS), potential impacts to marine mammals are evaluated based on their distribution and ecology relative to the stressor or activity being considered. Activities are evaluated for their potential impact on marine mammals in general, on taxonomic groupings of marine mammals as appropriate, and on species listed under the Endangered Species Act (ESA) in the Atlantic Fleet Training and Testing (AFTT) Study Area.

The following subsections provide introductions to marine mammal species that occur in the Study Area. General information relevant to all marine mammal species is provided in Section 3.7.2.1 (General Background) followed by subsections that discuss the status, habitats, population trends, predator-prey interactions, and species-specific threats. The complete analysis and summary of potential impacts of the proposed training and testing activities on marine mammals is found in Section 3.7.3 (Environmental Consequences) and Section 3.7.4 (Summary of Potential Impacts on Marine Mammals).

3.7.2 Affected Environment

3.7.2.1 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, 2016).

All marine mammals in the United States (U.S.) are protected under the Marine Mammal Protection Act (MMPA), and some species receive additional protection under the ESA. Within the framework of the MMPA, a marine mammal "stock" is defined as "a group of marine mammals of the same species or smaller taxon (subspecies) in a common spatial arrangement that interbreed when mature" (16 United States Code [U.S.C.] section 1362). Per 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" (National Marine Fisheries Service, 2016a). However, in practice, recognized management stocks may fall short of this ideal because of a lack of information or, in some cases, stocks may even include multiple species in a management unit, such as with *Mesoplodon* species (spp.) (beaked whales) and the two *Kogia* spp. (dwarf and pygmy sperm whales) occurring in the AFTT Study Area (Waring et al., 2016).

The ESA provides for listing species, subspecies, or distinct population segments 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 (61 *Federal Register* 4722, February 7, 1996) defines a distinct population segment as, "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." If a population meets the criteria to be identified as a distinct population segment, it is eligible for listing under the ESA as a separate species (National Marine Fisheries Service, 2016a). MMPA stocks do not necessarily coincide with distinct population segments under the ESA (81 *Federal Register* 62660–62320, September 8, 2016).

There are 48 marine mammal species known to exist in the AFTT Study Area. Among these species are 93 stocks managed by either the National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (USFWS) in the U.S. Exclusive Economic Zone. These species and stocks are presented in Table 3.7-1 along with an abundance estimate, an associated coefficient of variation value, and minimum abundance. Table 3.7-1 also includes each species' occurrence within oceanographic features in open ocean areas, large marine ecosystems, and inshore waters (including bays, rivers, and estuaries) that overlap with the AFTT Study Area. Refer to Section 3.0.2 (Ecological Characterization of the Study Area) for a description of each feature. For each species and stock, relevant information on their status, distribution, population trends, and ecology is presented in Section 3.7.2 (Affected Environment), incorporating the best available science in addition to the analyses provided in the most recent U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessment Reports (Hayes et al., 2018). Some material contained in this chapter was summarized from the book *Marine Mammals of the World: A Comprehensive Guide to Their Identification* (Jefferson et al., 2015).

For summaries of the general biology and ecology of marine mammals beyond the scope of this section, see Rice (1998), Twiss and Reeves (1999), Hoelzel (2002) , Berta et al. (2006), Jefferson et al. , Jefferson et al. (2015), and Committee on Taxonomy (2008). Additional species profiles and information on the biology, life history, species distribution, and conservation of marine mammals can also be found through the following organizations:

- NMFS Office of Protected Resources (includes species distribution maps)
- Ocean Biogeographic Information System-Spatial Ecological Analysis of Megavertebrate Populations (known as OBIS-SEAMAP) species profiles
- National Oceanic and Atmospheric Administration Cetacean Density and Distribution Mapping Working Group
- International Whaling Commission
- International Union for Conservation of Nature, Cetacean Specialist Group
- Marine Mammal Commission

- Society for Marine Mammalogy

Four main types of marine mammals are generally recognized: cetaceans (whales, dolphins, and porpoises), pinnipeds (seals, sea lions, and walruses), sirenians (manatees and dugongs), and other marine carnivores (sea otters, marine otters, and polar bears) (Jefferson et al., 2015; Rice, 1998). To maintain consistency with past Navy analysis and retain familiar terminology, we have used "odontocetes" for toothed whales, dolphins, and porpoises, "mysticetes" for baleen whales, and "cetaceans" to be inclusive of both. Detailed reviews of the different groups of cetaceans can be found in Jefferson et al. (2015), Heithaus and Dill (2008), and Perrin and Geraci (2002). The different feeding strategies between mysticetes and odontocetes affect their distribution and occurrence patterns (Goldbogen et al., 2015). Odontocetes range in size from slightly longer than 3.3 feet (ft.) to more than 60 ft. and have teeth, which they use to capture and consume individual prey. Odontocetes are divided into several families. Mysticetes are universally large whales (more than 15 ft. as adults) that use baleen, a fibrous structure made of keratin (a type of protein like that found in human fingernails), instead of teeth to feed. Mysticetes are batch feeders that typically engulf, suck, or skim the water into their mouths and then push the water out as large numbers of prey items, such as small schooling fish, shrimp, or microscopic sea animals (i.e., plankton), are filtered by the baleen. Mysticetes are further divided into four families, two of which (right whales and rorquals) are found in the Study Area and two that are not found within the Study Area (gray whales and pygmy right whales).

Pinnipeds in the Study Area are of the order Carnivora and can be divided into three families: phocids (true seals) and walruses, both found in the Study Area, and otariids (fur seals and sea lions), which are not found in the Study Area. Other marine carnivores include polar bears, which are found in the northern portion of the AFTT Study Area, and sea otters, which are not found in the Study Area.

The order Sirenia (sirenians) includes one species found in the Study Area, the West Indian manatee (*Trichechus manatus*), a slow-moving plant eater that inhabits shallow coastal and inshore waters.

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Table 3.7-1: Marine Mammal Occurrence Within the Atlantic Fleet Training and Testing Study Area

Common Name	***Scientific Name***[1]	***Stock***[2]	***ESA/MMPA Status***[3]	***Stock Abundance***[4] ***Best / Minimum Population***	***Occurrence in Study Area***[5]		
					Open Ocean	***Large Marine Ecosystems***	***Inshore Waters***
Order Cetacea							
Suborder Mysticeti (baleen whales)							
Family Balaenidae (right whales)							
Bowhead whale	*Balaena mysticetus*	Eastern Canada-West Greenland	Endangered, strategic, depleted	7,660 (4,500–11,100)[6]	Labrador Current	Newfoundland-Labrador Shelf, West Greenland Shelf, Northeast U.S. Continental Shelf	–
North Atlantic right whale	*Eubalaena glacialis*	Western North Atlantic	Endangered, strategic, depleted	458 (0) / 455	Gulf Stream, Labrador Current, North Atlantic Gyre	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf, Gulf of Mexico (extralimital)	–
Family Balaenopteridae (rorquals)							
Blue whale	*Balaenoptera musculus*	Western North Atlantic (Gulf of St. Lawrence)	Endangered, strategic, depleted	Unknown / 440[7]	Gulf Stream, North Atlantic Gyre, Labrador Current	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf, Southeast U.S. Continental Shelf, Caribbean Sea, and Gulf of Mexico (strandings only)	–
Bryde's whale	*Balaenoptera brydei/edeni*	Northern Gulf of Mexico	Proposed endangered, strategic	33 (1.07) / 16	Gulf Stream, North Atlantic Gyre	Gulf of Mexico	–
Fin whale	*Balaenoptera physalus*	Western North Atlantic	Endangered, strategic, depleted	1,618 (0.33) / 1,234	Gulf Stream, North Atlantic Gyre, Labrador Current	Caribbean Sea, Gulf of Mexico, Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	–
		West Greenland	Endangered, strategic, depleted	4,468 (1,343–14,871)[8]	Labrador Current	West Greenland Shelf	–
		Gulf of St. Lawrence	Endangered, strategic, depleted	328 (306–350)[9]	–	Newfoundland-Labrador Shelf, Scotian Shelf	–
Humpback whale	*Megaptera novaeangliae*	Gulf of Maine	Strategic	335 (0.42) / 239	Gulf Stream, North Atlantic Gyre, Labrador Current	Gulf of Mexico, Caribbean Sea, Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	Lower Chesapeake Bay
Minke whale	*Balaenoptera acutorostrata*	Canadian East Coast	–	2,591 (0.81) / 1,425	Gulf Stream, North Atlantic Gyre, Labrador Current	Caribbean Sea, Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	–
		West Greenland[10]	–	16,609 (7,172–38,461) / NA[10]	Labrador Current	West Greenland Shelf	–

[1] Taxonomy follows Committee on Taxonomy (2016) and Perrin et al. (2009)
[2] Stock designations for the U.S. Exclusive Economic Zone and abundance estimates are from Atlantic and Gulf of Mexico Stock Assessment Reports prepared by NMFS (Hayes et al., 2018), unless specifically noted.
[3] Populations or stocks defined by the MMPA as "strategic" for one of the following reasons: (1) the level of direct human-caused mortality exceeds the potential biological removal level; (2) based on the best available scientific information, numbers are declining and species are likely to be listed as threatened species under the ESA within the foreseeable future; (3) species are listed as threatened or endangered under the ESA; (4) species are designated as depleted under the MMPA.
[4] Stock abundance, CV, and minimum population are numbers provided by the Stock Assessment Reports (Hayes et al., 2018), unless otherwise noted. The stock abundance is an estimate of the number of animals within the stock. The CV is a statistical metric used as an indicator of the uncertainty in the abundance estimate. The minimum population estimate is either a direct count (e.g., pinnipeds on land) or the lower 20th percentile of a statistical abundance estimate.
[5] Occurrence in the Study Area includes open ocean areas—Labrador Current, North Atlantic Gyre, Gulf Stream, and coastal/shelf waters of seven large marine ecosystems—West Greenland Shelf, Newfoundland-Labrador Shelf, Scotian Shelf, and Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Caribbean Sea, Gulf of Mexico, and inshore waters of Kennebec River, Piscataqua River, Thames River, Narragansett Bay, Rhode Island Sound, Block Island Sound, Buzzards Bay, Vineyard Sound, Long Island Sound, Sandy Hook Bay, Lower Chesapeake Bay, James River, Elizabeth River, Beaufort Inlet, Cape Fear River, Kings Bay, St. Johns River, Port Canaveral, St. Andrew Bay, Pascagoula River, Sabine Lake, Corpus Christi Bay, and Galveston Bay, (Figure 3.0-1, The Study Area with Large Marine Ecosystems and Open Ocean Areas, in Section 3.0.2, Ecological Characterization of the Study Area).
[6] The bowhead whale population off the west coast of Greenland is not managed by NMFS and, therefore, does not have an associated Stock Assessment Report. Abundance and 95 percent highest density interval were presented in Frasier et al. (2015).
[7] Photo identification catalog count of 440 recognizable blue whale individuals from the Gulf of St. Lawrence is considered a minimum population estimate for the western North Atlantic stock (Waring et al., 2010).
[8] The West Greenland stock of fin whales is not managed by NMFS and, therefore, does not have an associated Stock Assessment Report. Abundance and 95 percent confidence interval were presented in Heide-Jørgensen et al. (2010a).
[9] The Gulf of St. Lawrence stock of fin whales is not managed by NMFS and, therefore, does not have an associated Stock Assessment Report. Abundance and 95 percent confidence interval were presented in Ramp et al. (2014).
[10] The West Greenland stock of minke whales is not managed by NMFS and, therefore, does not have an associated Stock Assessment Report. Abundance and 95 percent confidence interval were presented in Heide-Jørgensen et al. (2010b).
CV: coefficient of variation; ESA: Endangered Species Act; MMPA: Marine Mammal Protection Act; NA: not applicable; NMFS: National Marine Fisheries Service

Table 3.7-1: Marine Mammal Occurrence Within the Atlantic Fleet Training and Testing Study Area (continued)

Common Name	Scientific Name[1]	Stock[2]	ESA/MMPA Status[3]	Stock Abundance[4] Best (McVey & Wibbels)/ Min	Occurrence in Study Area[5] Open Ocean	Large Marine Ecosystems	Inshore Waters
Sei whale	*Balaenoptera borealis*	Nova Scotia	Endangered, strategic, depleted	357 (0.52) / 236[11]	Gulf Stream, North Atlantic Gyre	Gulf of Mexico, Caribbean Sea, Southeast Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	–
		Labrador Sea	Endangered, strategic, depleted	Unknown[12]	Labrador Current	Newfoundland-Labrador Shelf, West Greenland Shelf	–
Family Physeteridae (sperm whale)							
Suborder Odontoceti (toothed whales)							
Sperm whale	*Physeter macrocephalus*	North Atlantic	Endangered, strategic, depleted	2,288 (0.28) / 1,815[13]	Gulf Stream, North Atlantic Gyre, Labrador Current	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf, Caribbean Sea	–
		Northern Gulf of Mexico	Endangered, strategic, depleted	763 (0.38) / 560[14]	–	Gulf of Mexico	–
		Puerto Rico and U.S. Virgin Islands	Endangered, strategic, depleted	Unknown	North Atlantic Gyre	Caribbean Sea	–
Family Kogiidae (sperm whales)							
Pygmy and dwarf sperm whales	*Kogia breviceps* and *Kogia sima*	Western North Atlantic	–	3,785 (0.47) / 2,598[15]	Gulf Stream, North Atlantic Gyre	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf, Caribbean Sea	–
		Gulf of Mexico	–	186 (1.04) / 90[15]	–	Gulf of Mexico, Caribbean Sea	–
Family Monodontidae (beluga whale and narwhal)							
Beluga whale	*Delphinapterus leucas*	Eastern High Arctic/Baffin Bay[16]	–	21,213 (10,985–32,619)[16]	Labrador Current	West Greenland Shelf	–
		West Greenland[17]	–	10,595 (4.904–24,650)[17]	–	West Greenland Shelf	–
Narwhal	*Monodon monoceros*	NA[18]	–	NA[18]	–	Newfoundland-Labrador Shelf, West Greenland Shelf	–
Family Ziphiidae (beaked whales)							
Blainville's beaked whale	*Mesoplodon densirostris*	Western North Atlantic[19]	–	7,092 (0.54) / 4,632[20]	Gulf Stream, North Atlantic Gyre, Labrador Current	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	–
		Northern Gulf of Mexico [19]	–	149 (0.91) / 77[21]	–	Gulf of Mexico, Caribbean Sea	–
Cuvier's beaked whale	*Ziphius cavirostris*	Western North Atlantic	–	6,532 (0.32) / 5,021[19]	Gulf Stream, North Atlantic Gyre	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	–
		Northern Gulf of Mexico	–	74 (1.04) / 36[19]	–	Gulf of Mexico, Caribbean Sea	–
		Puerto Rico and U.S. Virgin Islands	Strategic	Unknown[22]	–	Caribbean Sea	–

[11] Estimates are from Hayes et al. (2017).
[12] The Labrador Sea stock of sei whales is not managed by NMFS and, therefore, does not have an associated Stock Assessment Report. Information was obtained in Prieto et al. (2014).
[13] Estimates for these stocks are from Waring et al. (2015).
[14] Estimates for these stocks are from Waring et al. (2016).
[15] Estimates include both the pygmy and dwarf sperm whales in the western North Atlantic (Hayes et al., 2017) and the northern Gulf of Mexico (Waring et al., 2013).
[16] Beluga whales in the Atlantic are not managed by NMFS and have no associated Stock Assessment Report. Abundance and 95 percent confidence interval for the Eastern High Arctic/Baffin Bay stock were presented in Innes et al. (2002).
[17] Beluga whales in the Atlantic are not managed by NMFS and have no associated Stock Assessment Report. Abundance and 95 percent confidence interval for the West Greenland stock were presented in Heide-Jørgensen et al. (2009).
[18] NA: Not applicable. Narwhals in the Atlantic are not managed by NMFS and have no associated Stock Assessment Report.
[19] Estimates for these western North Atlantic stocks are from Waring et al. (2014) and the Gulf of Mexico stocks are from Waring et al. (2013) as applicable.
[20] Estimate includes undifferentiated *Mesoplodon* species.
[21] Estimate includes Gervais' and Blainville's beaked whales.
[22] Estimates from these Puerto Rico and U.S. Virgin Islands stocks are from Waring et al. (2012).

Table 3.7-1: Marine Mammal Occurrence Within the Atlantic Fleet Training and Testing Study Area (continued)

Common Name	Scientific Name[1]	Stock[2]	ESA/MMPA Status[3]	Stock Abundance[4] Best (McVey & Wibbels)/ Min	Occurrence in Study Area[5]		
					Open Ocean	Large Marine Ecosystems	Inshore Waters
Gervais' beaked whale	*Mesoplodon europaeus*	Western North Atlantic[19]	–	7,092 (0.54) / 4,632[20]	Gulf Stream, North Atlantic Gyre	Southeast U.S. Continental Shelf, Northeast United States Continental Shelf	–
		Northern Gulf of Mexico[19]	–	149 (0.91) / 77[21]	Gulf Stream, North Atlantic Gyre	Gulf of Mexico, Caribbean Sea	–
Northern bottlenose whale	*Hyperoodon ampullatus*	Western North Atlantic	–	Unknown[13]	Gulf Stream, North Atlantic Gyre, Labrador Current	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	–
Sowerby's beaked whale	*Mesoplodon bidens*	Western North Atlantic[13]	–	7,092 (0.54) / 4,632[20]	Gulf Stream, North Atlantic Gyre	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	–
True's beaked whale	*Mesoplodon mirus*	Western North Atlantic[19]	–	7,092 (0.54) / 4,632[20]	Gulf Stream, North Atlantic Gyre	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	–
Family Delphinidae (dolphins)							
Atlantic spotted dolphin	*Stenella frontalis*	Western North Atlantic	–	44,715 (0.43) / 31,610[19]	Gulf Stream	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf	–
		Gulf of Mexico	–	Unknown[14]	–	Gulf of Mexico, Caribbean Sea	–
		Puerto Rico and U.S. Virgin Islands	Strategic	Unknown[22]	–	Caribbean Sea	–
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Western North Atlantic	–	48,819 (0.61) / 30,403	Gulf Steam, Labrador Current	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	–
Clymene dolphin	*Stenella clymene*	Western North Atlantic	–	Unknown[19]	Gulf Stream	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf	–
		Gulf of Mexico	–	129 (1.0) / 64[19]	–	Gulf of Mexico, Caribbean Sea	–
Common bottlenose dolphin	*Tursiops truncatus*	Western North Atlantic, Offshore[11]	–	77,532 (0.40) / 56,053[23]	Gulf Stream, North Atlantic Gyre	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf	–
		Western North Atlantic Northern Migratory Coastal	Strategic, depleted	6,639 (0.41) / 4,759	–	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf	Long Island Sound, Sandy Hook Bay, Lower Chesapeake Bay, James River, Elizabeth River
		Western North Atlantic Southern Migratory Coastal	Strategic, depleted	3,751 (0.06) / 2,353	–	Southeast U.S. Continental Shelf	Lower Chesapeake Bay, James River, Elizabeth River, Beaufort Inlet, Cape Fear River, Kings Bay, St. Johns River
		Western North Atlantic South Carolina/ Georgia Coastal	Strategic, depleted	6,027 (0.34) / 4,569	–	Southeast U.S. Continental Shelf	Kings Bay, St. Johns River
		Northern North Carolina Estuarine System	Strategic	823 (0.06) / 782	–	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf	Beaufort Inlet, Cape Fear River
		Southern North Carolina Estuarine System	Strategic	Unknown	–	Southeast U.S. Continental Shelf	Beaufort Inlet, Cape Fear River
		Northern South Carolina Estuarine System	Strategic	Unknown[14]	–	Southeast U.S. Continental Shelf	–
		Charleston Estuarine System	Strategic	Unknown[14]	–	Southeast U.S. Continental Shelf	–
		Northern Georgia/ Southern South Carolina Estuarine System	Strategic	Unknown[14]	–	Southeast U.S. Continental Shelf	–

[19] Estimates for these western North Atlantic stocks are from Waring et al. (2014) and the Gulf of Mexico stock are from Waring et al. (2013) as applicable.
[20] Estimate includes undifferentiated *Mesoplodon* species.
[21] Estimate includes Gervais' and Blainville's beaked whales.
[22] Estimates from these Puerto Rico and U.S. Virgin Islands stocks are from Waring et al. (2012).
[23] Estimate may include sightings of the coastal form.

Table 3.7-1: Marine Mammal Occurrence Within the Atlantic Fleet Training and Testing Study Area (continued)

Common Name	Scientific Name[1]	Stock[2]	ESA/MMPA Status [3]	Stock Abundance[4] Best / Min	Occurrence in Study Area[5]		
					Open Ocean	Large Marine Ecosystems	Inshore Waters
Common bottlenose dolphin (continued)	*Tursiops truncatus* (continued)	Central Georgia Estuarine System	Strategic	192 (0.04) / 185[14]	-	Southeast U.S. Continental Shelf	–
		Southern Georgia Estuarine System	Strategic	194 (0.05) / 185[14]	–	Southeast U.S. Continental Shelf	Kings Bay, St. Johns River
		Western North Atlantic Northern Florida Coastal	Strategic, depleted	877 (0.49) / 595	–	Southeast U.S. Continental Shelf	Kings Bay, St. Johns River
		Jacksonville Estuarine System	Strategic	Unknown[14]	–	Southeast U.S. Continental Shelf	Kings Bay, St. Johns River
		Western North Atlantic Central Florida Coastal	Strategic, depleted	1.218 (0.35) / 913	–	Southeast U.S. Continental Shelf	Port Canaveral
		Indian River Lagoon Estuarine System	Strategic	Unknown[14]	–	Southeast U.S. Continental Shelf	Port Canaveral
		Biscayne Bay	Strategic	Unknown[24]	–	Southeast U.S. Continental Shelf	–
		Florida Bay	–	Unknown[24]	–	Gulf of Mexico	–
		Gulf of Mexico Continental Shelf	–	51,192 (0.10) / 46,926[14]	–	Gulf of Mexico	–
		Gulf of Mexico Eastern Coastal	–	12,388 (0.13) / 11,110[14]	–	Gulf of Mexico	–
		Gulf of Mexico Northern Coastal	–	7,185 (0.21) / 6,044[14]	–	Gulf of Mexico	St. Andrew Bay, Pascagoula River
		Gulf of Mexico Western Coastal	–	20,161 (0.17) / 17,491[14]	–	Gulf of Mexico	Corpus Christi Bay, Galveston Bay
		Gulf of Mexico Oceanic	–	5,806 (0.39) / 4,230[13]	–	Gulf of Mexico	–
		Gulf of Mexico Bay, Sound, and Estuaries	Strategic	Unknown[11]	–	Gulf of Mexico	St. Andrew Bay, Pascagoula River, Sabine Lake, Corpus Christi Bay, and Galveston Bay
		Barataria Bay Estuarine System	Strategic	2,306 (0.09) / 2,138	–	Gulf of Mexico	–
		Mississippi Sound, Lake Borgne, Bay Boudreau	Strategic	3,046 (0.06) / 2,896	-	Gulf of Mexico	–
		St. Joseph Bay	Strategic	152 (0.08) / Unknown[14]	–	Gulf of Mexico	–
		Choctawhatchee Bay	Strategic	179 (0.04) / Unknown[14]	–	Gulf of Mexico	–
		Puerto Rico and U.S. Virgin Islands	Strategic	Unknown[22]	–	Caribbean Sea	–
False killer whale	*Pseudorca crassidens*	Western North Atlantic	Strategic	442 (1.06) / 212[13]	–	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf	–
		Gulf of Mexico	–	Unknown[19]	–	Gulf of Mexico, Caribbean Sea	–
Fraser's dolphin	*Lagenodelphis hosei*	Western North Atlantic	–	Unknown[25]	Gulf Stream	Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf	–
		Northern Gulf of Mexico	–	Unknown[19]	–	Gulf of Mexico, Caribbean Sea	–

[24] Estimates for these stocks are from Waring et al. (2014).
[25] Estimates for these western North Atlantic stocks are from Waring et al. (2007).

Table 3.7-1: Marine Mammal Occurrence Within the Atlantic Fleet Training and Testing Study Area (continued)

Common Name	Scientific Name[1]	Stock[2]	ESA/MMPA Status [3]	Stock Abundance[4] Best / Min	Occurrence in Study Area[5]		
					Open Ocean	Large Marine Ecosystems	Inshore Waters
Killer whale	*Orcinus orca*	Western North Atlantic	–	Unknown[13]	Gulf Stream, North Atlantic Gyre, Labrador Current	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	–
		Gulf of Mexico	–	28 (1.02) / 14[19]	–	Gulf of Mexico, Caribbean Sea	–
Long-finned pilot whale	*Globicephala melas*	Western North Atlantic	Strategic	5,636 (0.63) / 3,464[11]	Gulf Stream	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	–
Melon-headed whale	*Peponocephala electra*	Western North Atlantic	–	Unknown[25]	Gulf Stream, North Atlantic Gyre	Southeast U.S. Continental Shelf	–
		Northern Gulf of Mexico	–	2,235 (0.75) / 1,274[19]	-	Gulf of Mexico, Caribbean Sea	–
Pantropical spotted dolphin	*Stenella attenuata*	Western North Atlantic	–	3,333 (0.91) / 1,733[18]	Gulf Stream	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf	–
		Northern Gulf of Mexico	–	50,880 (0.27) / 40,699[24]	–	Gulf of Mexico, Caribbean Sea	–
Pygmy killer whale	*Feresa attenuata*	Western North Atlantic	–	Unknown[25]	Gulf Stream, North Atlantic Gyre	Southeast U.S. Continental Shelf	–
		Northern Gulf of Mexico	–	152 (1.02) / 75[19]	–	Gulf of Mexico, Caribbean Sea	–
Risso's dolphin	*Grampus griseus*	Western North Atlantic	–	18,250 (0.46) / 12,619	Gulf Stream, North Atlantic Gyre	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	–
		Northern Gulf of Mexico	–	2,442 (0.57) / 1,563[14]	–	Gulf of Mexico, Caribbean Sea	–
Rough-toothed dolphin	*Steno bredanensis*	Western North Atlantic	–	271 (1.00)/ 134[19]	Gulf Stream, North Atlantic Gyre	Caribbean Sea, Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf	–
		Northern Gulf of Mexico	–	624 (0.99) / 311[11]	–	Gulf of Mexico, Caribbean Sea	–
Short-finned pilot whale	*Globicephala macrorhynchus*	Western North Atlantic	Strategic	21,515 (0.37) / 15,913[11]	Gulf Stream	Northeast Continental Shelf, Southeast U.S. Continental Shelf	–
		Northern Gulf of Mexico	–	2,415 (0.66) / 1,456[14]	–	Gulf of Mexico, Caribbean Sea	–
		Puerto Rico and U.S. Virgin Islands	Strategic	Unknown[22]	–	Caribbean Sea	–
Spinner dolphin	*Stenella longirostris*	Western North Atlantic	–	Unknown[19]	Gulf Stream, North Atlantic Gyre	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf	–
		Northern Gulf of Mexico	–	11,441 (0.83) / 6,221[19]	–	Gulf of Mexico, Caribbean Sea	–
		Puerto Rico and U.S. Virgin Islands	Strategic	Unknown[22]	–	Caribbean Sea	–
Striped dolphin	*Stenella coeruleoalba*	Western North Atlantic	–	54,807 (0.30) / 42,804[19]	Gulf Stream	Northeast U.S. Continental Shelf, Scotian Shelf	–
		Northern Gulf of Mexico	–	1,849 (0.77) / 1,041[19]	–	Gulf of Mexico, Caribbean Sea	–
Short-beaked common dolphin	*Delphinus delphis*	Western North Atlantic	–	70,184 (0.28) / 55,690	Gulf Stream	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	–
White-beaked dolphin	*Lagenorhynchus albirostris*	Western North Atlantic	–	2,003 (0.94) / 1,023[25]	Labrador Current	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	–

Table 3.7-1: Marine Mammal Occurrence Within the Atlantic Fleet Training and Testing Study Area (continued)

Common Name	*Scientific Name*[1]	*Stock*[2]	*ESA/MMPA Status*[3]	*Stock Abundance*[4] *Best / Min*	*Occurrence in Study Area*[5]		
					Open Ocean	*Large Marine Ecosystems*	*Inshore Waters*
				Family Phocoenidae (porpoises)			
Harbor porpoise	*Phocoena phocoena phocoena*	Gulf of Maine/Bay of Fundy	–	79,883 (0.32) / 61,415	–	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	Narragansett Bay, Rhode Island Sound, Block Island Sound, Buzzards Bay, Vineyard Sound, Long Island Sound, Piscataqua River, Thames River, Kennebec River
		Gulf of St. Lawrence[26]	–	Unknown[26]	Labrador Current	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	–
		Newfoundland[27]	–	Unknown[27]	Labrador Current	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	–
		Greenland[28]	–	Unknown[28]	Labrador Current	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf, West Greenland Shelf	–
				Order Carnivora			
				Family Ursidae (bears)			
Polar bear	*Ursus maritimus*	NA[29]	Threatened, strategic, depleted	Unknown[29]	–	Newfoundland-Labrador Shelf, West Greenland Shelf	–
				Suborder Pinnipedia			
				Family Phocidae (true seals)			
Bearded seal	*Erignathus barbatus*	NA[30]	–	Unknown[30]	–	Newfoundland-Labrador Shelf, West Greenland Shelf	–
Gray seal	*Halichoerus grypus atlantica*	Western North Atlantic	27,131 (0.10) / 23,158	Unknown	–	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	Narragansett Bay, Rhode Island Sound, Block Island Sound, Buzzards Bay, Vineyard Sound, Long Island Sound, Piscataqua River, Thames River, Kennebec River
Harbor seal	*Phoca vitulina*	Western North Atlantic	–	75,834 (0.15) / 66,884	–	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	Chesapeake Bay, Narragansett Bay, Rhode Island Sound, Block Island Sound, Buzzards Bay, Vineyard Sound, Long Island Sound, Piscataqua River, Thames River, Kennebeck River
Harp seal	*Pagophilus groenlandicus*	Western North Atlantic	–	Unknown[24]	–	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	–
Hooded seal	*Cystophora cristata*	Western North Atlantic	–	Unknown[25]	–	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf, West Greenland Shelf	Narragansett Bay, Rhode Island Sound, Block Island Sound, Buzzards Bay, Vineyard Sound, Long Island Sound, Piscataqua River, Thames River, Kennebec River
Ringed seal	*Phoca hispida*	NA[30]	Strategic	Unknown[30]	–	Newfoundland-Labrador Shelf, West Greenland Shelf	–

[26] Harbor porpoise in the Gulf of St. Lawrence are not managed by NMFS and have no associated Stock Assessment Report.
[27] Harbor porpoise in Newfoundland are not managed by NMFS and have no associated Stock Assessment Report.
[28] Harbor porpoise in Greenland are not managed by NMFS and have no associated Stock Assessment Report.
[29] NA: Not applicable. Polar bears are managed by the U.S. Fish and Wildlife Service (USFWS) but do not occur in the Atlantic U.S. Exclusive Economic Zone and, therefore, have no associated Stock Assessment Reports. See the appropriate subsections below for details of populations that may be found within the Study Area.
[30] NA: Not applicable. These species do not occur within the Atlantic U.S. Exclusive Economic Zone and, therefore, are not managed by NMFS in the Atlantic and have no associated Stock Assessment Reports. See the appropriate subsections below for details of populations that may be found within the Study Area.

Table 3.7-1: Marine Mammal Occurrence Within the Atlantic Fleet Training and Testing Study Area (continued)

Common Name	Scientific Name[1]	Stock[2]	ESA/MMPA Status[3]	Stock Abundance[4] Best / Minimum Population	Occurrence in Study Area[5]		
					Open Ocean	Large Marine Ecosystems	Inshore Waters
Family Odobenidae (walrus)							
Walrus	*Odobenus rosmarus*	NA[31]	–	NA[31]	–	Newfoundland-Labrador Shelf, West Greenland Shelf	–
Order Sirenia							
Family Trichechidae (manatees)							
West Indian manatee	*Trichechus manatus latirostris* (Florida subspecies)	Florida	Threatened, strategic, depleted	6,350 (5,310–7,390) [32]	–	Gulf of Mexico, Southeast U.S. Continental Shelf	Cape Fear River, Bogue Sound, St. Johns River, Kings Bay, Port Canaveral, Pascagoula River, St. Andrew Bay, Corpus Christi Bay, Sabine Lake, and Galveston Bay
	Trichechus manatus (Antillean subspecies)	Puerto Rico		142[33]	–	Caribbean Sea	–

[31] NA: Not applicable. Walruses are managed by the USFWS but do not occur in the Atlantic U.S. Exclusive Economic Zone and, therefore, have no associated Stock Assessment Report. See the appropriate subsections below for details of populations that may be found within the Study Area.
[32] The West Indian manatee is managed by the USFWS. Based on surveys in 2011 and 2012 (Martin et al., 2015a).
[33] Minimum population estimate for Antillean manatees in Puerto Rico, based on January 2013 complete island-wide surveys (U.S. Fish and Wildlife Service, 2014b).

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3.7.2.1.1 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 sizes and structures of these groups are dynamic and, based on the species, can range from several to several thousand individuals. 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 acoustic effects modeling 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 using available published and unpublished literature, including journals, books, technical reports, survey cruise reports, raw data from cruises, theses, and dissertations. The results of this review were compiled into a technical report (U.S. Department of the Navy, 2017c) and include tables listing group size information by species along with relevant citations.

3.7.2.1.2 Habitat Use

Marine mammals occur in every marine environment in the Study Area, from coastal and inshore waters to the open Atlantic Ocean. Their distribution is influenced by many factors, primarily patterns of major ocean currents, bottom relief, water temperature, water depth, and salinity, 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 in upwelling zones (Jefferson et al., 2015). For most cetaceans, prey distribution, abundance, and quality largely determine where they occur at any specific time (Heithaus & Dill, 2008). Most of the baleen whales are migratory, but many of the toothed whales do not migrate in the strictest sense. Instead, they undergo seasonal dispersal or shifts in density distribution and occupy habitats preferable for feeding, breeding, and other important behaviors. Pinnipeds occur mostly in coastal habitats or over continental shelves, while manatees and polar bears are strongly associated with coastal waters as habitat for reproducing, resting, and, in some cases, feeding, though polar bears can also range far offshore.

In 2011, the National Oceanic and Atmospheric Administration convened a working group to map cetacean density and distribution within U.S. waters. 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, current science compilation, 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 concentrated. Areas identified through this process have been termed biologically important areas (Ferguson et al., 2015; Van Parijs, 2015).

It is important to note that 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. Ferguson et al. (2015) outlines 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, including the potential addition of newly defined areas. Additionally, biologically important areas identified in the AFTT Study Area by LaBrecque et al. (2015a, 2015b) do not represent static, unchanging areas but instead may evolve 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). This evolution may include new information that indicates a biologically important area is actually no longer important to an important life function or may show that a species may migrate to different areas due to environmental changes. Products of the initial assessment process, including U.S. East Coast biologically important areas, were compiled and published in March 2015 (Ferguson et al., 2015; LaBrecque et al., 2015a, 2015b).

Eighteen biologically important areas were identified for seven species within the AFTT Study Area (LaBrecque et al., 2015a, 2015b): minke whales, sei whales, fin whales, North Atlantic right whales, humpback whales, harbor porpoises, and bottlenose dolphins. Feeding areas were identified for humpback, minke, sei, fin, and North Atlantic right whales; migratory and reproductive areas for North Atlantic right whales; and small and resident population areas for harbor porpoise, Bryde's whale, and several stocks of bottlenose dolphins. Figure 5.4-4 (Mitigation Areas and Habitats Considered off the Northeastern United States), Figure 5.4-5 (Mitigation Areas and Habitats Considered off the Mid-Atlantic and Southeastern United States), and Figure 5.4-6 (Mitigation Areas and Habitats Considered in the Gulf of Mexico) show the habitats that the Navy considered when developing mitigation areas, including areas that were identified by LaBrecque et al. (2015a, 2015b) as being biologically important for marine mammals for feeding, breeding, migrating, or having a small and resident population within the AFTT Study Area. As depicted in the figures, many of the habitats considered overlap each other.

3.7.2.1.3 Dive Behavior

Most marine mammals spend a considerable portion 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 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 an observer's ability to detect them for purposes of mitigation and monitoring. In addition, their relative distribution through the water column is an important consideration when conducting acoustic exposure and direct strike analyses. 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, 2017c) that provides estimates of time at depth based on available research. The dive data and group size information compiled in this technical report was incorporated into the Navy acoustic effects modeling.

3.7.2.1.4 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, 2014; 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 in pinnipeds, it is narrow and sealed with wax and debris (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, which are 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 (Finneran, 2015; Finneran et al., 2016). For marine mammal species for which access is limited and therefore psychophysical or auditory evoked potential measurements are 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.

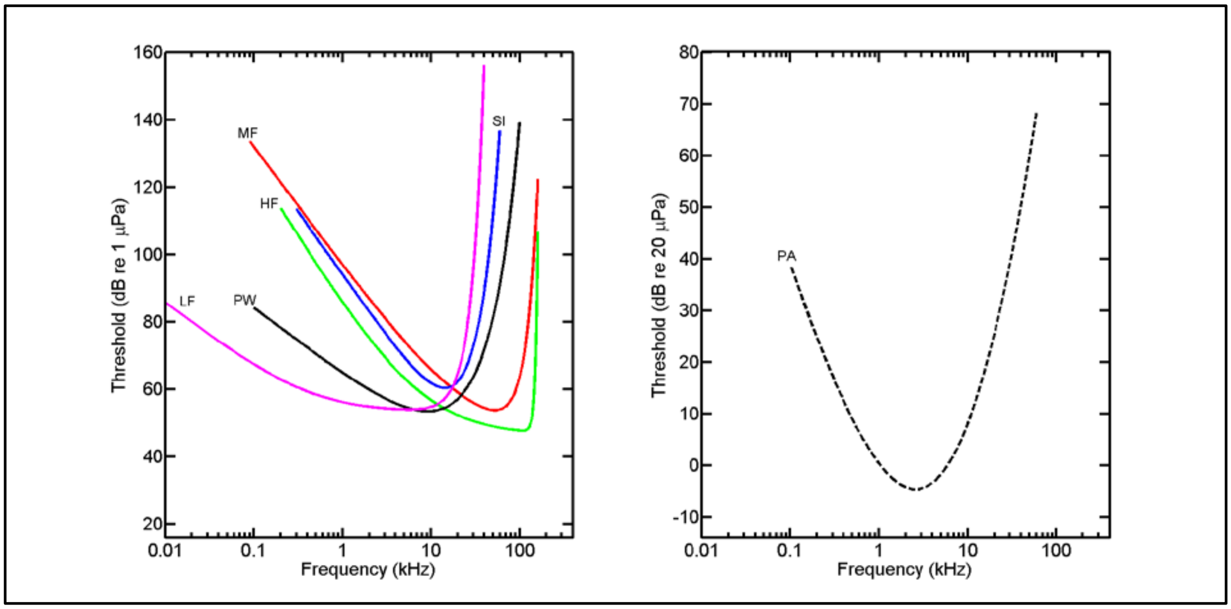
Direct measurements of hearing sensitivity exist for approximately 25 of the nearly 130 species of marine mammals. Table 3.7-2 summarizes hearing capabilities for marine mammal species in the Study Area. For this analysis, marine mammals are arranged into the following functional hearing groups based on their generalized hearing sensitivities: high-frequency cetaceans (group HF: porpoises, Kogia spp.), mid-frequency cetaceans (group MF: delphinids, beaked whales, sperm whales), low-frequency cetaceans (group LF: mysticetes), otariids and other non-phocid marine carnivores in water and air (groups OW and OA: sea lions, walruses, otters, polar bears), and phocids in water and air (group PW and PA: true seals). Note that the designations of high-, mid-, and low-frequency cetaceans are based on relative differences of hearing sensitivity between groups, as opposed to conventions used to describe active sonar systems. For analyses, a single representative composite audiogram (see Figure 3.7-1) 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 Analysis (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., 2017). 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 3.7-2: Species in Marine Mammal Hearing Groups Potentially Within the Study Area

Functional Hearing Group	***Species in the Study Area***
High-frequency cetaceans	Dwarf sperm whale
	Harbor porpoise
	Pygmy sperm whale
Mid-frequency cetaceans	Atlantic spotted dolphin
	Atlantic white-sided dolphin
	Beluga whale
	Bottlenose dolphin
	Clymene dolphin
	Common dolphin
	False killer whale
	Fraser's dolphin
	Gervais' beaked whale
	Killer whale
	Long-finned pilot whale
	Melon-headed whale
	Narwhal
	Northern bottlenose whale
	Pantropical spotted dolphin
	Pygmy killer whale
	Risso's dolphin
	Rough-toothed dolphin
	Short-finned pilot whale
	Sowerby's beaked whale
	Sperm whale
	Spinner dolphin
	Striped dolphin
	True's beaked whale
	White-beaked dolphin
Low-frequency cetaceans	Bowhead whale
	Blue whale
	Bryde's whale
	Fin whale
	Humpback whale
	Minke whale
	North Atlantic right whale
	Sei whale
Sirenians	West Indian manatee
Odobenids	Walrus
Polar bear	Polar bear

Table 3.7-2: Species in Marine Mammal Hearing Groups Potentially Within the Study Area (continued)

Functional Hearing Group	*Species in the Study Area*
Phocids	Bearded seal
	Gray seal
	Harbor seal
	Harp seal
	Hooded seal
	Ringed seal



For hearing in the water (left) and in air (right, phocids only).
LF: low frequency; MF: mid-frequency; HF: high frequency; SI: sirenians; PW: phocids in water; PA: phocids in air
Source: *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (U.S. Department of the Navy, 2017)

Figure 3.7-1: Composite Audiograms for Hearing Groups Likely to be 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). Of particular note are the very low-frequency calls of mysticete whales that range from tens of hertz (Hz) to several kHz, and have source levels of 150 to 200 dB 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 (Smultea et al., 2008a).

Odontocete cetaceans, sirenians, 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, the calls of manatees and dugongs, 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 to 200 μs), 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).

3.7.2.1.5 General Threats

Marine mammal populations can be influenced by various natural factors and human activities. There can be direct effects, such as from disease or activities such as hunting and whale watching, or indirect effects, such as reduction in prey availability or lowered reproductive success of individuals. Twiss and Reeves (1999) and National Marine Fisheries Service (2011a) provide a general discussion of marine mammal conservation and the threats they face. As detailed in National Marine Fisheries Service (2011a), investigations of stranded marine mammals are undertaken to monitor threats to marine mammals and out of concern for animal welfare and ocean stewardship. Marine mammals have also been recognized as sentinels of ecosystem health and may therefore provide valuable links to human health issues (Simeone et al., 2015). Investigations into the cause of death for stranded animals can also provide indications of the general threats to marine mammals in a given location (Bradford & Lyman, 2015; Carretta et al., 2016b; Helker et al., 2015). The causes for strandings include infectious disease, parasite infestation, starvation, climate change reducing 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, tectonic events such as underwater earthquakes, and ingestion or interaction with marine debris (National Marine Fisheries Service, 2016c). For a general discussion of strandings and their causes, as well as strandings in association with U.S. Navy activity, see the technical report titled *Marine Mammal Strandings Associated with U.S. Navy Sonar Activities* (U.S. Department of the Navy, 2017b).

3.7.2.1.5.1 Water Quality

Chemical pollution and impacts to water quality is of great concern, although its effects on marine mammals are just starting to be understood (Desforges et al., 2016; Godard-Codding et al., 2011; Jepson & Law, 2016; Law, 2014; Peterson et al., 2014; Peterson et al., 2015). 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, 2010a; Matkin et al., 2008).

The Mississippi Canyon-252 *Deepwater Horizon* oil spill of 2010 was the largest offshore oil spill in U.S. history, spilling millions of barrels of oil into the Gulf of Mexico. Photographic evidence and field observations conducted by various organizations from April 2010 to May 2012 documented 11 cetacean species swimming through the oil and sheen with oil adhered to their skin (Dias et al., 2017). Participating organizations included the Southeast Fisheries Science Center Miami, National Centers for Coastal Ocean Science, Marine Mammal Oil Spill Assessment Survey, Mississippi Sound Natural Resource Damage Assessment, National Oceanic and Atmospheric Administration, U.S. Coast Guard, Louisiana Department of Wildlife and Fisheries, and the Marine Mammal Health and Stranding Response Program (Dias et al., 2017). The stranding response phase associated with the oil spill lasted from April 28, 2010 to May 2011 which confirmed 13 live and 178 dead stranded marine mammals reported across four Gulf coast states and offshore waters (Wilkin et al., 2017). The National Oceanic and Atmospheric Administration declared a Cetacean Unusual Mortality Event in the northern Gulf of Mexico from March 2010 to July 2014 consisting of over 1,000 reported mortalities, with some marine mammal strandings likely associated with this disaster (National Marine Fisheries Service, 2018a). One study determined that bottlenose dolphin mortalities during this Cetacean Unusual Mortality Event were likely related to the increased exposure to petroleum hydrocarbons from the *Deepwater Horizon* disaster (Venn-Watson et al., 2015). A passive acoustic monitoring study, conducted on the first year responses to the oil spill of resident deep-diving marine mammals, detected multiple marine mammal species including sperm whale, pygmy and dwarf sperm whale, four species of beaked whales and at least four different *Stenella* species (Sidorovskaia et al., 2016). Visual and acoustic monitoring was conducted at two locations; the northern location was 15 kilometers (km) away from the spill site, and the southern location was 40 km away from the spill site. Results showed a shift in sperm whale and beaked whale distribution at these locations from 2007 to 2010, after the spill. Sperm whale abundance decreased in 2010 at the northern location close to the spill site compared with 2007. However, beaked whale abundance increased in 2010 at the same location. Sidorovskaia et al. (2016) suggested that the sperm whale shift away from the spill site was due to their preference on feeding grounds away from that location, while increased beaked whale activity in the area was due to an increase in prey availability after fishing operations were required to stop after the spill. This study did not provide information on physiological impacts to these species.

The *Deepwater Horizon* Natural Resource Damage Assessment Trustees developed an injury quantification based on measured bottlenose dolphin injuries observed within Barataria Bay and

Mississippi Sound between 2010 and 2013. This data was applied to bay, sound, and estuary stocks, coastal stocks, and oceanic stocks of other cetacean species within the oil spill footprint. Analyses determined the percent of sperm whales, Bryde's whales, dwarf/pygmy sperm whales, beaked whales, rough-toothed dolphins, bottlenose dolphins, pantropical spotted dolphins, Atlantic spotted dolphins, spinner dolphins, Clymene dolphins, striped dolphins, Risso's dolphins, melon-headed whales, pygmy killer whales, and short-finned pilot whales in the Gulf of Mexico that were exposed to oil (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016). The report also estimated the number of years for these Gulf of Mexico stocks to recover without active restoration efforts, which ranged from 10 years for beaked whales up to 105 years for spinner dolphins (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016).

Although information on effects of oil and chemical spills on marine mammals is limited, they can be harmed by direct exposure to oil or chemicals and indirectly due to pollutants' impacts on prey and habitat quality. Potential physical/physiological effects of exposure to oil and chemical spills include irritation, inflammation, necrosis (premature death of living tissue), and chemical burns of skin, eyes, and nose areas, and inhalation of toxic fumes with potential long-term respiratory effects, such as inflammation, pulmonary emphysema, and infection (Engelhardt, 1983; Marine Mammal Commission, 2010b). Ingestion of oil and dispersants directly or through feeding on contaminated prey that have eaten dispersants can lead to short or longer-term effects from inflammation, ulcers, bleeding, and possible damage to liver, kidney, and brain tissues (Engelhardt, 1983; Marine Mammal Commission, 2010b).

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 can flow as runoff into the marine environment and can bioaccumulate in the bodies of marine mammals and be transferred to their young through mother's milk (Fair et al., 2010). The presence of these chemical contaminants in marine mammals has been assumed to put those animals at greater risk for adverse health effects and potential impact on their reproductive success (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).

3.7.2.1.5.2 Commercial Industries

Human impacts on marine mammals have received much attention in recent decades and include fisheries interaction, including bycatch (accidental or indirect catch), gear entanglement, and indirect effects from takes of prey species, noise pollution, marine debris (ingestion and entanglement), hunting (both commercial and subsistence), vessel strikes, entrainment into power plant water intakes, increased ocean acidification, and general habitat deterioration or destruction.

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 (Geijer & Read, 2013; Hamer et al., 2010; Northridge, 2008; Read, 2008). In 1994, the MMPA was amended to formally address bycatch. 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 Atlantic declined by a total of 59 percent from 1994 to 2006 (Geijer & Read, 2013). Cetacean bycatch declined by 44 percent, from 3,153 in 1994 to 1,764 in 2006, and pinniped bycatch declined by 78 percent, from 2,210 to 476 over the same time period. Despite these reductions, fisheries interactions continue to be the primary human-related source of mortality for most marine mammal stocks (Roman et al., 2013). Regulatory efforts have not reduced the lethal effects of human activities on large whales in the northwest Atlantic on a population-range basis (Knowlton et al., 2012; Van der Hoop et al., 2013), although targeted measures for specific local habitats were not analyzed in these studies.

Other Fisheries Interactions

Fishery interactions other than bycatch also include entanglement from abandoned or partial nets, fishing line, hooks, and the ropes and lines connected to fishing gear (Bradford & Forney, 2014; Bradford & Lyman, 2015; Carretta et al., 2013; Carretta et al., 2014; Carretta et al., 2016b; Helker et al., 2015; Morin & Kenney, 2013; Morin et al., 2014; Saez et al., 2012). 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 cetaceans in the AFTT Study Area, Cassoff et al. (2011) reported that in the western North Atlantic, mortality due to entanglement has slowed the recovery of some populations of mysticetes, including minke, Bryde's, North Atlantic right, and humpback whales. In 2013 and 2014, there were 39 confirmed cases of large whale entanglements reported off the east coasts of the U.S and Canada; species included North Atlantic right whales, humpback whales, fin whales, and minke whales (Morin & Kenney, 2013; Morin et al., 2014). In September 2016, two North Atlantic right whales were found dead off the coast of Maine and a third one was disentangled from fishing gear off the coast of Cape Cod (Miller, 2016). Cause of death from one of the dead right whales was determined to be chronic entanglement. From 1970 through 2009, death by entanglement in fishing gear was on aggregate the most commonly diagnosed cause of death across eight large whale species. Where the cause of death could be determined (43 percent of all known mortalities), 43 percent were entangled, 23 percent were vessel struck, and 33 percent died of non-human-related causes (Van der Hoop et al., 2013). Knowlton et al. (2012) summarized sublethal entanglement in North Atlantic right whales for the period between 1980 and 2009. Of 626 individual animals, 83 percent had been entangled at least once and 59 percent had been entangled more than once (Knowlton et al., 2012).

Noise

In some locations, especially where urban or industrial activities or commercial shipping is intense, anthropogenic noise can be a potential habitat level stressor (Clark et al., 2009; Dunlop, 2016; Dyndo et al., 2015; Erbe et al., 2014; Frisk, 2012; Gedamke et al., 2016; Hermannsen et al., 2014; Li et al., 2015; Melcón et al., 2012; Miksis-Olds & Nichols, 2015; Nowacek et al., 2015; Pine et al., 2016; Williams et al., 2014). 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 (Erbe, 2002; Erbe et al., 2016; Hildebrand, 2009; Rolland et al., 2012; Tyack et al., 2011). 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; Tyack, 2009; Würsig & Richardson, 2008). 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, shoreline construction projects, and acoustic deterrent and harassment devices), foreign navies, recreational boating and whale-watching activities, offshore power generation (including offshore windfarms), and research (including sound from air guns, sonar, and telemetry).

Commercial vessel noise in particular is a major contributor to noise in the ocean and intensively used inshore waters. Commercial shipping's contribution to ambient noise in the ocean has increased by as much as 12 decibels (dB) between the 1960s and 2005 (Hildebrand, 2009; McDonald et al., 2008). Frisk (2012) confirms the trend and reported that between 1950 and 2007, ocean noise in the 25- to 50-Hz frequency range has increased 3.3 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). Subsequently, Miksis-Olds and Nichols (2015) have demonstrated that increasing trends of low-frequency ocean sound levels are not uniform across the globe.

In 2016, construction to expand the Panama Canal was completed, which increased the canal's capacity to accommodate larger container ships. In July 2016, the Port of Baltimore received the first container ship, a 1,095-ft. Taiwanese cargo ship, that traveled through the expanded canal (Campbell, 2016). One potential impact from this expansion includes a shift of vessel traffic from the West Coast to the Gulf and East Coasts, increasing the number of larger container ships transiting through the Atlantic and Gulf Coasts. Key international trade advisers predict that no more than 5 percent of containerized imports currently routed through the West Coast would be diverted to the Gulf and East Coasts; however, it is still too early to evaluate the impact to U.S. ports from the expansion (Kruse, 2016) or how it will impact ocean noise levels.

In many areas of the world, oil and gas seismic exploration in the ocean is undertaken using groups of air guns towed behind large research vessels. The air guns 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 air guns is heard as low-frequency sound, which can travel long distances and has the potential to impact marine mammals. NMFS routinely issues permits for the taking of marine mammals associated with these commercial activities.

Offshore wind energy projects are another contributor to ocean noise. Impacts to marine mammals primarily result from pile-driving noise during construction of these facilities, whereas the operational phase has resulted in variable impacts (Bergström et al., 2014). The U.S. Department of Energy conducted a study within the mid-Atlantic Outer Continental Shelf to collect baseline ecological data and develop predictive models on wildlife distributions, abundance, and movements in locations where future wind energy facilities are proposed offshore of Delaware, Maryland, and Virginia (Williams et al., 2015). A variety of species were observed during boat, aerial, satellite telemetry, and passive acoustic surveys associated with this effort, including birds, fish, sea turtles, and marine mammals. While no information is available on large whale interactions with offshore wind facilities, bottlenose dolphins and common dolphins were identified as being most likely to be exposed to the proposed windfarm development activities based on the abundance of these species documented during the study period (Williams et al., 2015).

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 with other countries, including Canada (Roman et al., 2013).

Since 1971 the Canadian Department of Fisheries and Oceans has been regulating the commercial hunting of seals, including harp, hooded, and gray seals. Of the six species of seals found off the Atlantic coast of Canada, the harp seal is the most abundant and accounts for almost all the seals harvested commercially, followed by small numbers of gray seals and very few hooded seals (Fisheries and Oceans Canada, 2011). Ringed and bearded seals are primarily harvested for subsistence purposes, but it is prohibited to harvest harbor seals (Fisheries and Oceans Canada, 2011). Approximately 70 percent of Canadian seal harvests occurs in an area off the north and east coasts of Newfoundland and southern Labrador. Total allowable catches for each species are established and based on the long-term impacts of various harvest levels. For the 2016 hunting season, total allowable catches for hooded seals and harp seals are 8,200 and 400,000 animals, respectively, which includes remaining quotas rolled over from the 2015 hunting season (Fisheries and Oceans Canada, 2016a). Harp seal quotas are shared as percentages for the Quebec North Shore, Magdalen Islands, Western Newfoundland, and Gulf/Maritime Provinces (Fisheries and Oceans Canada, 2011). Hooded seals are not authorized to be harvested in the Gulf of St. Lawrence. Gray seal hunts typically occur along the eastern shore of Nova Scotia and in the Southern Gulf of St. Lawrence, from early February to early March. The total allowable catch for 2016 is 60,000 gray seals and includes a rollover from 2015 quotas (Fisheries and Oceans Canada, 2016b). The Front Sealing Areas, covering nearshore areas of Newfoundland and Labrador, and portions of the Gulf of St. Lawrence area, covering nearshore areas of Nova Scotia, overlap with the AFTT Study Area.

Vessel Strike

Ship strikes are also a growing issue for most large 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 (Currie et al., 2017; Van der Hoop et al., 2013; Van der Hoop et al., 2015).

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 underreporting 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. Between 2010 and 2014, there were 71 confirmed vessel strikes of baleen whales reported along the Atlantic Canadian Provinces, the U.S. Atlantic Coast, and the Gulf of Mexico, 34 of which resulted in mortality (Henry et al., 2016). Forty-seven of these strikes either occurred or likely occurred within U.S. waters. Species impacted included North Atlantic right whale, humpback whale, fin whale, sei whale, and minke whale. Henry et al. (2016) characterized vessels by size (greater than or less than or equal to 65 ft. in length) and speed (greater than or less than or equal to 10 knots), if known. One vessel strike occurred in 2012, which was specifically attributed to a submarine, approximately 3.1 NM offshore of Fort Story, Virginia. Another record was attributed to a racing sailboat, and two records were attributed to recreational vessels. All other strike records did not specify the type of vessel associated with the interaction. Aside from the submarine, the number of strikes specifically resulting from Navy vessels is not disclosed in the report.

An investigation of large whale strandings, mortalities, and necropsies reported between 1970 and 2009 on the Atlantic coasts of the United States and Canada found that, while vessel strike was the third leading cause of death for all marine mammal species combined, it was the main leading cause of death for fin and right whales alone (Van der Hoop et al., 2013). Impacts from ship strikes may have population-level implications for specific marine mammal species, particularly in small populations and possibly on larger scales (Laist et al., 2001; Van Waerebeek et al., 2007; Vanderlaan et al., 2009). Based on their behavior, North Atlantic right whales are significantly more vulnerable to ship strikes, and their small population size increases the likelihood of negative consequences to their population compared with other marine mammal species (Huntington, 2009; Knowlton & Kraus, 2001; Vanderlaan & Taggart, 2007). The North Atlantic right whale is two orders of magnitude more prone to vessel strike when the number of species-specific strikes are normalized by population sizes (Vanderlaan & Taggart, 2007). Findings also indicate that, to date, regulations and restrictions (both mandatory and voluntary) on vessel speeds and routing have not had a measurable effect on reducing the number of marine mammal mortalities from vessel strikes (Van der Hoop et al., 2015). For example, female right whales appear to be struck more often than males, which has detrimental effects for species recovery (Van der Hoop et al., 2012). Indeed, it has been suggested that preventing two female right whale mortalities per year may increase population growth to recovery levels (Fujiwara & Caswell, 2001). Similarly, West Indian manatees are highly susceptible to vessel strikes due to their inshore and coastal distribution and overlap with high levels of vessel traffic, making vessel strikes the leading anthropogenic cause of manatee mortality (Rommel et al., 2007).

Power Plant Entrainment

Coastal power plants use seawater as a coolant during power plant operation. Intakes into these plants can sometimes trap (i.e., entrain) marine mammals that swim too close to the intake pipe. Power plant entrainment contributes to human-related mortalities for gray seals (Waring et al., 2016). Conversely, Florida manatees rely on warm-water refuges typically associated with warm-water discharges from coastal power plants for winter habitats (Laist et al., 2013).

3.7.2.1.5.3 Disease and Parasites

Just as in humans, disease affects marine mammal health, especially older animals. Occasionally, disease epidemics can also injure or kill a large percentage of a population (Keck et al., 2010; Paniz-Mondolfi & Sander-Hoffmann, 2009). For example, since July 2013, bottlenose dolphins from all age classes have been stranding at elevated rates along the Atlantic coast from New York to Florida. Some live animals have stranded, but most were found dead. NMFS has attributed this unusual mortality event to cetacean morbillivirus (National Oceanic and Atmospheric Administration Fisheries, 2016).

Mass die-offs of some marine mammal species have been linked to toxic algal blooms, which occur as larger organisms consume multiple prey containing those toxins, thereby accumulating fatal doses. 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 2010; 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, 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).

An intense *Alexandrium tamarense* algal bloom occurred during the summer of 2008 in the St. Lawrence Estuary consisting of paralytic shellfish toxins that resulted in unprecedented mass mortalities of multiple species, including marine fish, birds, and marine mammals (Starr et al., 2017). Marine mammal mortalities from this bloom included 10 beluga whales, 7 harbor porpoises, 85 seals, and 1 juvenile fin whale. Presence of the paralytic shellfish toxins in live planktivorous fish, higher trophic level fish, benthic invertebrates, and zooplankton samples collected during the bloom provides direct evidence for the trophic transfer of the toxins to marine mammals, birds, and marine fish that feed on these organisms (Starr et al., 2017).

Mass mortality events of bottlenose dolphins and Florida manatees in Gulf waters and along the Florida Atlantic coast have been caused by severe blooms of *Karenia brevis*, a toxic algal species responsible for red tides (Fire et al., 2008; Fire et al., 2015; Keck et al., 2010; Paniz-Mondolfi & Sander-Hoffmann, 2009).

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).

3.7.2.1.5.4 Invasive Species

There are no known threats to marine mammals from invasive species in the Study Area.

3.7.2.1.5.5 Climate Change

The global climate is warming and impacting some populations of marine mammals (Baker et al., 2016; Fleming et al., 2016; Salvadeo et al., 2010; Shirasago-Germán et al., 2015; Silber et al., 2017; Simmonds & Eliott, 2009). Climate change can affect marine mammal species directly through habitat loss (especially for species that depend on ice or terrestrial areas) or gain, which may result in shifting distribution to match physiological tolerance under changing environmental conditions (Doney et al., 2012; Silber et al., 2017). Climate change can also affect marine mammals indirectly via impacts on prey, changing prey distributions and locations, and changes in water temperature. Species or populations with limited ranges, specialized diets, or similarly limiting ecological features may be particularly vulnerable to a changing climate (Baker et al., 2016). In more northern latitudes, the loss of sea ice and changing ice habitat are impacting marine mammals that are dependent on ice for resting, foraging, and reproduction (Jay et al., 2012; Laidre et al., 2015; Rode et al., 2014). Changes in prey can impact marine mammal foraging success, which in turn affects reproduction success and survival. Warmer ocean temperatures may appear to benefit cold-sensitive marine species, such as the Florida manatee; however, findings suggest that major threats to manatee populations, including vessel strikes from increased vessel traffic and harmful algal blooms, would likely increase as a result of climate change (Edwards, 2013).

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).

Climate change may indirectly influence marine mammals through changes in human behavior, such as increased shipping and oil and gas extraction, which benefit from sea ice loss (Alter et al., 2010). Ultimately, impacts from global climate change may result in an intensification of current and ongoing threats to marine mammals (Edwards, 2013). In addition, the ability of marine mammals to alter behaviors may serve as a buffer against measurable climate change–induced impacts and could delay or mask any adverse effects until critical thresholds are reached (Baker et al., 2016).

Marine mammals are influenced by climate-related phenomena, such as storms and other extreme weather patterns such as the 2015 to 2016 El Niño in the ocean off the U.S. west coast. Generally, not much is known about how large storms and other weather patterns affect marine mammals other than the fact that mass strandings (when two or more marine mammals become beached or stuck in shallow water) sometimes coincide with hurricanes, typhoons, and other tropical storms (Bradshaw et al., 2006; Marsh, 1989; Rosel & Watts, 2008) or other oceanographic conditions. There have also been correlations in time and space between strandings and the occurrence of earthquakes. However, there has been no scientific investigation demonstrating evidence for or against a relationship between earthquakes and the occurrence of marine mammal strandings. Indirect impacts may include altered water chemistry in estuaries (low dissolved oxygen or increased nutrient loading), causing massive fish kills (Burkholder et al., 2004), changing prey distribution and availability for cetaceans (Stevens et al., 2006). Human responses to extreme weather events may indirectly affect behavior and reproductive rates of marine mammals. For example, Miller et al. (2010) reported an increase in reproductive rates in bottlenose dolphins in the Mississippi Sound after Hurricane Katrina, presumably resulting from an increase in fish abundance due to a reduction in fisheries landings, a decrease in recreational and commercial boat activities (National Marine Fisheries Service, 2007a), and an increase in the number of reproductively active females available during the breeding seasons following the storm. Smith et al. (2013) supplemented the findings from this study and documented a marked increase in foraging activity in newly identified foraging areas that were observed during the 2-year study period after the storm.

Habitat deterioration and loss is a major concern for almost all coastal and inshore species of marine mammals, with effects ranging from depleting a habitat's prey base to the complete loss of habitat (Ayres et al., 2012; Kemp, 1996; Smith et al., 2009). 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., 2010; Sydeman et al., 2015). Poloczanska et al. (2016) analyzed climate change impact data that integrate multiple climate-influenced changes in ocean conditions (i.e., temperature, acidification, dissolved oxygen, and rainfall) to assess anticipated changes to a number of key ocean fauna across representative areas. In relation to the AFTT Study Area, the density of krill, an important prey item for marine mammals, has likely decreased in the southwest Atlantic because phytoplankton, a food source for krill, are also declining with warming temperatures and decreasing sea ice extent (Poloczanska et al., 2016). However, Poloczanska et al. (2016) also reports that zooplankton have displayed the highest rate of range expansion within the northeast Atlantic, supporting the general expectation that marine species will shift poleward within open oceans. On the other hand, for the northern Gulf of Mexico where coastlines prohibit poleward distributional shifts, marine species distributions, including fish and marine invertebrates, have displayed a depth shift toward cooler waters (Poloczanska et al., 2016). A similar marine mammal distributional response may occur based on observations made on select prey species, but marine mammal responses to climate change are currently unknown (Poloczanska et al., 2016).

3.7.2.1.5.6 Marine Debris

Marine debris is a global threat to marine mammals (National Oceanic and Atmospheric Administration Marine Debris Program, 2014). A literature review by Baulch and Perry (2014), found that 56 percent of cetacean species are documented as having ingested marine debris. Interactions between marine mammals and marine debris, including derelict fishing gear and plastics, are significant sources of injury and mortality (Baulch & Perry, 2014). Comparing the Baulch and Perry (2014) 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). 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 a 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 (Stamper et al., 2006; Tarpley & Marwitz, 1993), and sperm whales (Jacobsen et al., 2010; Sadove & Morreale, 1989). Manatee rescue records from 1993 to 2007 show that 27 percent of the cases were directly or indirectly associated with entanglement in or ingestion of marine debris, making entanglement and ingestion the top reason for rescuing manatees (Reinert et al., 2011).

In late 2009 through 2010, seafloor surveys were conducted about 64 km off the coast of Jacksonville, Florida, encompassing an area of approximately 754 square kilometers and about 86 km east of Mayport, Florida, of an area approximately 2,400 square kilometers within the Jacksonville Operating Area (OPAREA) (U.S. Department of the Navy, 2010, 2011d). These surveys were conducted to provide bottom mapping and habitat characterization in the Undersea Warfare Training Range within the Jacksonville OPAREA. Incidentally, images from a remotely operated vehicle used during ground-truthing operations revealed a few types of military expended materials, including a marine location marker (smoke float) used for antisubmarine warfare and search and rescue operations, as well as a 76-millimeter (mm) cartridge like that expended from U.S. Navy frigate usage (U.S. Department of the Navy, 2010, 2011d). While the amount of marine debris (non-military) observed during the surveys far exceeded the amount of military expended materials that was encountered, the reports did not quantify the levels of either marine debris or military expended materials present in the area. More general information about marine debris along the southeast Atlantic coast indicates that the vast majority of marine debris is either land-based (38 percent), general-source debris (42 percent), or from ocean-based recreational and commercial sources (20 percent) (Ribic et al., 2010); no items of military origin were differentiated.

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 (cm), commonly referred to as microplastics (Hidalgo-Ruz et al., 2012). Other researchers have defined microplastics as particles with a diameter ranging from a few micrometers up to 5 mm and are not readily visible to the naked eye (Andrady, 2015; Andrady, 2011). 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. The region of highest plastic concentration in the Northwest Atlantic is associated with the North Atlantic Subtropical Gyre, and lower concentrations were measured along the Florida coast and the Gulf of Maine (Law et al., 2010). Adjacent to the AFTT Study Area, Lusher et al. (2014) calculated the microplastic density in the Northeast Atlantic to be 2.46 particles per cubic meter. Filter feeders, such as baleen whales, routinely encounter microplastics without any apparent ill effects because there are no enzymes to breakdown the synthetic polymers, so they are never digested or absorbed (Andrady, 2011). 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 size from 1 mm to 17 cm. 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; Andrady, 2011).

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.

3.7.2.2 Endangered Species Act-Listed Species

As shown in Table 3.7-1 the marine mammal species and applicable stocks listed under the ESA and occurring within in the Study Area are bowhead whale, North Atlantic right whale, blue whale, fin whale, sei whale, sperm whale, polar bear, and West Indian manatee. The following subsections provide detailed species descriptions, including status and management, habitat and geographic range, population trends, predator and prey interactions, and species-specific threats.

3.7.2.2.1 Bowhead Whale (*Balaena mysticetus*)

3.7.2.2.1.1 Status and Management

The bowhead whale is listed as endangered under the ESA and is designated as depleted and considered a strategic stock under the MMPA. Three geographically distinct bowhead whale stocks are recognized in the Atlantic: the Spitsbergen, Baffin Bay-Davis Strait, and Hudson Bay-Fox Basin stocks (Allen & Angliss, 2010; Muto et al., 2016; Rugh et al., 2003; Wiig et al., 2007). Satellite tracking studies of whales tagged from the Baffin Bay-Davis Strait and Hudson Bay-Fox Basin stocks suggested and confirmed these two stocks should be considered as one stock (Eastern Canada-West Greenland stock) based on overlapping wintering areas (Frasier et al., 2015; Heide-Jørgensen et al., 2006). These stocks do not occur within U.S. Atlantic waters and are not managed under NMFS jurisdiction. The Eastern Canada-West Greenland stock is designated as a species of special concern by the Committee on the Status of Endangered Wildlife in Canada (Frasier et al., 2015).

3.7.2.2.1.2 Habitat and Geographic Range

Bowhead whales are the northernmost of all whales and are found in arctic and subarctic regions of the Atlantic and Pacific Oceans (55° N to 85° N). They are also found in the Bering, Beaufort, Chukchi, and Okhotsk Seas, as well as in the northern parts of Hudson Bay (Wiig et al., 2007). Their range can expand and contract depending on access through ice-filled Arctic straits (Rugh et al., 2003). Habitat selection varies seasonally, although this is clearly the most polar species of whale. Bowhead whales are found in continental slope and shelf waters during spring and summer while feeding on abundant zooplankton (Citta et al., 2015; Wiig et al., 2007).

Migration is associated with ice edge movements. All but the Sea of Okhotsk stock reside in higher Arctic latitudes during summer and move south in fall as the ice edge grows, spending their winters within the marginal ice zone in lower-latitude areas (Jefferson et al., 2015). The Eastern Canada-West Greenland stock spends winters in northern Hudson Bay, Hudson Strait, and from Labrador across to west Greenland and move north to spend summers in the Canadian High Arctic and around Baffin Island (Heide-Jørgensen et al., 2003). Summer aggregation areas are in northern Hudson Bay and around Baffin Island.

Bowhead whales would likely be found only in the Labrador Current open ocean area. The winter range of the Eastern Canada-West Greenland stock includes the shelf areas of west Greenland, northeastern Hudson Bay and Hudson Strait, the mouths of Cumberland Sound and Frobisher Bay on southeast Baffin Island, and northern Labrador. Bowhead whales would be expected to occur in winter within the Newfoundland-Labrador and Western Greenland Shelf Large Marine Ecosystems from November through April (Heide-Jørgensen et al., 2006). Two bowhead whales were stranded on Newfoundland in 1998 and 2005, from 45° N to 47° N and 52° W to 56° W, which at the time represented the southernmost records of this species in the western North Atlantic (Ledwell et al., 2007). In March 2012, a bowhead whale was observed in Cape Cod Bay and the same whale (identified from photographs) was again observed in Cape Cod Bay in April 2014 (Schweitzer, 2014). These sightings, in the Northeast U.S. Continental Shelf Large Marine Ecosystem now represent the southernmost record of this species in the western North Atlantic.

3.7.2.2.1.3 Population Trends

All estimates suggest that the population numbers have increased significantly since protection of bowheads from commercial whaling began in the first half of the 20th century (Committee on the Status of Endangered Wildlife in Canada, 2009).

3.7.2.2.1.4 Predator and Prey Interactions

Killer whales are the primary natural predator of the bowhead whale (George et al., 1994). Scars from killer whale attacks are observed on some individuals (Jefferson et al., 2015; Rugh & Shelden, 2009).

Bowheads feed at the surface, in the water column, and near the seafloor (Rugh & Shelden, 2009). Preferred prey are various species of copepods and euphausiids (Budge et al., 2008; Rugh & Shelden, 2009; Wiig et al., 2007). Laidre et al. (2007) found calanoid copepods were the primary prey of bowhead whales feeding off west Greenland.

3.7.2.2.1.5 Species-Specific Threats

Threats to bowhead whales include ship strikes, entanglement in fishing gear, contaminants, anthropogenic noise, especially from offshore oil exploration and development, and climate change. Section 3.7.2.1.5 (General Threats) discusses threats to marine mammals.

3.7.2.2.2 North Atlantic Right Whale (*Eubalaena glacialis*)

3.7.2.2.2.1 Status and Management

The North Atlantic right whale population is considered one of the most critically endangered populations of large whales in the world (Clapham et al., 1999). The size of this stock is considered extremely low relative to the Optimum Sustainable Population in the U.S. Atlantic Exclusive Economic

Zone, and this species is listed as endangered under the ESA. A recovery plan for the North Atlantic right whale is in effect (National Marine Fisheries Service, 2005a). The North Atlantic right whale has been protected from commercial whaling since 1949 by the International Convention for the Regulation of Whaling (62 Stat. 1716; 161 United Nations Treaty Series 72). A NMFS ESA status review in 1996 concluded that the western North Atlantic stock remains endangered. This conclusion was reinforced by the International Whaling Commission (Best et al., 2003), which expressed grave concern regarding the status of this stock. Relative to populations of southern right whales, there are also concerns about growth rate, percentage of reproductive females, and calving intervals in the North Atlantic right whale population. The total level of human-caused mortality and serious injury is unknown, but reported human-caused mortality was a minimum of three right whales per year from 2006 through 2010. Any mortality or serious injury to individuals within this stock should be considered significant. This is a strategic stock because the average annual human-related mortality and serious injury rates exceed potential biological removal and because the North Atlantic right whale is an endangered species.

Two ESA-designated critical habitats (Figure 3.7-3) for North Atlantic right whales have been designated by NMFS to encompass physical and biological features essential to conservation of the species (81 *Federal Register* 4838–4874, January 27, 2016). The northern unit includes the Gulf of Maine and Georges Bank region, which are key areas essential for right whale foraging. The southern unit includes the coast of North Carolina, South Carolina, Georgia, and Florida, which are key areas essential for calving. These two ESA-designated critical habitats were established in January 2016 to replace three smaller previously ESA-designated critical habitats (Cape Cod Bay/Massachusetts Bay/Stellwagen Bank, Great South Channel, and the coastal waters of Georgia and Florida in the southeastern United States) that had been designated by NMFS in 1994 (59 *Federal Register* 28805, June 3, 1994). Two additional critical habitat areas in Canadian waters, Grand Manan Basin and Roseway Basin, were identified in Canada's final recovery strategy for the North Atlantic right whale (Brown et al., 2009).

3.7.2.2.2.2 Habitat and Geographic Range

The western North Atlantic right whale population ranges primarily from calving grounds in coastal waters of the southeastern United States to feeding grounds in New England waters and the Canadian Bay of Fundy, Scotian Shelf, and Gulf of St. Lawrence. Generally, right whales can likely be found in Labrador Current, North Atlantic Gyre, and Gulf Stream open ocean areas, based on limited satellite tag, sighting, and historical whaling data.

Research suggests the existence of seven major habitats or congregation areas for western North Atlantic right whales. These include winter breeding grounds in the coastal waters of the southeastern United States and summer feeding grounds in the Great South Channel, Jordan Basin, Georges Bank along its northeastern edge, Cape Cod and Massachusetts Bays, the Bay of Fundy, and the Roseway Basin on the Scotian Shelf. Movements within and between habitats are extensive, evidenced by one whale making the round-trip migration from Cape Cod to Georgia and back at least twice during the winter (Brown & Marx, 2000). Results from satellite tags clearly indicate that sightings separated by perhaps 2 weeks should not necessarily be assumed to indicate a stationary or resident animal. Instead, telemetry data show rather lengthy and somewhat distant excursions, including into deep water off the continental shelf (Baumgartner & Mate, 2005; Mate et al., 1997).

The summer range for North Atlantic right whales includes the northeastern United States continental shelf, Scotian Shelf, and Newfoundland-Labrador shelf large marine ecosystems. New England waters are an important feeding habitat for right whales. Research suggests that right whales must locate and exploit extremely dense patches of zooplankton to feed efficiently (Mayo & Marx, 1990). These dense zooplankton patches are likely a primary characteristic of the spring, summer, and fall right whale habitats (Kenney et al., 1986; Kenney et al., 1995). Although feeding in the coastal waters off Massachusetts has been better studied than in other areas, right whale feeding has also been observed on the margins of Georges Bank, in the Great South Channel, in the Gulf of Maine, in the Bay of Fundy, and over the Scotian Shelf. The consistency with which right whales occur in such locations is relatively high, but these studies also highlight the high interannual variability in right whale use of some habitats.

LaBrecque et al. (2015a) identified three seasonal right whale feeding areas located in or near the Study Area (Figure 3.7-2) based on vessel and aerial survey efforts: (1) February to April on Cape Cod Bay and Massachusetts Bay, (2) April to June in the Great South Channel and on the northern edge of Georges Bank, and (3) June and July and October to December on Jeffreys Ledge in the western Gulf of Maine. A potential mating area was identified in the central Gulf of Maine (from November through January) based on a demographic study of North Atlantic right whale habitats, and the migratory corridor area along the U.S. East Coast between the southern calving grounds and northern feeding areas. The migratory corridor was substantiated through vessel- and aerial-based survey data, photo-identification data, radio-tracking data, and expert judgment. North Atlantic right whales migrate south to calving grounds in November and December and migrate north to the feeding areas in March and April.

Passive acoustic monitoring is demonstrating that the current understanding of the distribution and movements of right whales in the Gulf of Maine and surrounding waters is incomplete. Right whale calls have been detected by autonomous passive acoustic sensors deployed between 2005 and 2010 at three sites (Massachusetts Bay, Stellwagen Bank, and Jeffreys Ledge) in the southern Gulf of Maine (Morano et al., 2012a; Mussoline et al., 2012). Acoustic detections demonstrate that right whales are present more than aerial survey observations indicate. Comparisons between detections from passive acoustic recorders with observations from aerial surveys in Cape Cod Bay between 2001 and 2005 demonstrated that aerial surveys found whales on approximately two-thirds of the days during which acoustic monitoring detected whales (Clark et al., 2010).

The winter range for North Atlantic right whales includes the Southeast U.S. Continental Shelf Large Marine Ecosystem. LaBrecque et al. (2015a) used habitat analyses of sea surface temperatures and water depths and aerial sightings data to delineate a calving area in the southeast Atlantic, extending from Cape Lookout, North Carolina, to Cape Canaveral, Florida, that overlaps with the AFTT Study Area. This area, identified as biologically important, encompasses waters from the shoreline to the 25-meter (m) isobath from mid-November through late April. Passive acoustic monitoring conducted offshore of Cape Hatteras and in Onslow Bay, North Carolina, in 2011 and 2007, respectively, confirmed winter occurrence of North Atlantic right whales in these areas (McLellan et al., 2014).

Since 2004, consistent aerial survey efforts have been conducted during the migration and calving season (November 15 to April 15) in coastal areas of Georgia and South Carolina to the north of currently defined ESA-designated critical habitat (Glass & Taylor, 2006; Khan & Taylor, 2007; Sayre & Taylor, 2008; Schulte & Taylor, 2010). Results suggest that this region may not only be part of the migratory route but also a seasonal residency area. Results from an analysis by Schick et al. (2009) suggest that the migratory corridor of North Atlantic right whales is broader than initially estimated and that suitable habitat exists beyond the 20-nautical mile (NM) coastal buffer presumed to represent the primary migratory pathway (National Marine Fisheries Service, 2008a). Results were based on data modeled from two females with satellite-monitored radio tags as part of a previous study.

Four right whale sightings were documented during monthly aerial surveys approximately 50 miles (mi.) (80 km) offshore of Jacksonville, Florida, from 2009 to May 2016, including a female that was observed giving birth in 2010 (Foley et al., 2011). These sightings occurred well outside existing ESA-designated critical habitat for the right whale (Foley et al., 2011; U.S. Department of the Navy, 2011a). However, sighting data alone may not accurately represent North Atlantic right whale distribution. Beginning in April 2009 through May 2015, marine autonomous recording units have been deployed between 60 and 150 km offshore from Jacksonville, Florida. While sightings have generally occurred within continental shelf waters offshore from northeastern Florida and southeastern Georgia, recordings of North Atlantic right whales were detected in deeper waters during these monitoring efforts (Kumar et al., 2013; Norris et al., 2012), suggesting that distribution of this species extends further offshore than sighting data previously indicated (Oswald et al., 2016).

Right whales have occasionally been recorded in the Gulf of Mexico Large Marine Ecosystem (Moore & Clark, 1963; Ward-Geiger et al., 2011), but their occurrence there is likely extralimital. The few published records from the Gulf of Mexico represent either distributional anomalies, normal wanderings of occasional animals, or a more extensive historical range beyond the sole known calving and wintering ground in the waters of the southeastern United States (Moore & Clark, 1963; Ward-Geiger et al., 2011).

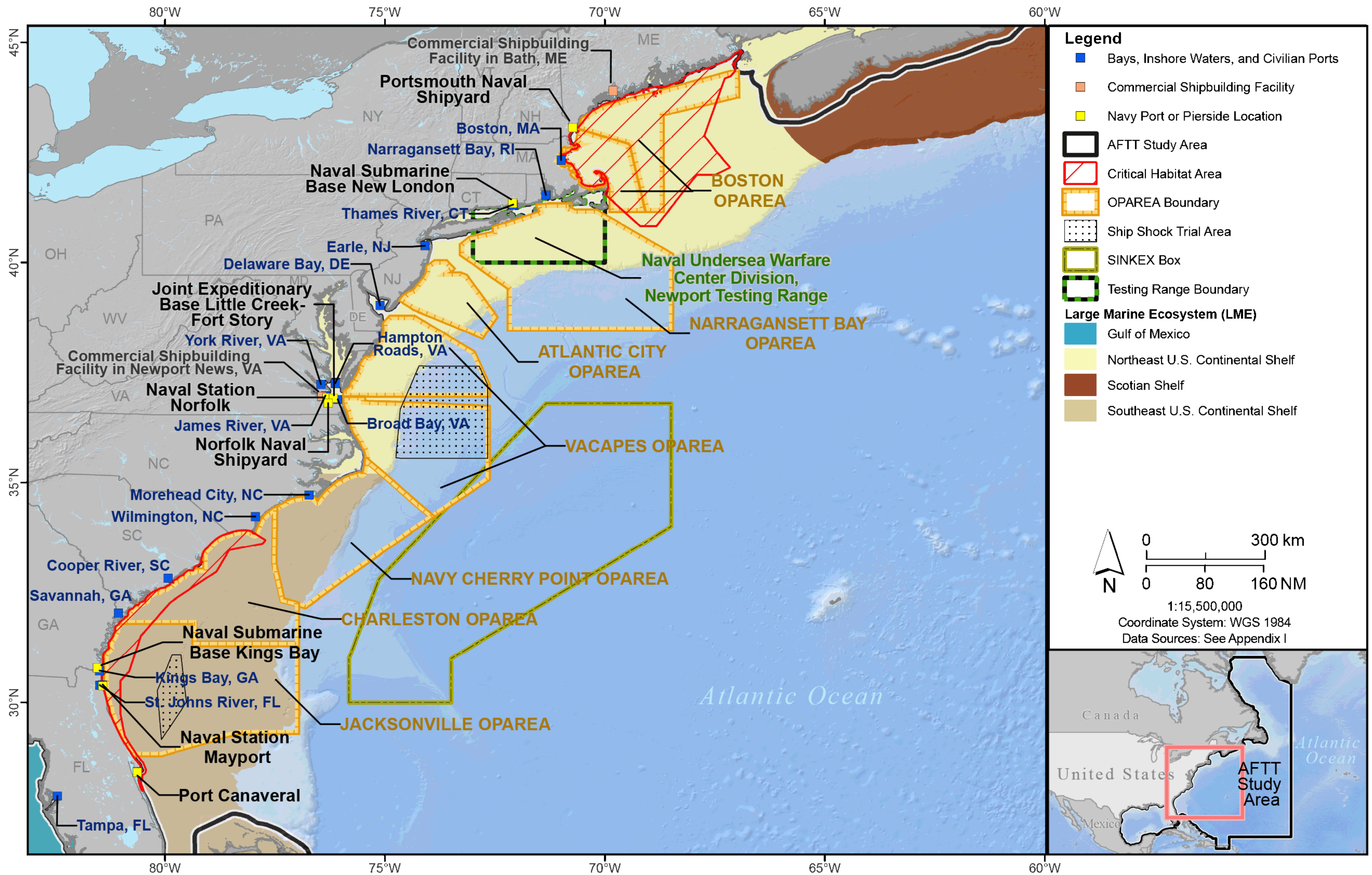
3.7.2.2.2.3 Population Trends

The population growth rate reported for 1986 to 1992 by Knowlton et al. (1994) was 2.5 percent (CV=0.12), suggesting that the stock was showing signs of slow recovery. However, subsequent work suggested that survival probability of an individual (averaged at the population level) declined from 0.99 per year in the early 1980s to about 0.94 in the late 1990s (Best et al., 2001; Caswell et al., 1999). Historical patterns of mortalities, including those in the first half of 2005, suggest an increase in the annual mortality rate, which would reduce population growth by approximately 10 percent annually (Kraus et al., 2005). However, the population continued to grow since that apparent interval of decline until 2012. Examination of the minimum number alive population index calculated from the individual sightings database (as it existed on October 27, 2015) for 1990 to 2012 suggests a declining trend in numbers (Hayes et al., 2017). There seems to be a considerable change in right whale habitat use patterns in areas where most of the population has previously been observed, which decreases the likelihood of finding right whales. Hayes et al. (2017) cautions interpreting the apparent downward trend in abundance in 2012, but without evidence to the contrary, it is possible that this deflection represents a true population decline.

3.7.2.2.2.4 Predator and Prey Interactions

The North Atlantic right whale is preyed on by killer whales and large sharks. Calves and juveniles are known to be the primary target of killer whales, and analysis of scars on some individuals suggests that they are also attacked by false killer whales (Jefferson et al., 2015; Kenney, 2008).

The North Atlantic right whale preys primarily on the copepod *Calanus finmarchicus* (a type of zooplankton) and on other copepods and small invertebrates, such as krill and larval barnacles (Jefferson et al., 2015). Right whales are skim feeders and are known to feed below or at the surface (Kenney et al., 2001) or within a few meters of the seafloor on near-bottom aggregations of copepods (Baumgartner, 2009; Baumgartner et al., 2009; Warren, 2009). The copepod *Calanus finmarchicus* is one of the most common species of prey found throughout the North Atlantic right whale's range (Baumgartner & Mate, 2003; Jefferson et al., 2015).



Notes: AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area; SINKEX: Sinking Exercise; VACAPES: Virginia Capes

Figure 3.7-2: Designated Critical Habitat Areas for North Atlantic Right Whale in the Study Area

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3.7.2.2.2.5 Species-Specific Threats

Primary sources of human-caused serious injury and mortality include entanglement in fishing gear and ship strikes. From 2011 to 2015, the minimum annual average human-induced mortality and serious injury incurred by this stock was 5.36 right whales per year, with incidental fishery entanglement records accounting for 4.55 whales per year and vessel strike records accounting for 0.81 whales per year (Hayes et al., 2018). Entanglement records from 1990 through 2007 maintained by NMFS Northeast Regional Office included 46 confirmed right whale entanglements, including right whales in weirs (stationary nets fixed in place), gillnets, and trailing line and buoys. Because whales often free themselves of gear following an entanglement event, scarring may be a better indicator of fisheries interaction than entanglement records. A review of scars detected on identified individual right whales over a period of 30 years (1980 to 2009) documented 1,032 definite, unique entanglement events on the 626 individual whales identified (Knowlton et al., 2012). Most individual whales (83 percent) were entangled at least once, and almost half of them (306 of 626) were definitely entangled more than once. About a quarter of the individuals identified in each year (26 percent) were entangled during that year. Juveniles and calves were entangled at higher rates than were adults. Scarring rates suggest that entanglements are occurring at about an order of magnitude greater than that detected from observations of whales with gear on them. Since 2009, new entanglement mitigation measures (79 *Federal Register* 26585-26621, June 27, 2014) have been implemented as part of the Atlantic Large Whale Take Reduction Plan, but their effectiveness has yet to be evaluated (Hayes et al., 2018). For additional detail on entanglement and large whales, refer to Section 3.7.3.5 (Entanglement Stressors, Mysticetes).

Ship strikes pose a particularly serious threat to the North Atlantic right whale. Vessel speed as well as angle of approach can influence the severity of ship strikes (Silber et al., 2010). Research shows that the probability of right whales dying after being struck by a ship is more than 80 percent when a vessel is traveling at 15 knots or more; when speeds are reduced to 10 knots or less, the chance of mortality drops to just above 20 percent. To reduce the number of ship strikes, NMFS has established regulations (73 *Federal Register* 60173–60191, October 10, 2008) imposing speed restrictions in seasonal management areas for commercial ships 65 ft. or longer. Analysis by Laist et al. (2014) incorporated an adjustment for drift around areas regulated under the ship strike rule and produced weak evidence on the effectiveness of the rule within seasonal management areas. However, Van der Hoop et al. (2015) concluded that large whale mortalities due to vessel strikes decreased inside seasonal management areas and increased outside inactive seasonal management areas. For additional detail on ship strikes and right whales, refer to Section 3.7.3.4.1 (Impacts from Vessels and In-Water Devices).

NMFS declared an unusual mortality event beginning June 2017 for North Atlantic right whales throughout their range along the Atlantic coast. Increased mortalities have been observed predominantly in the Gulf of St. Lawrence region in Canada and around Cape Cod, Massachusetts. In 2017, a total of 17 confirmed dead whales stranded in Canada and the U.S., and one additional whale stranded in the U.S. in 2018, bringing the total mortalities to 18 (National Marine Fisheries Service, 2018b). Full necropsy examinations have been conducted on 11 of the 18 North Atlantic right whale carcasses (National Marine Fisheries Service, 2018b). The results of necropsy reports for seven of those whales, which were found in the southern Gulf of St. Lawrence, are summarized in Daoust et al. (2018). Primary cause of death for four of the seven whales was attributed to acute trauma, likely caused by vessel collision, while two were considered to have died from acute entanglement in snow crab fishing gear with subsequent drowning (Daoust et al., 2018). The cause of death of one whale could not be determined because of advanced post-mortem decomposition, but some observations suggested blunt trauma. As of July 2018, the results of the remaining four necropsies were still pending.

3.7.2.2.3 Blue Whale (*Balaenoptera musculus*)

3.7.2.2.3.1 Status and Management

Blue whales are listed as endangered under the ESA, and the species is designated as a depleted and strategic stock under the MMPA. Critical habitat is not designated for blue whales. A recovery plan is in place for the blue whale in U.S. waters (National Marine Fisheries Service, 1998). Blue whales in the western North Atlantic are classified as a single stock (Waring et al., 2010).

Widespread whaling over the last century is believed to have decreased the worldwide population to approximately 1 percent of its pre-whaling population size; some authors have concluded that their population was about 200,000 animals before whaling (Branch, 2007). There was a documented increase in the blue whale population size in some areas between 1979 and 1994, but there is no evidence to suggest an increase in the population since then (Barlow & Taylor, 2001).

3.7.2.2.3.2 Habitat and Geographic Range

The distribution of the blue whale in the western North Atlantic generally extends from the Arctic to at least mid-latitude waters. Blue whales are most frequently sighted in the waters off eastern Canada, with the majority of recent records from the Gulf of St. Lawrence. Members of the North Atlantic population spend much of their time on continental shelf waters from eastern Canada (near the Quebec north shore) to the St. Lawrence Estuary and Strait of Belle Isle. Sightings were reported along the southern coast of Newfoundland during late winter and early spring (Reeves et al., 2004). Blue whales may be found in Labrador Current, North Atlantic Gyre, and Gulf Stream open ocean areas. Migratory movements in the western North Atlantic Ocean are largely unknown, but acoustic data indicate that blue whales winter as far north as Newfoundland and as far south as Bermuda and Florida, and they have been sighted along the mid-Atlantic ridge (Ryan et al., 2013).

The blue whale is best considered as an occasional visitor in U.S. Atlantic Exclusive Economic Zone waters, which may represent the current southern limit of its feeding range (Cetacean and Turtle Assessment Program, 1982). All five sightings described in the foregoing two references occurred in August. Using the U.S. Navy's Sound Surveillance System, blue whales were detected and tracked acoustically in much of the North Atlantic, including in subtropical waters north of the West Indies and in deep water east of the U.S. Atlantic Exclusive Economic Zone, indicating the potential for long-distance movements (Clark, 1995). Most of the acoustic detections were around the Grand Banks area of Newfoundland and west of the British Isles. Historical blue whale observations collected by Reeves et al. (2004) show a broad longitudinal distribution in tropical and warm temperate latitudes during the winter months, with a narrower, more northerly distribution in summer. Blue whales tagged in the Gulf of St. Lawrence in late fall left the St. Lawrence Estuary and used habitat more than 1,000 km offshore, as well as shelf and coastal waters of the eastern United States and Canada (Lesage et al., 2016).

Although the exact extent of their southern boundary and wintering grounds are not well understood, blue whales are occasionally found in waters off the U.S. Atlantic coast (Waring et al., 2013). Monthly aerial surveys have been conducted offshore of Cape Hatteras and Onslow Bay, North Carolina, since May 2011, although no visual sightings of blue whales have been documented. However, acoustic monitoring has also been conducted in the same region since 2011 and resulted in the detections of blue whales on bottom-mounted high-frequency acoustic recording packages (McLellan et al., 2014; Read et al., 2014). Yochem & Leatherwood (1985) summarized records that suggested an occurrence of this species south to Florida and the Gulf of Mexico, although the actual southern limit of the species' range is unknown. Blue whale strandings have been recorded as far south as the Caribbean and the Gulf of Mexico (Waring et al., 2010).

3.7.2.2.3.3 Population Trends

There are insufficient data to determine population trends for this species (Waring et al., 2010).

3.7.2.2.3.4 Predator and Prey Interactions

This species preys almost exclusively on various types of zooplankton, especially krill. They lunge feed and consume approximately 6 tons (5,500 kilograms) of krill per day (Jefferson et al., 2015; Pitman et al., 2007). They often feed at depths greater than 100 m, where their prey maintains dense groupings (Acevedo-Gutiérrez et al., 2002; Calambokidis et al., 2009; Croll et al., 2001). Blue whales are documented as being preyed on by killer whales (Jefferson et al., 2015; Pitman et al., 2007). There is little evidence that killer whales attack this species in the North Atlantic or southern hemisphere, but 25 percent of photo-identified whales in the Gulf of California carry rake scars from killer whale attacks (Sears & Perrin, 2008).

3.7.2.2.3.5 Species-Specific Threats

Threats to North Atlantic blue whales are poorly known but may include ship strikes, pollution, entanglement in fishing gear, and long-term changes in climate that may affect their prey distribution. Section 3.7.2.1.5 (General Threats) discusses threats to marine mammals.

3.7.2.2.4 Fin Whale (*Balaenoptera physalus*)

3.7.2.2.4.1 Status and Management

The fin whale is listed as endangered under the ESA and is considered a depleted and strategic stock under the MMPA. A final recovery plan was published in July 2010 for fin whales in U.S. waters. The International Whaling Commission recognizes seven management stocks of fin whales in the North Atlantic Ocean: (1) Nova Scotia (2) Newfoundland-Labrador, (3) West Greenland, (4) East Greenland-Iceland, (5) North Norway, (6) West Norway-Faroe Islands, and (7) British Isles-Spain-Portugal. NMFS assumes management of the western North Atlantic stock, which is likely equivalent to the Nova Scotia management stock. The stock identity of North Atlantic fin whales has received relatively little attention, and whether the current stock boundaries define biologically isolated units has long been uncertain (Hayes et al., 2017). Fin whales in the Gulf of St. Lawrence may be a separate stock (Ramp et al., 2014).

3.7.2.2.4.2 Habitat and Geographic Range

Fin whales prefer temperate and polar waters and are rarely seen in warm tropical waters (Reeves et al., 2002a). They typically congregate in areas of high productivity and spend most of their time in coastal and shelf waters but can often be found in waters approximately 2,000 m deep (Aissi et al., 2008; Reeves et al., 2002a). Fin whales are often seen closer to shore after periodic patterns of upwelling (underwater motion) and the resultant increased krill density (Azzellino et al., 2008). This species is highly adaptable, following prey, typically off the continental shelf (Azzellino et al., 2008; Panigada et al., 2008). Fin whales are likely common in Labrador Current, North Atlantic Gyre, and Gulf Stream open ocean areas while undergoing seasonal migrations. However, some fin whales remain in higher latitudes during colder months and in lower latitudes during warmer months, indicating that seasonal fin whale movements differ from the seasonal migrations of other mysticetes, such as blue whales and humpback whales (Edwards et al., 2015). Fin whales are also common off the Atlantic coast of the United States in waters immediately off the coast seaward to the continental shelf (at about the 1,000-fathom contour).

In the mid-Atlantic region, they tend to occur north of Cape Hatteras where they accounted for about 46 percent of the large whales observed in surveys conducted between 1978 and 1982 (National Marine Fisheries Service, 2010a). During the summer, fin whales in this region tend to congregate in feeding areas between 41°20' N and 51°00' N, from the shore seaward to the 1,000-fathom contour. In the western Atlantic, they winter from the edge of sea ice (near the Gulf of St. Lawrence) south to the Gulf of Mexico and the West Indies (National Marine Fisheries Service, 2010a).

Fin whales are observed in the Gulf of Maine, the Bay of Fundy, the Gulf of St. Lawrence, and in offshore areas of Nova Scotia (Coakes et al., 2005; Johnston et al., 2005). Near the Bay of Fundy, fin whales are known to congregate close to the tip of Campobello Island, where they feed within localized upwellings and fronts in the Northeast U.S. Continental Shelf Large Marine Ecosystem (Johnston et al., 2005).

Fin whale sightings and acoustic detections are greatest in New England waters during spring and summer, with scattered sightings over the northeast shelf in winter, indicating that some fin whales are present during the non-feeding season (Hain et al., 1992; Morano et al., 2012b; Waring et al., 2014). Fin whales are also observed in the Gulf of Maine, the Bay of Fundy, the Gulf of St. Lawrence, and in offshore areas of Nova Scotia (Coakes et al., 2005; Johnston et al., 2005). Near the Bay of Fundy, fin whales are known to congregate close to the tip of Campobello Island, where they feed within localized upwellings and fronts in the Northeast U.S. Continental Shelf Large Marine Ecosystem (Johnston et al., 2005). Acoustic data from the U.S. Navy's Sound Surveillance System arrays suggest that animals undertaking southward migrations in the fall generally travel south past Bermuda to the West Indies (Clark, 1995); however, a migration corridor for fin whales in the U.S. Atlantic Exclusive Economic Zone is not known (LaBrecque et al., 2015a).

New England waters are considered a major feeding ground for fin whales, and there is evidence that females continually return to this site (Hayes et al., 2017). Forty-nine percent of fin whales sighted in the feeding grounds of Massachusetts Bay were sighted again within the same year, and 45 percent were sighted again in multiple years (Hayes et al., 2017). LaBrecque et al. (2015a) identified three feeding areas for fin whales in the North Atlantic within the Study Area: (1) June to October in the northern Gulf of Maine, (2) year-round in the southern Gulf of Maine, and (3) March to October east of Montauk Point, as substantiated through vessel-based survey data, photo-identification data, and expert judgment.

Calving may take place during October to January in latitudes of the U.S. mid-Atlantic region; however, it is unknown where calving, mating, and wintering occur for most of the population (Hain et al., 1992). Results from the Navy's Sound Surveillance System (Clark, 1995) indicate a substantial deep-ocean distribution of fin whales. It is likely that fin whales occurring in the U.S. Exclusive Economic Zone in the Atlantic Ocean undertake migrations into Canadian waters, open-ocean areas, and perhaps even subtropical or tropical regions. However, the popular notion that entire fin whale populations make distinct annual migrations like some other mysticetes has questionable support from the data.

Aerial surveys conducted monthly around the Norfolk Canyon began in January 2015 and have resulted in eight fin whale sightings, six of which were documented in May 2016.

Fin whales have been detected frequently throughout the winter months during passive acoustic monitoring efforts conducted from 2007 through 2015 within the continental shelf break and slope waters off Onslow Bay, North Carolina (Hodge et al., 2014, 2015, 2016; U.S. Department of the Navy, 2013c). Aerial surveys conducted monthly offshore of Cape Hatteras since May 2011 have resulted in seven total sightings of fin whales, primarily during the fall and spring (McLellan et al., 2014). Additional sightings during small vessel fieldwork conducted off the coast of Cape Hatteras survey area between July 2009 and December 2014 occurred in 2012 (one individual) and 2013 (two individuals) (Foley et al., 2015). Visual surveys, acoustic and satellite tagging, passive acoustic monitoring, biopsy, and photo-identification efforts conducted from January 2014 to December 2014 resulted in three biopsy samples in 2013 and a new photo-identification catalogue in 2014 for a fin whale that was previously observed offshore of Cape Hatteras in 2013 (Foley et al., 2015).

Visual surveys and passive acoustic monitoring conducted from 2007 to 2011 in Onslow Bay, North Carolina, indicate fin whale occurrence in this area between late fall and early spring (Hodge, 2011). Monthly aerial surveys conducted between June 2007 and April 2011 only resulted in one sighting of fin whales in March 2010. However, high-frequency recording packages deployed between November 2007 and April 2010 in Onslow Bay detected 20-Hz pulses from fin whales primarily in the winter months, starting in November and continuing through mid-April, suggesting that fin whales are migrating past Onslow Bay during this time (Hodge, 2011).

In the western Atlantic, limited data indicate that some fin whales winter from the edge of sea ice (near the Gulf of St. Lawrence) south to the Gulf of Mexico and the West Indies (Clark, 1995).

3.7.2.2.4.3 Population Trends

Due to imprecise abundance estimates and variable survey design, a population trend analysis has not been conducted for fin whales (Hayes et al., 2018).

3.7.2.2.4.4 Predator and Prey Interactions

This species preys on small invertebrates such as copepods, as well as squid and schooling fishes such as capelin, herring, and mackerel (Goldbogen et al., 2006; Jefferson et al., 2015). The fin whale is not known to have a significant number of predators. However, in regions where killer whales are abundant, some fin whales exhibit attack scars on their flippers, flukes, and flanks, suggesting possible predation by killer whales (Aguilar, 2008).

3.7.2.2.4.5 Species-Specific Threats

Fin whales are susceptible to both ship strikes and entanglement in fishing gear. Section 3.7.2.1.5 (General Threats) discusses threats to marine mammals.

3.7.2.2.5 Sei Whale (*Balaenoptera borealis*)

3.7.2.2.5.1 Status and Management

The sei whale is listed as endangered under the ESA and is considered a depleted and strategic stock under the MMPA. Critical habitat is not designated for sei whales. A recovery plan for the sei whale was finalized in 2011 (National Marine Fisheries Service, 2011b). While the genetic differentiation between sei whale stocks in the North Atlantic is low, it is considered to be consistent with their extensive range of movements and does not fully support rejecting the existence of multiple stocks in the North Atlantic (Huijser et al., 2018). Two stocks of sei whale are recognized by NMFS in the North Atlantic: a Nova Scotia stock and a Labrador Sea stock (Hayes et al., 2017). The Nova Scotia stock is considered in the management unit under NMFS jurisdiction; it includes the continental shelf waters of the northeastern United States and extends northeastward to south of Newfoundland. The Labrador Sea stock is outside of NMFS jurisdiction but occurs within the Study Area.

3.7.2.2.5.2 Habitat and Geographic Range

Sei whales have a worldwide distribution and are found primarily in cold temperate to subpolar latitudes. Sei whales are typically found in the open ocean and are rarely observed near the coast (Horwood, 2008; Jefferson et al., 2015). They are generally found between 10° and 70° latitudes. Satellite tagging data indicate sei whales feed and migrate east to west across large sections of the North Atlantic (Olsen et al., 2009); they are not often seen within the equatorial Atlantic. In the Study Area, the open ocean range includes the Labrador Current, North Atlantic Gyre, and Gulf Stream open ocean areas.

During the winter, sei whales are found from 20° N to 23° N and during the summer from 35° N to 50° N (Horwood, 2008; Masaki, 1976, 1977; Smultea et al., 2010). They are considered absent or at very low densities in most equatorial areas and in the Arctic Ocean. Sei whales spend the summer feeding in subpolar high latitudes and return to lower latitudes to calve in winter. However, no migratory corridor for sei whales has been identified in U.S. Atlantic waters (LaBrecque et al., 2015a). There are no known sei whale mating or calving grounds in U.S. Atlantic waters (LaBrecque et al., 2015a). Whaling data provide some evidence of varied migration patterns, based on reproductive class, with females arriving at and departing from feeding areas earlier than males (Horwood, 1987; Perry et al., 1999). Sei whales are known to swim at speeds greater than 25 km per hour and may be one of the fastest cetaceans, after the fin whale (Horwood, 1987; Jefferson et al., 2015).

The range of the Nova Scotia stock includes the continental shelf waters of the northeastern United States and extends northeastward to south of Newfoundland. During the feeding season, a large portion of the Nova Scotia sei whale stock is centered in northerly waters of the Scotian Shelf (Hayes et al., 2017). The range of the Labrador Sea stock likely includes continental shelf waters near Labrador and Newfoundland, although satellite tag data indicate that most of that stock may use the deeper water areas between Greenland and Labrador (Prieto et al., 2014). Using data from vessel-based surveys, LaBrecque et al. (2015a) delineated a feeding area for sei whales in the northeast Atlantic between the 25-m contour off coastal Maine and Massachusetts to the 200-m contour in central Gulf of Maine, including the northern shelf break area of Georges Bank. The feeding area also includes the southern shelf break area of Georges Bank from 100 to 2,000 m and the Great South Channel. Feeding activity in the U.S. Atlantic waters is concentrated from May through November with a peak in July and August.

The southern portion of the species' range during spring and summer includes the northern portions of the U.S. Exclusive Economic Zone in the Atlantic Ocean, including the Gulf of Maine and Georges Bank. During spring and summer, sei whales occur in waters from the Bay of Fundy to northern Narragansett Bay. Large concentrations are often observed along the northern flank, eastern tip, and southern shelf break of Georges Bank. During the fall, sei whales may be found in limited shelf areas of the Northeast Channel and in the western Gulf of Maine (Cetacean and Turtle Assessment Program, 1982; Stimpert et al., 2003). Spring is the period of greatest abundance in Georges Bank and into the Northeast Channel area, along the Hydrographer Canyon (Cetacean and Turtle Assessment Program, 1982; Waring et al., 2010). Although uncommon near the coastline, two strandings of sei whales have been reported on the Virginia coast in 2003 and 2011 (King, 2011; Swingle et al., 2014).

Passive acoustic monitoring conducted offshore of Cape Hatteras, North Carolina, since 2011 resulted in the detections of sei whales on bottom-mounted high-frequency acoustic recording packages that were not observed during visual surveys (McLellan et al., 2014). Passive acoustic monitoring conducted offshore of Jacksonville, Florida, from 2009 through 2012 also included detections of sei whales on marine acoustic recording units during the winter of 2009 to 2010 (Oswald et al., 2016) and possible detections on high-frequency acoustic recording packages during the winter of 2010 and 2011 (Hodge & Read, 2013).

3.7.2.2.5.3 Population Trends

Due to imprecise abundance estimates and long periods of time between surveys, a trend analysis has not been conducted for sei whales (Hayes et al., 2017).

3.7.2.2.5.4 Predator and Prey Interactions

Sei whales feed on copepods, amphipods, euphausiids, shoaling fish, and squid (Horwood, 2008); (Nemoto & Kawamura, 1977). Feeding occurs primarily around dawn, which appears to be correlated with vertical migrations of prey species (Horwood, 2008). Unlike other rorquals, the sei whale skims to obtain its food, although like other rorqual species, it does some lunging and gulping (Horwood, 2008). Sei whales, like other baleen whales, are likely subject to occasional attacks by killer whales.

3.7.2.2.5.5 Species-Specific Threats

There are no significant species-specific threats to sei whales in the northwest Atlantic. Section 3.7.2.1.5 (General Threats) discusses general threats to marine mammals.

3.7.2.2.6 Sperm Whale (*Physeter macrocephalus*)

3.7.2.2.6.1 Status and Management

The sperm whale has been listed as an endangered species since 1970 under the precursor to the ESA (National Marine Fisheries Service, 2009) and is listed as depleted and strategic under the MMPA. Whether the northwestern Atlantic population is discrete from northeastern Atlantic is currently unresolved. The International Whaling Commission recognizes one stock for the North Atlantic, based on reviews of many types of stock studies (e.g., tagging, genetics, catch data, mark and recapture, biochemical markers). A recovery plan is in place for the sperm whale in U.S. waters (National Marine Fisheries Service, 1998). There are currently two stocks of sperm whales recognized within the Study Area managed under NMFS jurisdiction: the western North Atlantic and the Gulf of Mexico stocks. In 2013, NMFS determined that a petition to list the Gulf of Mexico stock as a distinct population segment was not warranted based on a review of best available information on physical, physiological, ecological, and behavioral factors (78 *Federal Register* 68032–68037, November 13, 2013). A 5-year review for sperm whales was finalized in 2015 (National Marine Fisheries Service, 2015b).

3.7.2.2.6.2 Habitat and Geographic Range

Sperm whales are found throughout the world's oceans in deep waters to the edge of the ice at both poles (Leatherwood & Reeves, 1983; Rice, 1989; Whitehead, 2002). Sperm whales show a strong preference for deep waters (Rice, 1989; Whitehead, 2003). Their distribution is typically associated with waters over the continental shelf break, over the continental slope, and into deeper waters and mid-ocean regions. However, in some areas, adult males are reported to consistently frequent waters with bottom depths less than 100 m and as shallow as 40 m (Jefferson et al., 2008b; Jefferson et al., 2015; Romero et al., 2001). 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). Sperm whales form large matrilineal social groups consisting of adult females and their offspring, which generally inhabit waters greater than 1,000 m deep at latitudes less than 40°. Young males stay with the matrilineal group for 4 to 21 years, then leave to join bachelor schools consisting of young males. As males age, they are found in progressively smaller groups and at progressively higher latitudes. Sperm whale migration is not well understood and is not as seasonally based as that observed in mysticete whales.

Sperm whales may be found in Labrador Current, North Atlantic Gyre, and Gulf Stream open ocean areas. Sperm whales are found throughout the Gulf Stream and North Atlantic Gyre, and adult male distribution likely extends into the Labrador Current. In 1972, extensive survey cruises covering much of the western and central North Atlantic Ocean found high densities of sperm whales in the Gulf Stream region, between 40° N and 50° N and over the North Atlantic Ridge (National Marine Fisheries Service, 2010b).

Off Nova Scotia, coastal whalers found sperm whales primarily in deep continental slope waters, especially in submarine canyons and around the edges of banks. During late spring and throughout the summer, sperm whales are found on the continental shelf in waters less than 100 m deep on the southern Scotian Shelf and into the northeast United States (National Marine Fisheries Service, 2010b; Palka, 2006). High densities of sperm whales were also found in the Grand Banks of Newfoundland (National Marine Fisheries Service, 2010b).

Sperm whales that occur in the eastern U.S. Exclusive Economic Zone in the Atlantic Ocean likely represent only a fraction of the total stock. The nature of linkages of the U.S. habitat with those to the south, north, and offshore is unknown. Historical whaling records compiled by Schmidly (1981) suggested an offshore distribution off the southeast United States, over the Blake Plateau, and into deep ocean waters. Distribution along the East Coast of the United States is centered along the shelf break and over the slope. In winter, sperm whales are concentrated east and northeast of Cape Hatteras, North Carolina. In spring, the center of distribution shifts northward to east of Delaware and Virginia and is widespread throughout the central portion of the mid-Atlantic Bight and the southern portion of Georges Bank. In summer, the distribution is similar but now also includes the area east and north of Georges Bank and into the Northeast Channel region, as well as the continental shelf (inshore of the 100-m isobath) south of New England. In fall, sperm whale occurrence south of New England on the continental shelf is at its highest level, and there remains a continental shelf edge occurrence in the mid-Atlantic Bight. Similar inshore (less than 200 m) observations were made on the southwestern and eastern Scotian Shelf, particularly in the region of "the Gully" (Whitehead & Weilgart, 1991).

Beginning January 2015, monthly aerial surveys have been conducted around the Norfolk Canyon, which to date has resulted in four sperm whale sightings during the summer and fall. Aerial surveys conducted offshore of Cape Hatteras, North Carolina, since 2011 have resulted in common occurrence of sperm whales, primarily in the spring and summer months (McLellan et al., 2014). Since 2012, passive acoustic monitoring has been conducted within continental shelf break and slope waters off Cape Hatteras. Sperm whale clicks have been detected consistently throughout the recording days; however, there is significant difference between day and night occurrence (U.S. Department of the Navy, 2013c). Additional passive acoustic monitoring continued in this area through 2015, which resulted in detection of sperm whale foraging clicks on 70 percent of the recording days, demonstrating seasonal variability patterns (Stanistreet et al., 2015). Tagging studies conducted between January and December 2014 resulted in two sperm whale encounters between May and October and one biopsy sample collected in June, and the first sperm whale photo-identification catalogue match occurred in 2014 with a sperm whale last seen in May 2013 (Foley et al., 2015).

Passive acoustic monitoring conducted in Onslow Bay, North Carolina, between 2007 and 2013 confirmed year-round occurrence of sperm whales, along with a nocturnal increase in occurrence of clicks and greater vocal activity on recorders located in deeper waters of the monitoring area (Hodge, 2011; Read et al., 2014; U.S. Department of the Navy, 2013c). Researchers confirmed occurrence of sperm whale vocalizations in Onslow Bay on a recorder deployed at water depths of 230 m and 366 m, along with regular nocturnal occurrence of sperm whale clicks near the shelf break, suggesting that foraging activities were occurring at that time (Hodge et al., 2013). This diel pattern is in contrast to what was recorded offshore of Cape Hatteras (Stanistreet et al., 2013). Habitat models also support findings of sperm whale occurrence in the U.S. Economic Exclusion Zone waters offshore of Onslow Bay (Best et al., 2012). Visual surveys in Onslow Bay and analysis of remotely sensed oceanographic data were used to determine the effects of dynamic oceanography. The findings from this study indicate that the presence of Gulf Stream frontal eddies and the location of the Gulf Stream Front influenced sperm whale vocalization rates, among other species (Thorne et al., 2012).

Monthly aerial surveys conducted since January 2009 offshore of Jacksonville, Florida, have only documented two sperm whale sightings in pelagic waters of the survey area (Cummings et al., 2016). Deployment of high-frequency acoustic recording packages off Jacksonville from 2009 through 2015 has resulted in zero sperm whale detections. However, sperm whales were one of the most commonly detected species on marine autonomous recording units deployed just beyond the shelf in approximate water depth of 183 m during the fall and winter of 2009 and 2010 offshore of Jacksonville (Oswald et al., 2016). Sperm whales detections were recorded exclusively near the continental shelf break during the fall deployment with detections recorded every day. They were also the third most common species with detections on all but 2 days during the winter deployment (Oswald et al., 2016). Recordings showed a strong diel pattern with almost all vocalization events occurring between sunset and sunrise (Kumar et al., 2013; Oswald et al., 2016).

The sperm whale is the most common large cetacean in the northern Gulf of Mexico (Palka & Johnson, 2007). The distribution of sperm whales in the Gulf of Mexico is strongly linked to surface oceanography, such as Loop Current eddies that locally increase production and availability of prey (O'Hern & Biggs, 2009). Most sperm whale groups were found within regions of enhanced sea surface chlorophyll (O'Hern & Biggs, 2009). Ship-based and aerial based surveys indicate that sperm whales are widely distributed only in waters deeper than 200 m in the northern Gulf of Mexico (Waring et al., 2014), specifically inhabiting the continental slope and oceanic waters (Fulling et al., 2003; Maze-Foley & Mullin, 2006; Mullin & Hoggard, 2000; Mullin & Fulling, 2004; Mullin et al., 2004). Seasonal aerial surveys confirm that sperm whales are present in the northern Gulf of Mexico in all seasons (Hansen et al., 1996; Mullin et al., 1994a; Mullin & Hoggard, 2000). Sperm whales aggregate at the mouth of the Mississippi River and along the continental slope in or near cyclonic cold-core eddies (counterclockwise water movements in the northern hemisphere with a cold center) or anticyclone eddies (clockwise water movements in the northern hemisphere) (Davis et al., 2007). Habitat models for sperm whale occurrence indicate a high probability of suitable habitat along the shelf break off the Mississippi delta, Desoto Canyon, and western Florida (Best et al., 2012; Weller et al., 2000). Due to the nutrient-rich freshwater plume from the Mississippi Delta the continental slope waters south of the Mississippi River Delta and the Mississippi Canyon play an important ecological role for sperm whales (Davis et al., 2002; Weller et al., 2000). Sightings during extensive surveys in this area consisted of mixed-sex groups of females, immature males, and mother-calf pairs as well as groups of bachelor males (Jochens et al., 2008; Weller et al., 2000). Female sperm whales have displayed a high level of site fidelity and year-round utilization off the Mississippi River Delta compared to males (Jochens et al., 2008), suggesting this area may also support year-round feeding, breeding, and nursery areas (Baumgartner et al., 2001; National Marine Fisheries Service, 2010a), although the seasonality of breeding in Gulf of Mexico sperm whales is not known (Jochens et al., 2008).

In the eastern Gulf of Mexico, the continental slope waters west of the Florida Keys and the Dry Tortugas also support sperm whale occurrence (Maze-Foley & Mullin, 2006; Mullin & Fulling, 2004) likely due to the influence of the Loop Current and eddies on primary productivity and prey availability in the area (Biggs et al., 2005; Oey et al., 2005). The information for southern Gulf of Mexico waters is more limited, but there are sighting and stranding records from each season, with sightings widely distributed in continental slope waters of the western Bay of Campeche (Ortega-Ortiz, 2002).

NMFS winter ship surveys of waters surrounding Puerto Rico and the U.S. Virgin Islands indicate that sperm whales inhabit continental slope and oceanic waters (Roden & Mullin, 2000; Swartz & Burks, 2000; Swartz et al., 2002). Earlier sightings from the northeastern Caribbean were reported by Erdman (1970), Erdman et al. (1973), and Taruski and Winn (1976), and these and other sightings from Puerto Rican waters are summarized by Mignucci-Giannoni (1988). For years up to 1989, Mignucci-Giannoni found 43 records for sperm whales in waters of Puerto Rico, U.S. Virgin Islands, and British Virgin Islands and suggested these whales occur from late fall through winter and early spring but are rare from April to September. In addition, sperm whales are one of the most common species to strand in waters of Puerto Rico and the Virgin Islands (Mignucci-Giannoni et al., 1999). In the southeast Caribbean, both large and small adults, as well as calves and juveniles of different sizes, are reported (Watkins et al., 1985).

3.7.2.2.6.3 Population Trends

There has been considerable variation in point estimates of northern Gulf of Mexico sperm whale abundance based on data collected from 1991 to 2009. Differences in temporal abundance will be difficult to interpret without a Gulf of Mexico-wide (including waters belonging to Mexico and Cuba) understanding of sperm whale abundance. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for changes in abundance (Waring et al., 2016). As a result, a trend analysis for the North Atlantic stock of sperm whales has not been conducted (Waring et al., 2016).

3.7.2.2.6.4 Predator and Prey Interactions

Sperm whales socialize for predator defense as well as foraging. Sperm whales feed on squid, other cephalopods (a type of mollusc), and bottom-dwelling fish and invertebrates (Davis et al., 2007; Marcoux et al., 2007; Rice, 1989). Exactly how sperm whales search for, detect, and capture their prey remains uncertain. Site-specific ecological factors, such as predation pressure and food availability, likely influence fundamental aspects of sperm whale social organization (Fais et al., 2015; Jaquet & Gendron, 2009). False killer whales, pilot whales, and killer whales have been documented harassing and, on occasion, attacking sperm whales (Baird, 2009).

3.7.2.2.6.5 Species-Specific Threats

The Gulf of Mexico stock of sperm whales was 1 of 31 cetacean stocks impacted by the 2010 *Deepwater Horizon* oil spill in the Gulf of Mexico. Injury quantification was based on measured bottlenose dolphin injuries observed within Barataria Bay and Mississippi Sound between 2010 and 2013 and was applied to bay, sound, and estuary stocks, coastal stocks, and oceanic stocks of other cetacean species within the oil spill footprint. Analyses determined that 16 percent of sperm whales in the Gulf of Mexico were exposed to oil, resulting in 6 percent excess mortality above baseline conditions, 7 percent excess failed pregnancies, and 6 percent higher likelihood for other adverse health effects. Without active restoration efforts, recovery of the Gulf of Mexico sperm whale stock will take an estimated 21 years (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016). Refer to Section 3.7.2.1.5.1 (Water

Quality) for additional information on the *Deepwater Horizon* oil spill. Section 3.7.2.1.5 (General Threats) discusses other threats to marine mammals.

3.7.2.2.7 Polar Bear (*Ursus maritimus*)

3.7.2.2.7.1 Status and Management

In May 2008, the polar bear was added as a threatened species under the ESA due to loss of sea ice habitat caused by climate change; it is also considered a strategic and depleted stock under the MMPA. Critical habitat was designated for areas of the Alaska coast in 2010, but there is no ESA-designated critical habitat within the AFTT Study Area. The polar bear is managed by the USFWS under the Department of the Interior, but it does not occur within the U.S. Exclusive Economic Zone in the Atlantic Ocean.

3.7.2.2.7.2 Habitat and Geographic Range

Polar bears can be found in multi-year pack ice throughout the Arctic, but they generally prefer annual ice over the continental shelf (Stirling, 2009). Typically, they are found near the floe edge and in areas of moving ice (Stirling, 2009). They appear to prefer areas with ice concentrations greater than 50 percent but less than 100 percent (Rozhnov et al., 2015) and have displayed repeated annual and seasonal movements to the same areas within their habitat range (i.e., home-range fidelity) (Sahanatien et al., 2015). However, they are also known to make migrations of 2,000 to 4,000 km (Jefferson et al., 2015). Polar bears generally do not spend much time on land, unless the ice has melted and they have no access to ice (Amstrup & DeMaster, 1988). Polar bears in Davis Strait, Foxe Bay, Hudson Bay, and Baffin Bay spend summer and autumn on shore during the ice-free period (Peacock et al., 2013). During light or late ice years elsewhere, polar bears undertake more extended swimming than in heavier ice years (Durner et al., 2011; Pagano et al., 2012). During aerial surveys in the Beaufort Sea conducted between 1987 and 2003, 3.8 percent of sightings were made in open water, and in aerial surveys conducted in 2004, 19.9 percent of sightings occurred in open water (Monnett & Gleason, 2006). Observations of free-swimming polar bears from 1987 to 2003 showed that they can occur at a distance of 4.9 to 75.3 km from land and 22 to 349 km from pack ice (Monnett & Gleason, 2006). An adult female polar bear in the Beaufort Sea swam continuously for 687 km over 9 days (Durner et al., 2011).

The polar bear occurs at the northern extreme of the Study Area in association with pack ice between Canada and Greenland. Polar bears are found throughout the Canadian Arctic to Greenland and Svalbard, Norway. Historically, they were found as far south as James Bay, Newfoundland, and Iceland in the North Atlantic (Amstrup & DeMaster, 1988; DeMaster & Stirling, 1981). The Davis Strait polar bear subpopulation, which accounts for most of the polar bears that occur in the Study Area, is distributed in the Labrador Sea, eastern Hudson Strait, Davis Strait, and southwest Greenland (Committee on the Status of Endangered Wildlife in Canada, 2002).

3.7.2.2.7.3 Population Trends

The Davis Strait subpopulation of polar bear is the most likely to occur within the Study Area, but the Foxe Basin and Baffin Bay subpopulations also occur near the Study Area (Committee on the Status of Endangered Wildlife in Canada, 2002; Hutchings & Festa-Bianchet, 2009). The subpopulation in Baffin Bay appears to be declining, whereas the subpopulations in Foxe Basin and Davis Strait are stable (International Union for Conservation of Nature, 2017).

3.7.2.2.7.4 Predator and Prey Interactions

Sea ice is the main platform from which polar bears forage (Auger-Methe et al., 2016). Polar bears obtain most of their prey from the sea but rarely hunt directly in the water (Amstrup, 2003; Jefferson et al., 2008b; Jefferson et al., 2015). They feed mainly on ringed seals but are also known to take bearded, hooded, and harp seals (Jefferson et al., 2015). Although seals are their primary source of prey, they are known to hunt larger animals, such as walruses and even small beluga whales and narwhals (Rugh & Shelden, 1993; Stirling, 2009). Similar to other bear species, polar bears will feed on human refuse and, when trapped on land for long periods, are known to feed on small amounts of terrestrial vegetation (Amstrup, 2003). They are also known to take birds, bird eggs, and caribou (Gormezano & Rockwell, 2013; Iles et al., 2013; Iverson et al., 2014), as well as Arctic cod (Jefferson et al., 2015). Polar bears in Hudson Bay and southeastern Baffin Island are known to fast for many months, while ice is melting during the summer, returning to the ice when it re-forms in the autumn. It appears that these animals have amazing fasting abilities but generally do not fast if they have regular access to sea ice throughout the year. Polar bears hunt by waiting near a hole in the ice used by seals for breathing and then attack when the seal surfaces to breathe. They have a well-developed sense of smell, which they use to do much of their hunting (Amstrup, 2003). In at least some areas, the diets of polar bears have shifted from species associated with ice (ringed and bearded seals) to species less associated with ice (harbor, harp and hooded seals) (McKinney et al., 2009). Polar bears have no natural predators.

3.7.2.2.7.5 Species-Specific Threats

The primary threat to this species is climate change and associated sea ice loss. Changes in sea ice patterns thought to be caused by climate change is reducing the size, growth, reproduction, and survival of polar bears in affected areas and is significantly shrinking their available habitat (Amstrup, 2003; Durner et al., 2009).

3.7.2.2.8 West Indian Manatee (*Trichechus manatus*)

3.7.2.2.8.1 Status and Management

In 2017, the USFWS issued a final rule to downlist the West Indian manatee from endangered to threatened under the ESA (82 *Federal Register* 16668–16704, April 5, 2017). The West Indian manatee is still considered a depleted and strategic stock under the MMPA.

The West Indian manatee is divided into the Florida (*Trichechus manatus latirostris*) and Antillean (*Trichechus manatus manatus*) subspecies (Lefebvre et al., 2001). Both subspecies may be found in the Study Area, although the Antillean manatee only occurs in the Caribbean Sea Large Marine Ecosystem, extending eastward to Puerto Rico (Lefebvre et al., 2001). The Antillean manatee (Puerto Rico stock) is managed by the USFWS Caribbean Ecological Services Field Office in Boquerón, Puerto Rico, with jurisdiction only in Puerto Rico and the U.S. Virgin Islands (U.S. Fish and Wildlife Service, 2014b). This population is considered as a single population with minimal, if any subdivisions within the island.

The Florida population is closely monitored and managed by the USFWS and the Florida Fish and Wildlife Conservation Commission (U.S. Fish and Wildlife Service, 2014a). The Florida manatee population is divided into four management units: the Upper St. Johns River (4 percent of the population), Atlantic Coast (46 percent), Southwest Florida (38 percent), and Northwest Florida (12 percent). Data indicate that the Upper St. Johns River and Northwest Florida management units are flourishing, and the Atlantic Coast management unit is likely stable. The USFWS is researching the status of the Southwest Florida management unit (U.S. Fish and Wildlife Service, 2010). Preliminary analyses from the USFWS indicate that all four management units are doing well.

Critical habitat is designated at multiple inland rivers and coastal waterways throughout Florida, although the designation does not define any primary constituent elements. The ESA-designated critical habitat only overlaps with the Study Area within the St. Johns River (Mayport), Banana River (Port Canaveral), St. Mary's River entrance channel (Kings Bay), and a small portion of inshore waters encompassed by the South Florida Ocean Measurement Facility Testing Range boundary (Figure 3.7-3). However, the Mayport basin and the Trident basin are not considered ESA-designated critical habitat by the USFWS. A petition to revise manatee ESA-designated critical habitat was submitted in 2009, and a 12-month finding on that petition by the USFWS stated that revisions should be made, including defining primary constituent elements. However, sufficient funding is not currently available (75 *Federal Register* 1574–1581, January 12, 2010). In 2012, the USFWS issued a final rule establishing a manatee refuge in Kings Bay, Citrus County, Florida, which includes its tributaries and connected waters (77 *Federal Register* 15617–15635, March 16, 2012). However, this new refuge does not overlap with the Study Area.

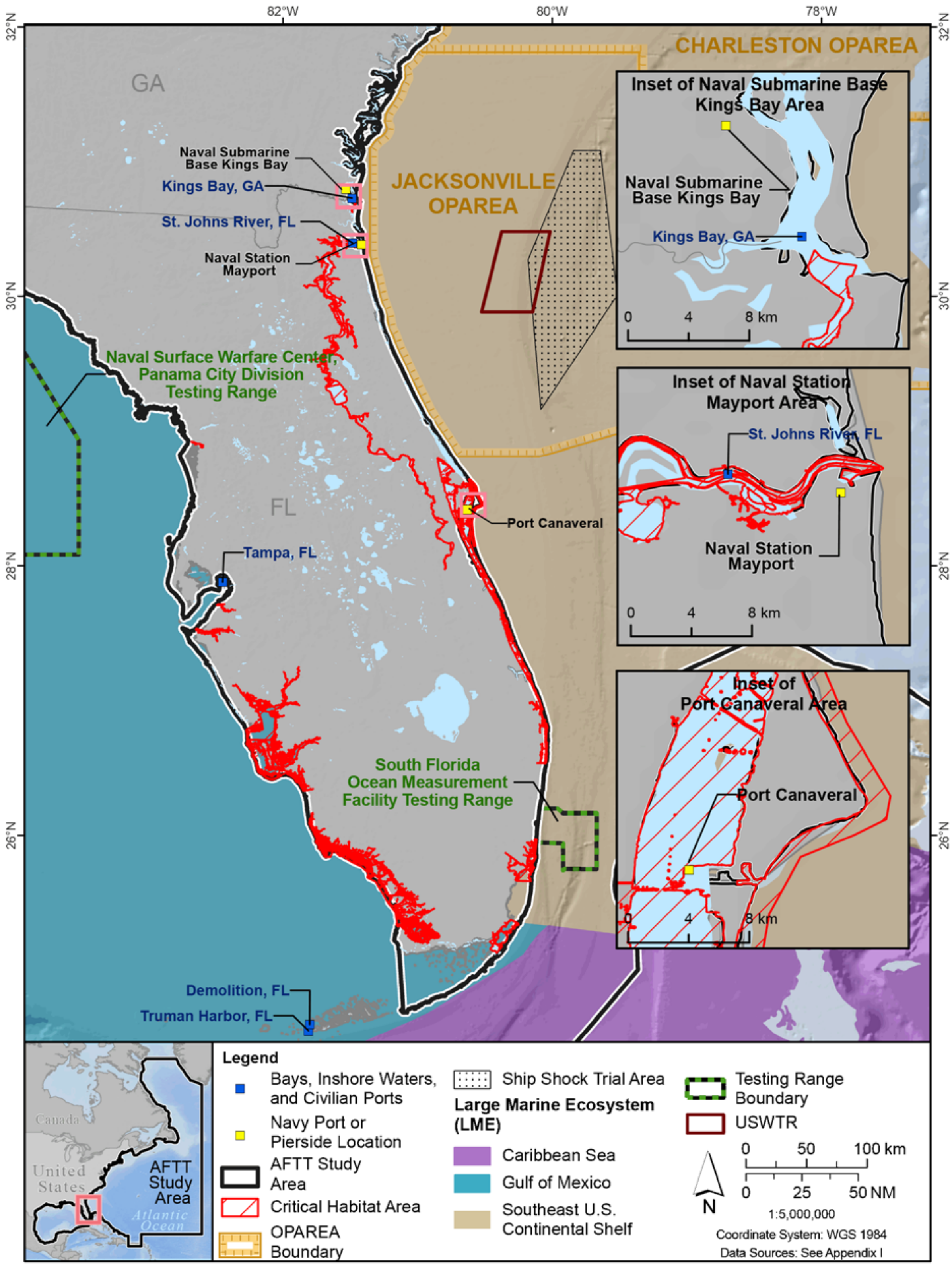
3.7.2.2.8.2 Habitat and Geographic Range

Manatees are found in coastal marine, brackish, and freshwater habitats. They are typically found in seagrass beds, canals, creeks, embayments, and lagoons near the mouths of rivers and sloughs (Lefebvre et al., 2000). Habitat selection is influenced by food, water temperatures, and freshwater resources. Females with calves are influenced by additional factors when selecting habitats, including ambient noise, currents, and increased amounts of forage (Gannon et al., 2007). Groups of manatees, sometimes in the hundreds, often congregate near sources of warm water (Deutsch et al., 2003; Jefferson et al., 2008b; Jefferson et al., 2015).

Florida manatees are found throughout the southeastern United States. Because manatees are a subtropical species with little tolerance for cold, they are generally restricted to the inshore and coastal waters of peninsular Florida during the winter, when they shelter in or near warm-water springs, industrial effluents, and other warm-water sites (Hartman, 1979; Lefebvre et al., 2001; Stith et al., 2006). In warmer months, manatees leave these sites and can disperse great distances. Individuals have been sighted as far north as Massachusetts, as far west as Texas, and in all states in between (Fertl et al., 2005; Rathbun, 1988). Warm-weather sightings are most common in Florida, coastal Georgia, and Alabama, but increased sightings have been reported in Mid-Atlantic states such as North Carolina and Virginia between June and October (Cummings et al., 2014).

As part of the 12-month finding to revise ESA-designated critical habitat, the USFWS recognizes the significance of warm water to the survival of the Florida manatee and the importance of availability and adequacy of warm-water refugia. Additional features to be considered in the analysis for revising ESA-designated critical habitat may include adequate forage within dispersal distance of a warm-water refuge, areas needed for calving and nursing, and important travel corridors for movements throughout Florida and beyond (75 *Federal Register* 1574–1581, January 12, 2010).

In the Study Area, the West Indian manatee (Florida subspecies) occurs from the southeastern U.S. to the Caribbean (Jefferson et al., 2015; Morales-Vela et al., 2003). The West Indian manatee's primary range extends along both the Atlantic and Gulf coasts of Florida, while the secondary range extends north to the coastal waters of North Carolina on the east side and into the Gulf of Mexico on the west side. Tagging efforts of manatees in Cumberland Sound, Georgia have documented manatees within the Naval Submarine Base Kings Bay. They were also documented to regularly use the Intracoastal Waterway, which may place them at higher risk of boat strikes (Bryan County News, 2017; Georgia Aquarium, 2017; Georgia Department of Natural Resources, 2017).



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

Figure 3.7-3: Designated Critical Habitat Areas for Florida Manatee in the Study Area

Most of the tagged individuals from this study head to Florida inshore areas in late summer, long before water temperatures decline, and spend the winter months around Brevard County, Florida. A few individuals delayed migration, which appeared to be triggered by a specific temperature. Tagging results showed these individuals stopping at man-made warm-water sites along the way. It was noted that these sites are not always operational, which could be critically detrimental to manatees that rely on man-made warm-water refuges. Possible implications for these individuals would include suffering from cold stress (Bryan County News, 2017; Georgia Aquarium, 2017; Georgia Department of Natural Resources, 2017). Manatees are reported regularly in coastal rivers of Georgia and South Carolina in warmer months (Lefebvre et al., 2001) as they migrate north from Florida winter sites to Georgia in the spring and occupy tidal waters throughout coastal Georgia from April through October (Bryan County News, 2017; Georgia Aquarium, 2017; Georgia Department of Natural Resources, 2017). Manatees are common in the St. Johns River and Port Canaveral and may have limited seasonal occurrence in the Pascagoula River, Great Bay, Sabine Lake, and Galveston Bay.

The Antillean subspecies of West Indian manatee is only found in eastern Mexico and Central America, northern and eastern South America, and in the Greater Antilles (Lefebvre et al., 1989) within the Caribbean Large Marine Ecosystem. All studies suggest that manatees in Puerto Rico are most often detected in protected areas around cays, in secluded bays, and in shallow seagrass beds east of San Juan; the east, south, and southwest coasts; and not far from freshwater sources (U.S. Fish and Wildlife Service, 2014a). The distribution of the Antillean manatee extends eastward only to Puerto Rico, except for one 1988 report in St. Thomas, U.S. Virgin Islands; however, transient animals are known to occur in the Lesser Antilles (Lefebvre et al., 2001). The offshore islands of Puerto Rico, including Caja de Muertos, Culebra, and Vieques are considered significant biogeographic features, although manatees do not use the western offshore islands of Mona and Desecheo (U.S. Fish and Wildlife Service, 2014b). Mona Passage constitutes a migratory barrier to these islands since it is characterized by strong currents and high surf. There have been few sightings in Caja de Muertos and Culebra Island. Vieques Island is within the range of the species, and manatees have been observed traveling to and from the east coast (Magor, 1979). Radio tagging techniques in Puerto Rico have documented general behavior of manatee populations, where males displayed more extensive movements than females (Slone et al., 2006).

3.7.2.2.8.3 Population Trends

Demographic analyses indicate that the Florida stock of manatees is increasing or stable throughout much of Florida (Runge et al., 2004; Runge et al., 2007). A survival rate analysis for the Florida manatee, conducted from 1983 through 2007, identifies a survival rates for four regions in Florida ranging from 97 to 98 percent (Runge et al., 2015). The fastest growing segment of this stock is found in the St. Johns River, with a growth rate of 6.2 percent (95 percent confidence interval 3.7 to 8.1 percent) (Runge et al., 2004). Population modeling of the Florida manatee predicts that assuming all current threats remain constant, there is less than a 2.5 percent chance that the southeastern U.S. population of Florida manatees will fall below 4,000 individuals over the next 100 years (Runge et al., 2015).

The USFWS suggests that the Puerto Rico stock of manatees (Antillean subspecies) is at least stable and possibly slightly increasing due to increasing numbers detected in annual surveys (U.S. Fish and Wildlife Service, 2014b), however they caution that information from direct counts cannot be used to determine population trends. Population viability analyses used to predict the likely future status of a given population describes the Antillean manatee population with positive growth, which would continue as long as human-induced mortality does not exceed 5 percent of the population (Castelblanco-Martinez et al., 2012).

The USFWS's 12-month finding to reclassify the West Indian manatee from endangered to threatened further confirms that populations are improving. Although the ranking of threats to the species have not changed, the impacts of those threats is considered lower due to a better understanding of the resiliency of the population (Runge et al., 2015).

3.7.2.2.8.4 Predator and Prey Interactions

West Indian manatees are herbivorous and are known to consume more than 60 species of plants. They typically feed on bottom vegetation, plants in the water column, and shoreline vegetation, such as hyacinths and marine seagrasses (Reynolds et al., 2008). In some areas, they are known to feed on algae and parts of mangrove trees (Jefferson et al., 2015; Mignucci-Giannoni & Beck, 1998).

Although large sharks, crocodiles, and killer whales are all considered to be potential predators, there is little evidence to confirm this (Weller, 2008).

3.7.2.2.8.5 Species-Specific Threats

The Florida manatee is negatively impacted by cold stress, hurricanes, toxic red tide poisoning, habitat destruction (such as loss of seagrass), and other natural and human-made factors. However, vessel strikes are the single greatest cause of death for Florida manatees, accounting for 24 percent of manatee deaths in Florida during the last 30 years (Jett & Thapa, 2010). A review of research on the effectiveness of laws reducing boat speeds in areas of known manatee habitat indicated that reducing boat speeds in specific areas is an appropriate, reasonable, and defensible management action, although more studies on the effectiveness of boat speed reduction have been recommended (Calleson & Frohlich, 2007).

Unlike the Florida manatee, mass mortalities due to red tide or need for warm water habitats do not pose a threat to the Antillean manatee, given their location in tropical habitats. One mass mortality (four males and one female) was documented in 2006 when the individuals were impacted by a large vessel in the San Juan Bay (U.S. Fish and Wildlife Service, 2014b). Similar to the Florida manatee, vessel strikes are the leading cause of human-induced mortalities of Antillean manatees (U.S. Fish and Wildlife Service, 2014b).

3.7.2.2.9 Ringed Seal (*Phoca hispida*)

On December 28, 2012, National Ocean and Atmospheric Administration Fisheries published a final rule listing the Arctic subspecies of the ringed seal (*Phoca hispida*) as threatened under the ESA. On March 11, 2016, the U.S. District Court for the District of Alaska used a decision vacating the listing of the Arctic ringed seal as threatened. Following an appeal, the U.S. Court of Appeals for the Ninth Circuit reversed and remanded the decision on February 12, 2018, thereby upholding the National Ocean and Atmospheric Administration Fisheries' listing of the Arctic ringed seals as a threatened species. The Arctic ringed seal may be re-listed once the U.S. District Court for the District of Alaska renders final judgment in this case. Therefore, though the ringed seal may be re-listed in the near future, for purposes of this EIS/OEIS, the ringed seal is included under Section 3.7.2.3 (Species Not Listed Under the Endangered Species Act) and is discussed in Section 3.7.2.3.32 (Ringed Seal [*Phoca hispida*]).

3.7.2.3 Species Not Listed Under the Endangered Species Act

As shown Table 3.7-1, most marine mammals are not listed under the ESA; however, all are afforded protection under the MMPA. Species not listed under the ESA are discussed in the following subsections.

3.7.2.3.1 Humpback Whale (*Megaptera novaeangliae*)

3.7.2.3.1.1 Status and Management

A recent status review identified 15 distinct population segments globally based primarily on breeding areas (Bettridge et al., 2015). Partially based on this status review, NMFS issued a final rule to divide the globally listed species into 14 distinct population segments and revise the listing status of each breeding population (81 *Federal Register* 62260–62320, September 8, 2016). After evaluating the danger of extinction of each distinct population segment, four distinct population segments (Cape Verde Islands/Northwest Africa, Western North Pacific, Central America, and Arabian Sea) are currently listed under the ESA as endangered and one distinct population segment (Mexico) is listed as threatened. The remaining nine distinct population segments, including the West Indies distinct population segment that occurs within the AFTT Study Area, do not warrant listing under the ESA because they are neither in danger of extinction nor likely to become so in the foreseeable future. All humpback whales feeding in the North Atlantic are considered part of the West Indies distinct population segment (Bettridge et al., 2015), including the Gulf of Maine stock. The West Indies distinct population segment feeding range primarily includes the Gulf of Maine, eastern Canada, and western Greenland (80 *Federal Register* 22304–22345, April 21, 2015) and breeding grounds include waters of the Dominican Republic and Puerto Rico (81 *Federal Register* 62260–62320, September 8, 2016).

For management purposes in U.S. waters, NMFS identified stocks that are based on feeding areas. Although the western North Atlantic population was once treated as a single management stock, the Gulf of Maine stock has been identified as a discrete subpopulation based on strong fidelity of humpbacks feeding in that region (Hayes et al., 2017). The Gulf of Maine stock is the only stock of humpbacks in the Atlantic managed under NMFS jurisdiction. However, it should be noted that several other discrete humpback whale subpopulations, based on feeding grounds, are in the western North Atlantic, including the Gulf of St. Lawrence, Newfoundland/Labrador, and western Greenland (Hayes et al., 2017).

3.7.2.3.1.2 Habitat and Geographic Range

Humpback whales are distributed worldwide in all major oceans and most seas. Most humpback whale sightings are in nearshore and continental shelf waters; however, humpback whales frequently travel through deep oceanic waters during migration (Calambokidis et al., 2001; Clapham & Mattila, 1990). Humpback whales of the western North Atlantic are typically found in Labrador Current, North Atlantic Gyre, and Gulf Stream open ocean areas during seasonal migrations from northern latitude feeding grounds, occupied during the summer, to southern latitude calving and breeding grounds occupied in the winter (Hayes et al., 2017). The Gulf of St. Lawrence, Newfoundland Grand Banks, West Greenland, and Scotian Shelf are summer feeding grounds for humpbacks (Cetacean and Turtle Assessment Program, 1982; Kenney & Winn, 1986; Stevick et al., 2006; Whitehead, 1982). The Gulf of Maine is also one of the principal summer feeding grounds for humpback whales in the North Atlantic. The largest numbers of humpback whales are present from mid-April to mid-November. Other feeding locations in this ecosystem are Stellwagen Bank, Jeffreys Ledge, the Great South Channel, the edges and shoals of Georges Bank, Cashes Ledge, and Grand Manan Banks (Cetacean and Turtle Assessment Program, 1982; Kenney & Winn, 1986; Stevick et al., 2006; Weinrich et al., 1997; Whitehead, 1982). LaBrecque et al. (2015a) delineated a humpback whale feeding area in the Gulf of Maine, Stellwagen Bank, and Great South Channel, substantiated through vessel-and aerial-based survey data, photo-identification data, radio-tracking data, and expert judgment. Humpback whales feed in this area from March through

December. Humpback feeding habitats are typically shallow banks or ledges with high seafloor relief (Hamazaki, 2002; Payne et al., 1990).

On breeding grounds, females with calves occur in much shallower waters than other groups of whales, and breeding adults use deeper more offshore waters (Ersts & Rosenbaum, 2003; Smultea, 1994). The habitat requirements of wintering humpbacks appear to be controlled by the conditions necessary for calving, such as warm water and relatively shallow, low-relief ocean bottom in protected areas, created by islands or reefs (Clapham, 2000; Craig & Herman, 2000; Smultea, 1994).

Individual variability in the timing of migrations may result in the presence of individuals in high-latitude areas throughout the year (Straley, 1990). Records of humpback whales off the U.S. mid-Atlantic coast (New Jersey to North Carolina) from January through March suggest these waters may represent a supplemental winter feeding ground used by juvenile and mature humpback whales of United States and Canadian North Atlantic stocks (LaBrecque et al., 2015a).

Humpbacks are most likely to occur near the mouth of the Chesapeake Bay and coastal waters of Virginia Beach between January and March; however, they could be found in the area year-round, based on sighting and stranding data in both mid-Atlantic waters and the Chesapeake Bay itself (Barco et al., 2002). Photo-identification data support the repeated use of the mid-Atlantic region by individual humpback whales (Barco et al., 2002). Preliminary results of vessel surveys offshore of Virginia show site fidelity in the AFTT Study Area for some individuals and a high level of occurrence within the shipping channels—an important high-use area by both the Navy and commercial traffic (Aschettino et al., 2015). Beginning January 2015, the offshore Norfolk Canyon Region was added to the monthly aerial survey efforts offshore of Virginia, which documented five sightings of humpback whales, mostly during the spring months. Line-transect survey efforts in the Mine Warfare Exercise box within Warning Area-50 of the Virginia Capes Range Complex from August 2012 through August 2015 have resulted in 26 humpback whale sightings across fall, winter, and spring months (Engelhaupt et al., 2015; Engelhaupt et al., 2016).

Aerial and vessel monitoring conducted offshore of Cape Hatteras, North Carolina, in Onslow Bay, North Carolina, and offshore of Jacksonville, Florida confirmed winter occurrence of humpback whales in these three areas of the Atlantic as well as observations in Onslow Bay during the spring months (U.S. Department of the Navy, 2013c).

There are occasional reports of humpback whales in the Gulf of Mexico but those sightings should be considered extralimital.

3.7.2.3.1.3 Population Trends

Current data suggest that the Gulf of Maine humpback whale stock is characterized by a positive trend in size (Hayes et al., 2018). This is consistent with an estimated average growth trend of 3.1 percent (SE=0.005) in the North Atlantic population overall for the period 1979 to 1993 (Stevick et al., 2003).

3.7.2.3.1.4 Predator and Prey Interactions

Humpback whales feed on a variety of invertebrates and small schooling fishes. The most common invertebrate prey are krill; the most common fish prey are herring, mackerel, sand lance, sardines, anchovies, and capelin (Clapham & Mead, 1999). Feeding occurs both at the surface and in deeper waters, wherever prey is abundant. The humpback whale is the only species of baleen whale that shows strong evidence of cooperation when feeding in large groups (D'Vincent et al., 1985). Humpback whales were observed using “bubble nets” to herd prey (Jefferson et al., 2015). Bubble nets are a feeding strategy where the whales dive and release bubbles of air that float up in a column and trap prey inside; the humpbacks then lunge through the column of trapped prey to feed.

Sensors attached to humpback whales foraging on Stellwagen Bank, Massachusetts allowed researchers to measure in fine detail the orientation and movement patterns of both humpback whales and their prey at meaningful ecological scales (Friedlaender et al., 2009). Findings indicate that differences between surface and bottom feeding behaviors in humpback whales correlated with vertical changes in the distribution and abundance of their primary prey, sand lance. In addition to prey abundance, other factors relate to humpback whale surface feeding in the Gulf of Maine, such as time of day and the height of the tides (Hazen et al., 2009). Characteristics of the prey, such as light emitted and the shape of the schools formed by the prey, also relate to humpback whale surface-feeding.

This species is known to be attacked by both killer whales and false killer whales, as evidenced by tooth rake scars on their bodies and fins (Jefferson et al., 2015).

3.7.2.3.1.5 Species-Specific Threats

Minimum annual rates of human-caused mortality and serious injury to the Gulf of Maine humpback whale stock averaged 8.25 animals per year from 2011 to 2015, including 6.45 whales per year from incidental fishery interactions and 1.8 whales per year from vessel collisions (Hayes et al., 2018). Mortalities and serious injuries were recorded for large whales in the Northwest Atlantic from 1970 to 2009 (Van der Hoop et al., 2013). Of 473 records of humpback whales, cause of death could be attributed for 203. Of the 203, 116 (57 percent) mortalities were caused by entanglements in fishing gear, and 31 (15 percent) were attributable to vessel strikes. Annually updated inferences made from scar prevalence and multistate models of Gulf of Mexico humpback whales indicate that (1) younger animals are more likely to become entangled than adults, (2) juvenile scarring rates may be trending upward, (3) maybe less than 10 percent of humpback entanglements are ever reported, and (4) 3 percent of the population may be dying annually as the result of entanglements (Robbins, 2009, 2010). NMFS has declared an unusual mortality event for humpback whale strandings along the Atlantic coast beginning January 2016 (National Marine Fisheries Service, 2017). Increased mortalities have been observed from Maine through North Carolina. As of the development of this document, 42 cases have been reported and 20 cases have been examined. Of those examined, 10 cases showed evidence of vessel strikes; however, investigations are still underway to determine the cause of the strandings.

3.7.2.3.2 Minke Whale (*Balaenoptera acutorostrata acutorostrata*)

3.7.2.3.2.1 Status and Management

Minke whales are the smallest species of mysticete in the Study Area and are classified as a single species with three subspecies recently recognized: *Balaenoptera acutorostrata davidsoni* in the North Atlantic, *Balaenoptera acutorostrata scammoni* in the North Pacific, and a subspecies that is formally unnamed but generally called the dwarf minke whale, which mainly occurs in the southern hemisphere (Jefferson et al., 2015). Hayes et al. (2018) uses *B. a. acutorostrata* for the Canadian East Coast stock.

There are four recognized populations in the North Atlantic: Canadian east coast, west Greenland, central North Atlantic, and northeastern North Atlantic (Donovan, 1991). Until better information is available, minke whales off the eastern coast of the United States are considered to be part of the Canadian East Coast stock, which inhabits the area from the western half of the Davis Strait (45°W) to the Gulf of Mexico (Hayes et al., 2018). The relationship between this stock and the other three stocks is uncertain.

3.7.2.3.2.2 Habitat and Geographic Range

Minke whales have a cosmopolitan distribution in temperate and tropical waters and generally occupy waters over the continental shelf, including inshore bays and even occasionally estuaries (Hayes et al., 2018). However, records from whaling catches and research surveys worldwide indicate there may be an open-ocean component to the minke whale's habitat (Jefferson et al., 2015; Perrin & Brownell, 2008), including the Labrador Current, Gulf Stream, and North Atlantic Gyre Open Ocean Areas while undergoing seasonal migrations. They have an extensive distribution in polar, temperate, and tropical waters in the northern and southern hemispheres (Jefferson et al., 2015; Perrin & Brownell, 2008), and are less common in the tropics than in cooler waters.

The minke whale is common and widely distributed within the U.S. Exclusive Economic Zone in the Atlantic Ocean (Cetacean and Turtle Assessment Program, 1982). There appears to be a strong seasonal component to minke whale distribution. Like most other baleen whales, minke whales generally occupy the continental shelf proper rather than the continental shelf edge region (Hayes et al., 2018). As with several other cetacean species, the possibility of a deep-ocean component to the distribution of minke whales exists but remains unconfirmed.

Minke whales generally undergo annual migrations between low-latitude breeding grounds in the tropics and subtropics in the winter and high-latitude feeding grounds (such as Gulf of Maine as well as the Saguenay-St. Lawrence region [Quebec]) in the summer (Kuker et al., 2005). Timing of movements between high-latitude summer feeding grounds to low-latitude winter habitats occurs between late September and late October (Risch et al., 2014a). Migration paths indicate a clockwise movement pattern, where whales are distributed closer to the shelf break edge during their northbound migration, following the currents of the Gulf Stream and prey availability in the spring and then follow a more directed southerly route in the fall, reaching warmer waters faster and avoiding swimming against the Gulf Stream (Risch et al., 2014a).

During summer and early fall, minke whales are found throughout the lower Bay of Fundy (Ingram et al., 2007). Spring and summer are times of relatively widespread and common occurrence, and are the seasons when the whales are most abundant in New England waters. In New England waters during fall there are fewer minke whales, while during winter the species appears to be largely absent.

LaBrecque et al. (2015a) delineated two minke whale feeding areas: (1) waters less than 200 m in the southern and southwestern section of the Gulf of Maine, including Georges Bank, the Great South Channel, Cape Cod Bay, Massachusetts Bay, and Stellwagen Bank, and (2) shallow waters around Parker Ridge and Cashes Ledges in the central Gulf of Maine. These feeding areas were substantiated by vessel- and aerial-based surveys, sightings from whale-watching vessels, and expert judgment. Minke whales would be expected in both feeding areas from March through November.

Minke whales occur in the warmer waters of the southern United States during winter. While no minke whale mating or calving founds have been found in U.S. Atlantic waters (LaBrecque et al., 2015a), other data suggest a potential winter breeding area offshore the southeastern United States and the Caribbean based on seasonal migration patterns, acoustic survey results, calf stranding records, and sightings of mother-calf pairs in Onslow Bay and offshore of Jacksonville, Florida (Risch et al., 2014a). Since January 2015, monthly aerial surveys have been conducted by the Navy in the offshore area near Norfolk Canyon and have recorded three minke whale sightings (McAlarney et al., 2016). In addition, aerial and vessel surveys conducted offshore of Cape Hatteras, North Carolina since 2011, Onslow Bay, North Carolina since 2007 and Jacksonville, Florida since 2009 resulted in minke whale encounters primarily during the winter months at all three locations (McLellan et al., 2014). High-frequency acoustic recording packages have been deployed at various locations offshore of Cape Hatteras, Onslow Bay, Jacksonville, and the offshore area near Norfolk Canyon since 2012, 2007, 2009, and 2014, respectively. Minke whale calls have shown a winter pattern of occurrence on the Cape Hatteras and Onslow Bay deployment sites, a few detections at the Norfolk Canyon Site, and detections between December and March in Jacksonville (Hodge et al., 2015, 2016; U.S. Department of the Navy, 2013c). Additional acoustic monitoring using marine autonomous recording units deployed between 60 and 150 km offshore of Jacksonville, Florida, in 2009 and 2010 revealed continuous vocalizations at the deep water sites during the winter deployment, while vocalization events were completely absent during the fall deployment suggesting a strong seasonal pattern of occurrence in this area (Oswald et al., 2016). Ongoing acoustic monitoring efforts offshore of Cape Hatteras since March 2012 in water depths of 950 m resulted in frequent detections of minke whales (Debich et al., 2016; Stanistreet et al., 2013), suggesting spring occurrence in this area as minke whales begin to migrate to northern feeding grounds for the summer months.

Although they are not typically expected to occur within the Gulf of Mexico, observation records exist for mostly immature individuals in the Gulf of Mexico and Florida Keys (Stewart & Leatherwood, 1985; Waring et al., 2013). Mitchell (1991) summarized several winter records of minke whale sightings off the southeast United States, Cuba Puerto Rico and the Antilles, hinting at a possible winter distribution in the West Indies, and in the mid-ocean south and east of Bermuda.

3.7.2.3.2.3 Population Trends

Due to imprecise abundance estimates and long periods of time between surveys, a trend analysis has not been conducted for minke whales (Hayes et al., 2018).

3.7.2.3.2.4 Predator and Prey Interactions

This species preys on small invertebrates and schooling fishes, such as capelin, haddock, sand eels, pollock, herring, and cod (Jefferson et al., 2015; Kuker et al., 2005; Lindstrom & Haug, 2001; Reeves et al., 2002b). Similar to other rorquals, minke whales are lunge feeders, often plunging through patches of shoaling fish or krill (Hoelzel et al., 1989; Jefferson et al., 2015).

Minke whales are prey for killer whales (Ford et al., 2005); a common minke was observed under attack by killer whales near British Columbia (Weller, 2008).

3.7.2.3.2.5 Species-Specific Threats

Minke whales are documented as bycatch in gillnets in the mid-Atlantic and northeast fisheries. This species was also documented as bycatch in pelagic longline fisheries operating in the Atlantic Ocean, Caribbean, and Gulf of Mexico (Zollett, 2009). Minke whale mortality and serious injury has also been documented as a result of interactions with an unknown Canadian fishery. During 2011 to 2015, the average annual minimum detected human-caused mortality and serious injury was 9.15 minke whales per year, of which 7.75 were from U.S. and Canadian fisheries and 1.4 were from U.S. and Canadian vessel strikes (Hayes et al., 2018). Section 3.7.2.1.5 (General Threats) discusses general threats to marine mammals.

3.7.2.3.3 Bryde's Whale (*Balaenoptera brydei/edeni*)

3.7.2.3.3.1 Status and Management

Bryde's whales are among the least known of the baleen whales. The species-level taxonomy remains unresolved as well as the number of species or subspecies (Alves et al., 2010; Jefferson et al., 2015; Kato & Perrin, 2008). The Society for Marine Mammalogy's Committee on Taxonomy (2015) recognizes two subspecies of Bryde's whale: (1) *B. edeni* (Eden's whale) and (2) *B. brydei* (offshore Bryde's whale). In addition a Bryde's whale's "pygmy form" known as Omura's whale (Kato & Perrin, 2008; Rice, 1998) has been described. Rosel and Wilcox (2014) found that the Gulf of Mexico Bryde's whale population has a unique lineage and appears to be phylogenetically most closely related to Eden's whale, the smaller form found in coastal and continental shelf waters of the northern Indian Ocean and the western Pacific Ocean. Bryde's whales in the Gulf of Mexico are genetically distinct from other Bryde's whales and not genetically diverse within the Gulf of Mexico (Rosel & Wilcox, 2014). The International Whaling Commission continues to use the name *Balaenoptera edeni* for all Bryde's-like whales, although at least two species are recognized.

Current genetic research confirms that gene flow among Bryde's whale populations is low and suggests that management actions treat each as a distinct entity to ensure survival of the species (Kanda et al., 2007). Bryde's whales found in the northern Gulf of Mexico represent a resident stock and are thus considered a separate stock for management purposes. In April 2015, NMFS announced a 90-day finding on a petition to list the Gulf of Mexico population of Bryde's whale as an endangered distinct population segment under the ESA (80 *Federal Register* 18343–18346, April 6, 2015). NMFS determined that the petition presented substantial information and a status review was completed in December 2016 (Rosel et al., 2016). In December 2016, NMFS published a proposed rule to list the Gulf of Mexico Bryde's whale as endangered under the ESA (81 *Federal Register* 88639-88656, December 8, 2016), initiating a public comment period that ended on January 30, 2017. In February 2017, in response to a request for an extension, NMFS reopened the public comment period for an additional 15 calendar days, which ended on February 23, 2017 (82 *Federal Register* 9707-9708, February 8, 2017). At the time of this publication, a final rule to list the Bryde's whale had not been published.

3.7.2.3.3.2 Habitat and Geographic Range

Unlike other baleen whale species, Bryde's whales are restricted to tropical and subtropical waters and do not generally occur beyond latitude 40° in either the northern or southern hemisphere (Jefferson et al., 2015; Kato & Perrin, 2008). The primary range of Bryde's whales in the Atlantic is in tropical waters south of the Caribbean, outside the Study Area, with the exception of the Gulf of Mexico. Bryde's whales may range as far north as Virginia (Kato & Perrin, 2008). Long migrations are not typical of Bryde's whales, although limited shifts in distribution toward and away from the equator in winter and summer were observed (Best, 1996; Cummings, 1985). Based on assessment surveys, Bryde's whales do not consistently inhabit the southeast U.S. Atlantic (Rosel et al., 2016).

Bryde's whales are the only baleen whale known to occur year-round in the Gulf of Mexico (Jefferson & Schiro, 1997; Rosel et al., 2016; Waring et al., 2013; Waring et al., 2016; Würsig et al., 2000). Their distribution is currently restricted to a small area in the northeastern Gulf near De Soto Canyon in waters between 100 and 400 m deep along the continental shelf break (Davis & Fargion, 1996; Davis et al., 2000; Jefferson & Schiro, 1997; Rosel et al., 2016). There have been no confirmed sightings of Bryde's whales along the U.S. east coast during NMFS cetacean surveys (Rosel et al., 2016). Most of the sighting records of Bryde's whales in the northern Gulf of Mexico are from NMFS abundance surveys

(Waring et al., 2016), which were conducted during the spring (Davis & Fargion, 1996; Davis et al., 2000; Hansen et al., 1995; Hansen et al., 1996; Jefferson & Schiro, 1997; Maze-Foley & Mullin, 2006; Mullin & Hoggard, 2000; Mullin & Fulling, 2004). In addition, there are stranding records from throughout the year (Würsig et al., 2000). Information on Bryde's whale occurrence in the southern Gulf of Mexico is sparse (Rosel et al., 2016). The area between the 100- and 300-m isobaths in the eastern Gulf of Mexico from south of Pensacola (head of DeSoto Canyon) to northwest of Tampa Bay, Florida, has been identified by LaBrecque et al. (2015b) as a small and resident population. Rosel et al. (2016) recommend this area be better defined out to the 400-m depth contour to provide a buffer around the deeper water sightings as well as to Mobile Bay, Alabama to account for all sighting locations in the northern Gulf of Mexico.

3.7.2.3.3.3 Population Trends

Due to the relatively imprecise abundance estimates and long intervals between surveys, there are insufficient data to assess population trends for this species (Hayes et al., 2018). While not constituting a trend analysis, research studies conducted under the Natural Resource Damage Assessment estimated there was up to a 22 percent decline in population size resulting from the *Deepwater Horizon* oil spill (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016) (Hayes et al., 2018)).

3.7.2.3.3.4 Predator and Prey Interactions

Bryde's whales primarily feed on schooling fishes and are lunge feeders. Prey includes anchovy, sardine, mackerel, herring, krill, and pelagic red crab (Baker & Madon, 2007; Jefferson et al., 2015; Nemoto & Kawamura, 1977). Like humpback whales, Bryde's whales were observed using "bubble nets" to herd prey (Jefferson et al., 2015; Kato & Perrin, 2008). Bryde's whale is known to be prey for killer whales, as evidenced by an aerial observation of 15 killer whales attacking a Bryde's whale in the Gulf of California (Weller, 2008).

3.7.2.3.3.5 Species-Specific Threats

There was no documented fishery-caused mortality or serious injury for Gulf of Mexico Bryde's whales during 2011 through 2015; the mean annual mortality and serious injury from this time period from other human-caused actions (*Deepwater Horizon* oil spill) was 0.8 whales per year (Hayes et al., 2018). Northern Gulf of Mexico Bryde's whales were 1 of 31 cetacean stocks impacted by the 2010 *Deepwater Horizon* oil spill in the Gulf of Mexico. Injury quantification found that Bryde's whales were the most impacted of all cetacean shelf and oceanic stocks exposed to the oil spill, with 17 percent excess mortality, 22 percent excess failed pregnancies, and 18 percent higher likelihood for other adverse health effects. Without active restoration efforts, recovery of the northern Gulf of Mexico Bryde's whale stock will take an estimated 69 years (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016). Refer to Section 3.7.2.1.5.1 (Water Quality) for additional information on the *Deepwater Horizon* oil spill.

The status review identified the following factors thought to pose the greatest threat to Gulf of Mexico Bryde's whales: habitat destruction, modification, or curtailment of habitat range during energy exploration and development and oil spills; vessel collisions; anthropogenic noise during seismic surveys; and small population effects (Rosel et al., 2016).

Section 3.7.2.1.5 (General Threats) discusses other threats to marine mammals.

3.7.2.3.4 Dwarf/Pygmy Sperm Whale (*Kogia sima and Kogia breviceps*)

3.7.2.3.4.1 Status and Management

Before 1966, dwarf and pygmy sperm whales were thought to be a single species, until form and structure distinction were shown (Handley, 1966); misidentifications of these two species are still common (Jefferson et al., 2015). Dwarf and pygmy sperm whales are not often observed at sea, but they are among the more frequently stranded cetaceans (Caldwell & Caldwell, 1989; Jefferson et al., 2015; McAlpine, 2008). Rare sightings indicate they may avoid human activity, and they are rarely active at the sea surface. They usually appear slow and sluggish, often resting motionless at the surface with no visible blow (Baird, 2005; Jefferson et al., 2015). Because of the scarcity of biological information available for individual dwarf and pygmy sperm whales, the difficulty of species-level identifications, and the lack of data on individual stock structure and abundance estimates, dwarf and pygmy sperm whales are presented collectively here with species-specific information if available.

Although virtually nothing is known of population status for these species, stranding frequency suggests they may not be as uncommon as sighting records would suggest (Jefferson et al., 2015; Maldini et al., 2005). The western North Atlantic population(s) and the northern Gulf of Mexico population(s) are considered separate stocks for management purposes, but there is no genetic evidence that these two populations differ (Hayes et al., 2017; Waring et al., 2013).

3.7.2.3.4.2 Habitat and Geographic Range

Dwarf and pygmy sperm whales appear to be distributed worldwide in temperate to tropical waters (Caldwell & Caldwell, 1989; McAlpine, 2002). Both species may be found in the Gulf Stream and North Atlantic Gyre open ocean areas. Most sightings are in the Gulf Stream, perhaps an artifact of survey effort rather than a reflection of actual distribution. Dwarf and pygmy sperm whales can occur close to shore and sometimes over the outer continental shelf. However, several studies show that they may also generally occur beyond the continental shelf edge (Bloodworth & Odell, 2008; MacLeod et al., 2004). The pygmy sperm whale may frequent more temperate habitats than the dwarf sperm whale, which is more of a tropical species. The dwarf sperm whale may also have a more pelagic distribution, and dive deeper during feeding bouts, than pygmy sperm whales (Barros & Wells, 1998). Although deep oceanic waters may be the primary habitat for this species, there are very few oceanic sighting records offshore (Waring et al., 2014). The lack of sightings may have more to do with the difficulty of detecting and identifying these animals at sea and lack of effort than with any real distributional preferences.

In the Study Area, dwarf and pygmy sperm whales are found primarily in the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems, the Gulf of Mexico, and Caribbean Sea (Bloodworth & Odell, 2008; Caldwell & Caldwell, 1989; Cardona-Maldonado & Mignucci-Giannoni, 1999). A stranded pygmy sperm on the north shore of the Gulf of St. Lawrence represents the northernmost record for this species in the western Atlantic (Measures et al., 2004).

Aerial surveys conducted monthly offshore of Cape Hatteras since May 2011 have only resulted in three total sightings of dwarf and sperm whales, to date. Similarly, monthly aerial surveys offshore of Jacksonville since 2009 have only documented one sighting of these species. However, passive acoustic monitoring has been more successful in documenting dwarf and pygmy sperm whale occurrence in the Study Area. Analysis of vocalizations collected during passive acoustic monitoring efforts conducted offshore of Onslow Bay, North Carolina between 2007 and 2013 indicate that dwarf and pygmy sperm whales only occur sporadically in this area (Hodge, 2011; U.S. Department of the Navy, 2013c). Additional passive acoustic data collected in Onslow Bay between August 2011 and October 2012 resulted in dwarf and pygmy sperm whales click detections during August to December 2011 and July to October 2012 deployments with a peak in vocal activity in late November 2011 (Hodge et al., 2013). Dwarf/pygmy sperm whale clicks were present throughout a deployment period from October 2012 through the end of March 2013 with no specific temporal pattern in occurrence. This deployment resulted in more detections of dwarf/pygmy sperm whale clicks than any other deployment in Onslow Bay (Hodge & Read, 2015).

Aerial surveys conducted offshore of Jacksonville, Florida between January 2009 and December 2015 resulted in only one sighting of a dwarf/pygmy sperm whale (Cummings et al., 2016).

Pygmy sperm whales were one of the most commonly sighted species in the northern Gulf of Mexico from 1992 to 1994 and from 1996 to 2001 (Mullin & Fulling, 2004). Fulling and Fertl (2003) noted a concentration of sightings in continental slope waters near the Mississippi River Delta. The delta is considered an important area for cetaceans in the northern Gulf of Mexico because of its high levels of productivity associated with oceanographic features. Data from the Gulf of Mexico suggest that dwarf and pygmy sperm whales may associate with frontal regions along the continental shelf break and upper continental slope, where squid densities are higher (Baumgartner et al., 2001; Jefferson et al., 2015).

3.7.2.3.4.3 Population Trends

A trend analysis has not been conducted for dwarf and pygmy sperm whales in the western North Atlantic stock (Hayes et al., 2017). Furthermore, there are insufficient data to determine the population trends for northern Gulf of Mexico dwarf and pygmy sperm whales due to uncertainty in species identification at sea (Waring et al., 2013).

3.7.2.3.4.4 Predator and Prey Interactions

Dwarf and pygmy sperm whales feed on cephalopods and, less often, on deep-sea fishes and shrimp (Beatson, 2007; Caldwell & Caldwell, 1989). A study showed cephalopods (squid) were the primary prey of pygmy sperm whales in the Pacific Ocean, making up 78.7 percent of prey abundance and 93.4 percent contribution by mass. Stomach samples revealed an extreme diversity of cephalopod prey, with 38 species from 17 families (West et al., 2009).

Dwarf and pygmy sperm whales are likely subject to occasional killer whale predation, as are other whale species.

3.7.2.3.4.5 Species-Specific Threats

The northern Gulf of Mexico stocks of dwarf and pygmy sperm whales were among the 31 cetacean stocks impacted by the 2010 *Deepwater Horizon* oil spill in the Gulf of Mexico. Injury quantification determined that 15 percent of dwarf and pygmy sperm whales in the Gulf of Mexico were exposed to oil, resulting in 5 percent excess mortality above baseline conditions, 7 percent excess failed pregnancies, and 6 percent higher likelihood for other adverse health effects. Without active restoration efforts, recovery of the northern Gulf of Mexico dwarf and pygmy sperm whale stocks will take an estimated 11 years (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016). Refer to Section 3.7.2.1.5.1 (Water Quality) for additional information on the *Deepwater Horizon* oil spill. Section 3.7.2.1.5 (General Threats) discusses other threats to marine mammals.

3.7.2.3.5 Beluga Whale (*Delphinapterus leucas*)

3.7.2.3.5.1 Status and Management

The only stocks of beluga whales managed under NMFS jurisdiction occur outside of the Study Area in Alaska. Two recognized stocks of beluga whales may occur within the Study Area: the Eastern High Arctic/Baffin Bay and the West Greenland (Jefferson et al., 2015). Beluga whales should be listed as Near Threatened, based on classifications under the International Union for Conservation of Nature Red List Categories and Criteria (Jefferson et al., 2012). At the global level, the species does not qualify for a status of threatened, although there is substantial uncertainty about numbers and trends for some parts of their range. Moreover, national and international, taxon-specific conservation programs that currently monitor and manage hunting could result in the beluga whale qualifying for threatened status (under criterion A3) within 5 years.

3.7.2.3.5.2 Habitat and Geographic Range

Beluga whales are found only in high latitudes of the northern hemisphere. Belugas are found in Arctic and subarctic waters along the northern coasts of Canada, Alaska, Russia, Norway, and Greenland (O'Corry-Crowe, 2008; Stewart & Stewart, 1989).

Beluga whales occur primarily in coastal waters, as shallow as 1 to 3 m, although they can also be found in offshore waters greater than 800 m deep (Jefferson et al., 2008a; Jefferson et al., 2015; Richard et al., 2001). During the winter, beluga whales are believed to occur in offshore waters associated with pack ice, but little is known about the distribution, ecology, or behavior in winter. In most regions, beluga whales are believed to migrate in the direction of the advancing polar ice front. However, in some areas, they may remain behind this front and overwinter in enclosed areas of unfrozen water and ice leads. In the spring, they migrate to warmer shallow water in coastal estuaries, bays, and rivers for molting and calving (North Atlantic Marine Mammal Commission, 2000).

Beluga whales may be found in the Labrador Current open ocean area. This species is also known to occur in the extreme northwestern portion of the Study Area. Beluga whales are found on the west coast of Greenland and along the Newfoundland coast (Committee on the Status of Endangered Wildlife in Canada, 2004), but are not normally seen farther south. In June 2014, a beluga whale was observed in several bays and inlets of Rhode Island and Massachusetts (Swaintek, 2014). This sighting likely represents an extralimital beluga whale occurrence in the Northeast U.S. Continental Shelf Large Marine Ecosystem.

3.7.2.3.5.3 Population Trends

The current population trend for beluga whales within the Eastern High Arctic/Baffin Bay and the West Greenland stocks is unknown (Jefferson et al., 2012).

3.7.2.3.5.4 Predator and Prey Interactions

Beluga whales prey on various types of fish and invertebrates. In some parts of their range, it is clear that beluga whales are feeding in nearshore waters on seasonally abundant coastal fishes, such as salmon, herring, capelin, smelt, and saffron cod. Much of their prey depends on distribution and seasonal availability (Jefferson et al., 2008a; Jefferson et al., 2015). Killer whales and polar bears are predators of beluga whales.

3.7.2.3.5.5 Species-Specific Threats

There are no significant species-specific threats to beluga whales in the Northwest Atlantic. Section 3.7.2.1.5 (General Threats) discusses threats to marine mammals.

3.7.2.3.6 Narwhal (*Monodon monoceros*)

3.7.2.3.6.1 Status and Management

There is no stock of narwhal that occurs in the U.S. Exclusive Economic Zone in the Atlantic Ocean; however, populations from Hudson Strait and Davis Strait may extend into the Study Area at its northwest extreme (Heide-Jørgensen, 2008).

3.7.2.3.6.2 Habitat and Geographic Range

Narwhals prefer cold Arctic waters, and are the most northerly cetacean. They are also known to be a deepwater species. In the summer, they are found in more northern areas, and as ice begins to form, they tend to follow the ice to more open waters for the winter. They are often found in deep fjords and cracks and leads in the ice (Heide-Jørgensen, 2008; Reeves & Tracey, 1980). Narwhals may be found in the Labrador Current open ocean area.

Narwhals winter in the regions of Hudson Strait and Baffin Bay-Davis Strait, as well as Disko Bay in West Greenland. Narwhals wintering in Hudson Strait in smaller numbers are assumed to belong to the northern Hudson Bay summer population. Tagged narwhals in the summering grounds in Admiralty Inlet showed their annual migration following the ice during the autumn to more open waters of Melville Bay and Eclipse Sound in central and southern Baffin Bay and northern Davis Strait (Dietz et al., 2008; Heide-Jørgensen, 2008). Before the fast ice forms in the fall, narwhals move into deep water along the edge of the continental shelf, with depths of up to 1,000 to 2,000 m (Heide-Jørgensen, 2008).

3.7.2.3.6.3 Population Trends

There are insufficient data to assess population trends for this species (Muto et al., 2017).

3.7.2.3.6.4 Predator and Prey Interactions

Narwhals feed mainly on fish and squid, but much depends on seasonal availability. A large part of their diet consists of medium to large fish, such as turbot and cod (Jefferson et al., 2015). A recent study on stomach content analysis showed that in summer, their diet is mainly Arctic cod, polar cod, and squid (Heide-Jørgensen, 2008). In fall, squid is the main source of prey, and in winter, Greenland halibut and squid are the main sources (Laidre et al., 2003; Laidre & Heide-Jorgensen, 2005). This species uses suction to bring prey into the mouth.

Killer whales and polar bears are the only known predators of narwhals (Heide-Jørgensen, 2008). Killer whales hunt them in the summer open-water season, and polar bears hunt them from sea ice in winter and spring (Heide-Jørgensen, 2008).

3.7.2.3.6.5 Species-Specific Threats

There are no significant species-specific threats to narwhals in the northwest Atlantic, although climate change may be a concern because this species inhabits an extreme northern range. Section 3.7.2.1.5 (General Threats) discusses threats to marine mammals.

3.7.2.3.7 Beaked Whales (Various Species)

Six species of beaked whales are known in the western North Atlantic Ocean: Cuvier's beaked whale (*Ziphius cavirostris*), northern bottlenose whale (*Hyperoodon ampullatus*) (discussed in Section 3.7.2.3.8, Northern Bottlenose Whale), and four members of the genus *Mesoplodon* —True's (*M. mirus*), Gervais' (*M. europaeus*), Blainville's (*M. densirostris*), and Sowerby's (*M. bidens*) beaked whales. Cuvier's, Blainville's, and Gervais' beaked whales are also known to regularly occur in the Gulf of Mexico, based on stranding or sighting data (Hansen et al., 1995; Würsig et al., 2000). Sowerby's beaked whale in the Gulf of Mexico is considered extralimital because there is only one known stranding of this species (Bonde & O'Shea, 1989) and because it normally occurs in northern temperate waters of the North Atlantic (Mead, 1989b). With the exception of the Cuvier's beaked whale and northern bottlenose whale, beaked whales are nearly indistinguishable at sea (Coles, 2001). Because of the scarcity of biological information available for individual species, the difficulty of species-level identifications for *Mesoplodon*, and the lack of data on individual stock structure and abundance estimates, Cuvier's, True's, Gervais', Blainville's, and Sowerby's beaked whales are presented collectively here with species-specific information if available.

3.7.2.3.7.1 Status and Management

Stock structure of beaked whales in the Atlantic, Gulf of Mexico, and U.S. Virgin Islands is unknown; however, these are assumed to be separate for management purposes.

3.7.2.3.7.2 Habitat and Geographic Range

Cuvier's, True's, Gervais', Blainville's, and Sowerby's beaked whales are found in Labrador Current, North Atlantic Gyre, and Gulf Stream open ocean areas and are also known to occur in the Northeast U.S. Continental Shelf, Scotian Shelf, and Newfoundland-Labrador Shelf Large Marine Ecosystems. The continental shelf margins from southern Nova Scotia to Cape Hatteras have been identified as key areas for beaked whales in a global review by MacLeod and Mitchell (2006). Cuvier's, Gervais', Blainville's, and True's beaked whales may also occur in the Southeast U.S. Continental Shelf Large Marine Ecosystem, while Cuvier's, Gervais' and Blainville's beaked whales may occur in the Gulf of Mexico and Caribbean Sea Large Marine Ecosystems.

Cuvier's beaked whale is one of the more commonly seen and the best known. Similar to other beaked whale species, this oceanic species generally occurs in waters past the edge of the continental shelf and occupies almost all temperate, subtropical, and tropical waters of the world, as well as subpolar and even polar waters in some areas (Waring et al., 2014). The distribution of Cuvier's beaked whales is poorly known, and is based mainly on stranding records (Leatherwood et al., 1976). Strandings were reported from Nova Scotia along the eastern U.S. coast south to Florida, around the Gulf of Mexico, and within the Caribbean (Cetacean and Turtle Assessment Program, 1982; Heyning, 1989; Houston, 1990; Leatherwood et al., 1976; MacLeod, 2006; Mignucci-Giannoni et al., 1999). Cuvier's beaked whale sightings have occurred principally along the continental shelf edge in the mid-Atlantic region off the northeast U.S. coast (Cetacean and Turtle Assessment Program, 1982; Hamazaki, 2002; Palka, 2006; Waring et al., 1992; Waring et al., 2001) in late spring or summer, although strandings and sightings were reported in the Caribbean Sea and the Gulf of Mexico as well (Dalebout et al., 2006). Cuvier's beaked whales are generally sighted in waters with a bottom depth greater than 200 m and are frequently recorded in waters with bottom depths greater than 1,000 m (Falcone et al., 2009; Jefferson et al., 2008b; Jefferson et al., 2015).

True's beaked whales appear to occur only in temperate waters, and possibly only in warm temperate waters. Most records of it occurring in the northwest Atlantic suggest a probable relation with the Gulf Stream (MacLeod, 2000; Mead, 1989a).

Gervais' beaked whale occurs only in the Atlantic Ocean and Gulf of Mexico, within a range both north and south of the equator to a latitude of 40° (Jefferson et al., 2008b; Jefferson et al., 2015; MacLeod, 2006). Although the distribution seems to range across the entire temperate and tropical Atlantic, most records are from the western North Atlantic waters from New York to Texas (more than 40 published records), and they are the most common species of *Mesoplodon* to strand along the U.S. Atlantic coast (Waring et al., 2014).

Sowerby's beaked whales appear to inhabit more temperate waters than many other members of the genus. They are the most northerly distributed of Atlantic species of *Mesoplodon*, and are found in cold temperate waters of the North Atlantic Ocean, generally north of 30˚ N. In the Study Area, they range from Massachusetts to Labrador (MacLeod et al., 2006; Mead, 1989b). There were several at-sea sightings off Nova Scotia and Newfoundland, from New England waters north to the ice pack (MacLeod et al., 2006; Waring et al., 2010). Sowerby's beaked whale occurrence in the Gully Marine Protected Area (east of Nova Scotia) increased during the period from 1988 to 2011 (Whitehead, 2013).

Blainville's beaked whales are one of the most widely distributed of the distinctive toothed whales in the *Mesoplodon* genus (Jefferson et al., 2008b; MacLeod et al., 2006). In the Study Area, this species is known to occur in enclosed deepwater seas, such as the Gulf of Mexico and Caribbean Sea. There are records for this species from the eastern coast of the United States and Canada, from as far north as Nova Scotia and south to Florida and the Bahamas (MacLeod & Mitchell, 2006; Mead, 1989b).

Starting January 2015, monthly aerial surveys have been conducted in the offshore area near Norfolk Canyon and have resulted in only one True's beaked whale sighting to date. Passive acoustic monitoring conducted offshore of Cape Hatteras between March and April 2012 recorded beaked whale clicks on nearly 40 percent of the recording days (Stanistreet et al., 2013). Closer examination of these beaked whale click events suggested they belonged to Cuvier's and Gervais' beaked whales (Stanistreet et al., 2012). During aerial surveys conducted between May 2011 and December 2014, beaked whales were observed in every month of the year offshore of Cape Hatteras, with Cuvier's beaked whale being the most commonly encounter beaked whale species (McLellan et al., 2015). The highest number of beaked sightings occurred between May and August and all sightings occurred along the continental shelf break (McLellan et al., 2015). Tag data obtained from three Cuvier's beaked whales offshore of Cape Hatteras in September 2014 provided the first long-distance movement information for Cuvier's beaked whales off the U.S. Atlantic coast (Baird et al., 2015). Two individuals were tagged in the same encounter in September 2014 but remained separated by distances up to 214 km during the tag period. The three tagged whales exhibited varied movement patterns, transiting north and south of the tagging location, with two individuals returning to the tagging location. These results suggest some degree of residency for beaked whales in this area (Baird et al., 2015). Median water depths at tagging locations ranged from 1,725 to 2,274 m, with a maximum water depth of 3,015 m. Diving data captured by the tags showed a maximum dive depth of 2,800 m suggesting that many of the dives were likely to, or close to, the seafloor (Baird et al., 2015).

Passive acoustic monitoring conducted between 2007 and 2013 in Onslow Bay, North Carolina resulted in detections of multiple beaked whale vocalization events. Beaked whale detections were documented throughout the monitoring period with no specific diel pattern, but there were more detections from October 2012 through the end of March 2013 (Hodge & Read, 2015). Gervais' beaked whales were detected significantly more than any other beaked whale species. Cuvier's beaked whale clicks were detected in November 2012 and Blainville's beaked whale clicks were detected primarily in April and May 2013 (Hodge & Read, 2015). True's and Sowerby's beaked whales were not detected during this effort, but there were two detections in December 2012 of a click type assigned to an unidentified beaked whale species.

MacLeod and Mitchell (2006) described the northern Gulf of Mexico continental shelf margin as "a key area" for beaked whales. Beaked whales were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico (i.e., U.S. Gulf of Mexico) (Hansen et al., 1996; Mullin & Hoggard, 2000). Some of the aerial survey sightings may have included Cuvier's beaked whale, but identification of beaked whale species from aerial surveys is problematic. Beaked whale sightings made during spring and summer vessel surveys were widely distributed in waters greater than 500 m deep.

3.7.2.3.7.3 Population Trends

A trend analysis has not been conducted for the western North Atlantic Cuvier's beaked whale stock. Additionally, trend analyses have not been conducted for any of the four species of *Mesoplodon* in the western North Atlantic (Waring et al., 2014).

Further analysis of northern Gulf of Mexico Cuvier's beaked whale survey data from 1991 to 2009 is required in order to determine whether changes in abundance have occurred over this period (Waring et al., 2013). Additionally, a Gulf-wide assessment of Cuvier's beaked whale abundance has not been made (Waring et al., 2013). There are insufficient data to determine population trends for Blainville's and Gervais' beaked whales in the northern Gulf of Mexico.

3.7.2.3.7.4 Predator and Prey Interactions

Beaked whales are generally deepwater feeders and prey on both squid and fish. Examination of stomach contents from stranded *Mesoplodon* indicates that they feed primarily on deep-water cephalopods (MacLeod et al., 2003). Stomach content analyses of captured and stranded *Mesoplodon* suggest that beaked whales are deep divers that feed at or close to the bottom in deep oceanic waters, taking whatever suitable prey they encounter or feeding on whatever species are locally abundant (Ohizumi, 2002). Stomach content analyses from Cuvier's beaked whales show that they feed mostly on deep-sea squid, fish, and crustaceans (Hickmott, 2005; Santos et al., 2007). Data show that Cuvier's beaked whales use suction to ingest prey (Jefferson et al., 2008b; Jefferson et al., 2015; Werth, 2006).

3.7.2.3.7.5 Species-Specific Threats

Impacts from anthropogenic noise have become a serious concern with regard to beaked whales over the past decade. Section 3.7.3.1.1.6 (Stranding) summarizes several stranding events that have been associated with the use of naval sonar. In addition, disturbance by anthropogenic noise may prove to be an important habitat issue in some areas of beaked whales' range, notably in areas of concentrated military activity, oil and gas activity, or shipping. Ongoing studies are being conducted to address this issue and its impact, if any, on this and other marine species.

Gulf of Mexico stocks of Blainville's, Cuvier's, and Gervais' beaked whales were among the 31 cetacean stocks impacted by the 2010 *Deepwater Horizon* oil spill in the Gulf of Mexico. Injury quantification determined that 12 percent of these beaked whale species in the Gulf of Mexico were exposed to oil, resulting in 4 percent excess mortality above baseline conditions, 5 percent excess failed pregnancies, and 4 percent higher likelihood for other adverse health effects. Without active restoration efforts, recovery of the Gulf of Mexico Blainville's, Cuvier's, and Gervais' beaked whale stocks will take an estimated 10 years (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016). Refer to Section 3.7.2.1.5.1 (Water Quality) for additional information on the *Deepwater Horizon* oil spill. Section 3.7.2.1.5 (General Threats) discusses other threats to marine mammals.

3.7.2.3.8 Northern Bottlenose Whale (*Hyperoodon ampullatus*)

3.7.2.3.8.1 Status and Management

There are two populations of northern bottlenose whales in the western North Atlantic: one on the Scotian Shelf in the area referred to as the Gully and a second in Davis Strait off northern Labrador. The Gully is a unique ecosystem that appears to have long provided a stable year-round habitat for a distinct population of bottlenose whales (Dalebout et al., 2006). The Scotian Shelf population of northern bottlenose whales is listed as endangered by the Committee on the Status of Endangered Wildlife in Canada and the Davis Strait-Baffin Bay-Labrador Sea population is designated as a population of special concern (Committee on the Status of Endangered Wildlife in Canada, 2011).

3.7.2.3.8.2 Habitat and Geographic Range

Northern bottlenose whales are largely a deep-water species and seldom found in waters less than 2,000 m deep (Mead, 1989a). Distribution is concentrated in areas of high relief, including shelf breaks and submarine canyons.

Northern bottlenose whales are commonly found in the Labrador Current and likely occur in the Gulf Stream open ocean areas. The Gully straddles the Scotian Shelf and Gulf Stream areas.

Northern bottlenose whales are distributed in the North Atlantic primarily from Nova Scotia to about 70° in the Davis Strait, along the east coast of Greenland to 77°, and from England to the west coast of Spitzbergen (Waring et al., 2015). There are two main centers of bottlenose whale distribution in the western North Atlantic, the Scotian Shelf (including the Gully), and Davis Strait off northern Labrador (Reeves et al., 1993). Genetic studies have shown that these two populations are likely distinct from one another (Dalebout et al., 2006). Northern bottlenose whales have been sighted in deep waters off New England, but are uncommon in U.S. waters. Strandings have occurred as far south as North Carolina, although that is outside of the natural range or at the edge of the southern range for this more subarctic species (Jefferson et al., 2015; MacLeod et al., 2006).

3.7.2.3.8.3 Population Trends

There are insufficient data to determine population trends for northern bottlenose whales.

3.7.2.3.8.4 Predator and Prey Interactions

This species preys primarily on squid of the genus *Gonatus* but will also take fishes, sea cucumbers, sea stars, and prawns, as confirmed by stomach content analyses (Clarke & Kristensen, 1980; Gowans, 2009). They appear to be more benthic (bottom of the sea) feeders, foraging at depths of between 500 and 1,500 m (Hooker & Whitehead, 2002; Jefferson et al., 2015).

3.7.2.3.8.5 Species-Specific Threats

There are no significant species-specific threats to northern bottlenose whales in the northwest Atlantic. Section 3.7.2.1.5 (General Threats) discusses threats to marine mammals.

3.7.2.3.9 Rough-Toothed Dolphin (*Steno bredanensis*)

3.7.2.3.9.1 Status and Management

Rough-toothed dolphins are among the most widely distributed species of tropical dolphins, but little information is available on population status (Jefferson, 2008a; Jefferson et al., 2015). The Western North Atlantic and Gulf of Mexico populations of the rough-toothed dolphin are considered two separate stocks for management purposes, but there is insufficient genetic information to differentiate these stocks (Hayes et al., 2017; Waring et al., 2014; Wimmer & Whitehead, 2004).

3.7.2.3.9.2 Habitat and Geographic Range

The distribution of the rough-toothed dolphin is poorly understood worldwide. These dolphins are thought to be a tropical to warm-temperate species and historically have been reported in deep oceanic waters in the Atlantic, Pacific, and Indian Oceans and the Mediterranean and Caribbean Seas (Gannier & West, 2005; Leatherwood & Reeves, 1983; Perrin & Walker, 1975; Reeves et al., 2003). Rough-toothed dolphins occur in the Gulf Stream and North Atlantic Gyre open ocean areas.

Rough-toothed dolphins were observed in both shelf and oceanic waters in the northern Gulf of Mexico (Fulling et al., 2003; Mullin & Fulling, 2003) and off the U.S. East Coast from North Carolina to Delaware (Waring et al., 2014). In the western North Atlantic, tracking of five rough-toothed dolphins that were rehabilitated and released following a mass stranding on the east coast of Florida in 2005 demonstrated a variety of ranging patterns (Wells et al., 2008b). All tagged rough-toothed dolphins moved through a large range of water depths averaging greater than 100 ft. (30 m), though each of the five tagged dolphins transited through very shallow waters at some point, with most of the collective movements recorded over a gently sloping seafloor. Monthly aerial surveys conducted offshore of Cape Hatteras, North Carolina since 2011 have only resulted in one sighting of four individual rough-toothed dolphins just beyond the 100 m isobaths (U.S. Department of the Navy, 2013c).

Since 2007, monthly aerial surveys offshore of Onslow Bay, North Carolina have been conducted, but only three rough-toothed dolphin surveys have been documented during these efforts. However, passive acoustic monitoring efforts have supplemented the limited sighting data of this species. Analysis of clicks and whistles recorded during towed hydrophone array line-transect surveys in Onslow Bay, North Carolina between September 2007 and August 2010 characterized one recording session with vocalizations belonging to rough-toothed dolphins, which corresponded with one visual sighting of the species in 2009 (U.S. Department of the Navy, 2013c).

Aerial surveys conducted between 2009 and 2016 offshore of Jacksonville, Florida resulted in nine sightings of rough-toothed dolphins in primarily in the summer and fall months. Sightings from aerial surveys have been documented inside the 100 m isobaths in continental shelf waters (Cummings et al., 2016; U.S. Department of the Navy, 2013c).

3.7.2.3.9.3 Population Trends

Due to imprecise abundance estimates and long periods of time between surveys, a trend analysis has not been conducted for the Western North Atlantic stock of rough-toothed dolphins (Waring et al., 2014).

A trend analysis has not been conducted for the northern Gulf of Mexico stock (Hayes et al., 2017). Two point estimates of abundance have been made based on data from surveys during 2003 to 2004 and 2009. To determine whether changes in oceanic abundance have occurred over this period, an analysis of all the survey data needs to be conducted (Hayes et al., 2017).

3.7.2.3.9.4 Predator and Prey Interactions

Prey of rough-toothed dolphins includes fish and cephalopods. They are known to feed on large fishes such as mahi mahi (Miyazaki & Perrin, 1994; Pitman & Stinchcomb, 2002). They also prey on reef fish, and Perkins and Miller (1983) noted that parts of reef fish were found in the stomachs of stranded rough-toothed dolphins in Hawaii. Rough-toothed dolphins also feed during the day on near-surface fishes, including flying fishes (Gannier & West, 2005).

Predation on rough-toothed dolphins has not been documented, but they may be subject to predation by killer whales.

3.7.2.3.9.5 Species-Specific Threats

The northern Gulf of Mexico stock of rough-toothed dolphins was 1 of the 31 cetacean stocks impacted by the 2010 *Deepwater Horizon* oil spill in the Gulf of Mexico. Injury quantification determined that 41 percent of rough-toothed dolphins in the Gulf of Mexico were exposed to oil, resulting in 14 percent excess mortality above baseline conditions, 19 percent excess failed pregnancies, and 15 percent higher likelihood for other adverse health effects. Without active restoration efforts, recovery of the northern Gulf of Mexico rough-toothed dolphin stock will take an estimated 54 years (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016). Refer to Section 3.7.2.1.5.1 (Water Quality) for additional information on the *Deepwater Horizon* oil spill. Section 3.7.2.1.5 (General Threats) discusses other threats to marine mammals.

3.7.2.3.10 Common Bottlenose Dolphin (*Tursiops truncatus*)

3.7.2.3.10.1 Status and Management

Along the U.S. East Coast and northern Gulf of Mexico, the bottlenose dolphin stock structure is well studied. There are currently 53 management stocks identified by NMFS in the western North Atlantic and Gulf of Mexico, including oceanic, coastal, and estuarine stocks (Hayes et al., 2017; Hayes et al., 2018; Waring et al., 2015; Waring et al., 2016). Most stocks in the Study Area are designated as Strategic or Depleted under the MMPA. For a complete listing of currently identified stocks within the Study Area, see Table 3.7-1.

3.7.2.3.10.2 Habitat and Geographic Range

The bottlenose dolphin occurs in tropical to temperate waters of the Atlantic Ocean as well as inshore, nearshore, and offshore waters of the Gulf of Mexico and U.S. East Coast (Hayes et al., 2017; Hayes et al., 2018; Waring et al., 2015; Waring et al., 2016). They generally do not range north or south of 45° latitude (Jefferson et al., 2015; Wells & Scott, 2008). They occur in most enclosed or semi-enclosed seas in habitats ranging from shallow, murky, estuarine waters to deep, clear offshore waters in oceanic regions (Jefferson et al., 2015; Wells et al., 2009). Open ocean populations occur far from land; however, population density appears to be highest in nearshore areas (Scott & Chivers, 1990). Bottlenose dolphins occur in the North Atlantic Gyre and Gulf Stream open ocean areas.

There are two morphologically and genetically distinct bottlenose dolphin morphotypes (distinguished by physical differences) (Duffield, 1987; Duffield et al., 1983) described as coastal and offshore forms. Both inhabit waters in the western North Atlantic Ocean and Gulf of Mexico (Curry & Smith, 1997; Hersh & Duffield, 1990; Mead & Potter, 1995) along the U.S. Atlantic coast. The coastal morphotype of bottlenose dolphin is continuously distributed along the Atlantic coast south of Long Island, New York, around the Florida peninsula, and along the Gulf of Mexico coast. The range of the offshore bottlenose dolphin includes waters beyond the continental slope (Kenney, 1990), and offshore bottlenose dolphins may move between the Gulf of Mexico and the Atlantic (Wells et al., 1999). Dolphins with characteristics of the offshore type have stranded as far south as the Florida Keys.

In Canadian waters, bottlenose dolphins were occasionally sighted on the Scotian Shelf, particularly in the Gully (Gowans & Whitehead, 1995). Seasonally, bottlenose dolphins occur over the outer continental shelf and inner slope as far north as Georges Bank (Cetacean and Turtle Assessment Program, 1982; Kenney, 1990). Sightings occurred along the continental shelf break from Georges Bank to Cape Hatteras during spring and summer (Cetacean and Turtle Assessment Program, 1982; Kenney, 1990).

Acoustic monitoring data indicate that dolphins are present in coastal waters of Norfolk and Virginia Beach nearly every day (Lammers et al., 2015). Seasonally, diminished acoustic activity was observed in that area for the February timeframe. A combination of visual line-transect surveys, photo-identification, and acoustic monitoring methods were employed between August 2012 and December 2014 off the Atlantic coast Virginia. The majority of the sightings consisted of bottlenose dolphins, on which further analyses indicated spatial and seasonal variation in density and abundance (Engelhaupt et al., 2015). The greatest abundance was observed during the fall in an area from the shore out to 3.7 km, extending from Naval Station Norfolk down to the Virginia/North Carolina border (Engelhaupt et al., 2015). Diel patterns with increased detections during nighttime hours were documented at two sites near Naval Station Norfolk, and one site near Joint Expeditionary Base-Little Creek (Engelhaupt et al., 2015).

North of Cape Hatteras, the coastal and offshore morphotypes are separated across bathymetry during summer months. Aerial surveys flown during 1979 to 1981 indicated a concentration of bottlenose dolphins in waters less than 25 m deep corresponding to the coastal morphotype and an area of high abundance along the shelf break corresponding to the offshore stock (Cetacean and Turtle Assessment Program, 1982; Kenney, 1990). During winter months and south of Cape Hatteras, North Carolina, the ranges of the coastal and offshore morphotypes overlap to some degree. Bottlenose dolphins have been sighted regularly during surveys conducted offshore of Cape Hatteras from 2009 through 2014 (Baird et al., 2016a; Foley et al., 2015). Monthly aerial and vessel surveys conducted between June 2007 and June 2010 offshore of Onslow Bay, North Carolina showed the fauna was also dominated strongly by bottlenose dolphins, with year-round occurrence. Most bottlenose dolphin encounters occurred just off the shelf break (Read et al., 2014).

Similar with other U.S. Atlantic coast areas, bottlenose dolphins were among the most frequently observed cetacean species during vessel surveys conducted along the continental shelf break and pelagic waters offshore of Jacksonville, Florida from July 2009 through December 2013. Bottlenose dolphins were encountered throughout the area including within deeper pelagic waters (Swaim et al., 2014). Genetic analyses of biopsy samples confirmed that all sampled bottlenose dolphins were off the offshore morphotype, suggesting there is limited overlap between coastal and offshore populations in this area of the Atlantic Ocean (Swaim et al., 2014). Photo-identification catalogs of bottlenose dolphins from Cape Hatteras, Onslow Bay, Jacksonville survey areas have been compared, but no matches have been identified (Foley et al., 2015; Swaim et al., 2014) suggesting a high degree of residency to these areas.

Several lines of evidence support a distinction between coastal stock dolphins and those present primarily in the inshore waters of the bays, sounds, and estuaries (LaBrecque et al., 2015b). Photo-identification and genetic studies support the existence of more than 40 stock populations in bays, sounds, and estuaries. These populations inhabit estuaries and bays from North Carolina to the Gulf of Mexico coast (Caldwell, 2001; Gubbins et al., 2003; Litz, 2007; Mazzoil et al., 2005; Zolman, 2002).

LaBrecque et al. (2015a) identified nine small and resident bottlenose dolphin population areas within estuarine areas along the U.S. East Coast. These areas include estuarine and nearshore areas extending from Pamlico Sound, North Carolina down to Florida Bay, Florida and were substantiated through vessel- and aerial based survey data, photo-identification data, genetic analyses, and expert judgment (LaBrecque et al., 2015a). The Northern North Carolina, Southern North Carolina, and Charleston Harbor partially overlap with nearshore portions of the Navy Cherry Point Range Complex, and Jacksonville Estuarine System Populations partially overlap with nearshore portions of the Jacksonville Range Complex. The Southern Georgia Estuarine System Population area also overlaps with the Jacksonville Range Complex, specifically within Naval Submarine Base Kings Bay, Kings Bay, Georgia, and includes estuarine and intercoastal waterways from Altamaha Sound, to the Cumberland River (LaBrecque et al., 2015a). The remaining four biologically important areas are outside but adjacent to the AFTT Study Area boundaries.

In the Gulf of Mexico alone, 32 distinct stocks are recognized, although the structure of these stocks is uncertain but appears to be complex. Residency patterns of dolphins in bays, sounds, and estuaries range from transient to seasonally migratory to stable resident communities, and various stocks may overlap at times. Year-round residency patterns of some individual bottlenose dolphins in bays, sounds, and estuaries have been reported for almost every survey area where photo-identification or tagging studies have been conducted.

LaBrecque et al. (2015b) delineated 11 small and resident population areas for bottlenose dolphins within the Gulf of Mexico. These areas include bays, sounds, and estuaries ranging from Aransas Pass, Texas to the Florida Keys, Florida and were substantiated through a combination of extensive photo-identification data, genetic analyses, radio-tracking data, and expert knowledge (LaBrecque et al., 2015b). Of the 11 biologically important areas identified for bottlenose dolphins in the Gulf of Mexico, 3 overlap with the Gulf of Mexico Range Complex (Aransas Pass Area, Texas; Mississippi Sound Area, Mississippi; and St. Joseph Bay Area, Florida) and 8 are located adjacent to the AFTT Study Area boundaries.

3.7.2.3.10.3 Population Trends

A trend analysis has not been conducted for the following stocks of bottlenose dolphins: western North Atlantic Offshore stock, northern North Carolina Estuarine System stock, southern North Carolina Estuarine System stock, northern Gulf of Mexico Oceanic stock, northern Gulf of Mexico Continental Shelf stock, Gulf of Mexico Western Coastal stock, Gulf of Mexico Northern Coastal stock and Gulf of Mexico Eastern Coastal stock (Hayes et al., 2017; Hayes et al., 2018; Waring et al., 2015; Waring et al., 2016).

There are insufficient data to determine the population trends for the following stocks of bottlenose dolphins: northern South Carolina Estuarine System stock; Charleston Estuarine System stock; northern Georgia/southern South Carolina Estuarine System stock; Central Georgia Estuarine System stock; southern Georgia Estuarine System stock; Jacksonville Estuarine System stock; Indian River Lagoon Estuarine System stock; Biscayne Bay stock; Florida Bay stock; Barataria Bay Estuarine System stock; most of the Northern Gulf of Mexico Bay, Sound, and Estuary stocks; Mississippi Sound, Lake Borgne, and Bay Boudreau stocks; Choctawhatchee Bay stock; St. Joseph Bay stock; and Puerto Rico and U.S. Virgin Islands stock (Hayes et al., 2017; Hayes et al., 2018; Waring et al., 2012, 2014; Waring et al., 2015; Waring et al., 2016).

There are limited data available to assess population trends for the following stocks of bottlenose dolphins: western North Atlantic Northern Migratory Coastal stock, western North Atlantic Southern Migratory Coastal stock, western North Atlantic South Carolina-Georgia Coastal stock, western North

Atlantic Northern Florida Coastal stock, and western North Atlantic Central Florida Coastal stock (Hayes et al., 2017).

While not constituting a trend analysis, studies estimated that the maximum population decline in coastal and bay, sound, and estuary stocks of bottlenose dolphins impacted by the *Deepwater Horizon* oil spill range between 5 percent and 71 percent (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016; Hayes et al., 2018). Refer to Section 3.7.2.3.10.5 for a discussion of the oil spill impacts to bottlenose dolphin stocks in the Gulf of Mexico.

3.7.2.3.10.4 Predator and Prey Interactions

Bottlenose dolphins are opportunistic feeders, taking a variety of fishes, cephalopods, and crustaceans (Wells & Scott, 1999) and using a variety of feeding strategies (Barros & Myrberg, 1987; Barros & Wells, 1998; Shane et al., 1986). Nearshore bottlenose dolphins prey predominantly on coastal fishes and cephalopods, while offshore individuals prey on open ocean cephalopods and a large variety of near-surface and mid-water fishes (Mead & Potter, 1995).

This species is known to be preyed on by killer whales and sharks (Wells & Scott, 1999). As many as half the observed bottlenose dolphin in Florida exhibit scars from shark attacks. Primary shark predators are considered to be the bull, tiger, great white, and dusky sharks (Wells & Scott, 1999).

3.7.2.3.10.5 Species-Specific Threats

Thirteen stocks of bottlenose dolphins in the Gulf of Mexico occur within the footprint of the 2010 *Deepwater Horizon* oil spill. In response to the oil spill, the Deepwater Horizon Natural Resource Damage Assessment Trustees prepared a *Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (2016) to present the impacts and injuries sustained by habitats and species within the footprint. The findings from this report are summarized here. Injuries were quantified for four bay, sound, and estuary stocks of bottlenose dolphins: Barataria Bay, Mississippi River Delta, Mississippi Sound, and Mobile Bay. Perdido Bay, Pensacola Bay, Choctawhatchee Bay, and St. Andrew Bay stocks did not show evidence of excess strandings attributed to the oil spill; therefore they were not included in the injury quantification. The trustees also quantified injuries for two coastal stocks (Gulf of Mexico Western Coastal stock and the Gulf of Mexico Northern Coastal stock) and the northern Gulf of Mexico Oceanic stock. The northern Gulf of Mexico Continental Shelf stock of bottlenose dolphins was combined with continental shelf Atlantic spotted dolphins in a single continental shelf dolphin category for the injury quantification. In the report, excess mortality was calculated by comparing expected annual mortality rates for each stock based on historical stranding records and annual mortality rates calculated after the oil spill. By this method, excess mortality is considered to be mortalities attributable to the oil spill. The Trustees estimated the Mississippi River Delta stock to have the highest percentage of excess mortality (59 percent), followed by Gulf of Mexico Northern Coastal stock (38 percent), Barataria Bay stock (35 percent), Mississippi Sound stock (22 percent), Mobile Bay stock (12 percent), continental shelf dolphins (including the northern Gulf of Mexico Continental Shelf stock) (4 percent), northern Gulf of Mexico Oceanic stock (3 percent), and Gulf of Mexico Western Coastal stock (1 percent) (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016). Using population models that consider long-term impacts from mortalities, adverse reproductive effects, and persistent impacts from adverse health effects, the Trustees estimated that without active restoration, recovery of the affected bay, sound, and estuary, coastal, and oceanic bottlenose dolphin stocks will take between 39 and 52 years. The population models indicated that the maximum population reduction of continental shelf dolphins was only 3 percent. As a result, the Trustees were not able to calculate the number of years it would take for these stocks to recover because this level of decline was not considered significant compared to original population sizes of continental shelf bottlenose dolphins and Atlantic spotted dolphins (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016). Refer to Section 3.7.2.1.5.1 (Water Quality) for additional information on the *Deepwater Horizon* oil spill. Section 3.7.2.1.5 (General Threats) discusses other threats to marine mammals.

3.7.2.3.11 Pantropical Spotted Dolphin (*Stenella attenuata*)

3.7.2.3.11.1 Status and Management

The western North Atlantic and northern Gulf of Mexico populations are considered separate stocks for management purposes, although there is currently not enough information to distinguish them (Waring et al., 2016).

3.7.2.3.11.2 Habitat and Geographic Range

The pantropical spotted dolphin is distributed in offshore tropical and subtropical waters of the Atlantic Ocean between about 40° N and 40° S (Baldwin et al., 1999; Perrin, 2008d). The species is much more abundant in the lower latitudes of its range. It is found mostly in deeper offshore waters but does approach the coast in some areas (Jefferson et al., 2015; Perrin, 2001). Pantropical spotted dolphins may occur in the Gulf Stream open ocean area.

The pantropical spotted dolphin is the most commonly sighted species of cetacean in the oceanic waters of the northern Gulf of Mexico. Pantropical spotted dolphins were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen et al., 1996; Mullin & Hoggard, 2000). Most sightings of this species in the Gulf of Mexico and Caribbean occur over the lower continental slope (Mignucci-Giannoni et al., 2003; Moreno et al., 2005). Pantropical spotted dolphins in the offshore Gulf of Mexico do not appear to have a preference for any one specific habitat type, such as within the Loop Current, inside cold-core eddies, or along the continental slope (Baumgartner et al., 2001). Along the U.S. Atlantic coast, sightings have been concentrated in the slope waters east of New England and Florida, and sightings extend into the deeper slope and offshore waters of the mid-Atlantic east of Cape Hatteras (Waring et al., 2014).

3.7.2.3.11.3 Population Trends

There are insufficient data to determine population trends for the western North Atlantic stock of pantropical spotted dolphins, because prior to 1998, spotted dolphins were not differentiated during surveys (Waring et al., 2007).

Further analysis of Gulf of Mexico pantropical spotted dolphin survey data from 1991 to 2009 is required in order to determine whether changes in abundance have occurred (Waring et al., 2015). Additionally, a Gulf-wide assessment of pantropical spotted dolphin abundance has not been made (Waring et al., 2015).

3.7.2.3.11.4 Predator and Prey Interactions

Pantropical spotted dolphins prey on near-surface fishes, squid, and crustaceans and on some mid-water species (Perrin & Hohn, 1994). Results from various tracking and food habit studies suggest that pantropical spotted dolphins in the eastern tropical Pacific and off Hawaii feed primarily at night on surface and mid-water species that rise after dark with the deep scattering layer (stratified zones in the ocean, usually composed of marine organisms that migrate vertically from depth to surface and back again at different times of day) (Baird et al., 2001; Evans, 1994; Robertson & Chivers, 1997).

Pantropical spotted dolphins may be preyed on by killer whales and sharks and were observed fleeing killer whales in Hawaiian waters (Baird et al., 2006). Other predators may include the pygmy killer whale, false killer whale, and occasionally the short-finned pilot whale (Perrin, 2008d).

3.7.2.3.11.5 Species-Specific Threats

The northern Gulf of Mexico stock of pantropical spotted dolphins was 1 of the 31 cetacean stocks impacted by the 2010 *Deepwater Horizon* oil spill in the Gulf of Mexico. Injury quantification determined that 20 percent of pantropical spotted dolphins in the Gulf of Mexico were exposed to oil, resulting in 7 percent excess mortality above baseline conditions, 9 percent excess failed pregnancies, and 7 percent higher likelihood for other adverse health effects. Without active restoration efforts, recovery of the northern Gulf of Mexico pantropical spotted dolphin stock will take an estimated 39 years (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016). Refer to Section 3.7.2.1.5.1 (Water Quality) for additional information on the *Deepwater Horizon* oil spill. Section 3.7.2.1.5 (General Threats) discusses other threats to marine mammals.

3.7.2.3.12 Atlantic Spotted Dolphin (*Stenella frontalis*)

3.7.2.3.12.1 Status and Management

The Atlantic spotted dolphin occurs in two forms that may be distinct subspecies (Perrin et al., 1987; Rice, 1998): the large, heavily spotted form, which inhabits the continental shelf and is usually found inside or near the 200-m isobath; and the smaller, less spotted island and offshore form, which occurs in the Atlantic Ocean but is not known to occur in the Gulf of Mexico (Fulling et al., 2003; Mullin & Fulling, 2003, 2004). The western North Atlantic population is provisionally being considered a separate stock from the Gulf of Mexico stock(s) for management purposes based on genetic analysis (Waring et al., 2014; Waring et al., 2016). The U.S. Virgin Islands population is provisionally being considered a separate stock, although there is currently no information to differentiate this stock from the Atlantic Ocean and Gulf of Mexico stocks.

3.7.2.3.12.2 Habitat and Geographic Range

The Atlantic spotted dolphin is found in nearshore tropical to warm-temperate waters, predominantly over the continental shelf and upper slope (Waring et al., 2013, 2014). In the eastern Gulf of Mexico, for instance, the species often occurs over the mid-shelf (Griffin & Griffin, 2003). In the western Atlantic, this species is distributed from New England to Brazil and is found in the Gulf of Mexico as well as the Caribbean Sea (Perrin, 2008c). Atlantic spotted dolphins may occur in the Gulf Stream open ocean area.

The large, heavily spotted coastal form of the Atlantic spotted dolphin typically occurs over the continental shelf but usually at least 4.9 to 12.4 mi. offshore (Davis et al., 1998; Perrin, 2002). Atlantic spotted dolphin sightings have been concentrated in the slope waters north of Cape Hatteras, but in the shelf waters south of Cape Hatteras sightings extend into the deeper slope and offshore waters of the mid-Atlantic (Mullin & Fulling, 2003; Waring et al., 2014). Vessel surveys conducted between January 2009 and December 2014 offshore of Cape Hatteras, North Carolina resulted in multiple sightings of Atlantic spotted dolphins annually from 2011 to 2014 (Foley et al., 2015; U.S. Department of the Navy, 2013c). Aerial and shipboard surveys conducted between 2007 and 2010 in offshore waters of Onslow Bay, North Carolina indicate that spotted dolphins have a strong preference for waters over the continental shelf and do not typically occur beyond the shelf break (Read et al., 2014). Numerous re-sightings of multiple individuals over several years and across seasons supports the existence of considerable fine-scale population structure and a degree of residency for Atlantic spotted dolphins in Onslow Bay (Swaim et al., 2014).

Photo-identification catalogs of Atlantic spotted dolphins from Cape Hatteras, Onslow Bay, Jacksonville survey areas have been compared, but no matches have been identified (Foley et al., 2015; Swaim et al., 2014) suggesting a high degree of residency to these areas. Atlantic spotted dolphins were one of the dominant species sighted during vessel surveys conducted along the continental shelf break and pelagic waters offshore of Jacksonville, Florida from July 2009 through December 2013 (Swaim et al., 2014). Sightings were restricted to the relatively shallow shelf waters of the survey area. Photo-identification catalogs of Atlantic spotted dolphins from Cape Hatteras, Onslow Bay, Jacksonville survey areas have been compared, but no matches have been identified (Foley et al., 2015; Swaim et al., 2014) further supporting some degree of residency to these areas.

Higher numbers of spotted dolphins are reported over the west Florida continental shelf from November to May than during the rest of the year, suggesting that this species may migrate seasonally (Griffin & Griffin, 2003).

In the Gulf of Mexico, Atlantic spotted dolphins occur primarily from continental shelf waters 10 to 200 m deep to slope waters greater than 500 m deep (Fulling et al., 2003; Maze-Foley & Mullin, 2006; Mullin & Fulling, 2004). Atlantic spotted dolphins were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico from 1992 to 1998 (Hansen et al., 1996; Mullin & Hoggard, 2000).

3.7.2.3.12.3 Population Trends

Due to imprecise abundance estimates and long periods of time between surveys, a trend analysis has not been conducted for the western North Atlantic stock of Atlantic spotted dolphins (Waring et al., 2014).

The current population size for the Atlantic spotted dolphin in the northern Gulf of Mexico is unknown because the survey data from the continental shelf that covers the majority of this stock's range are more than 8 years old (Wade & Angliss, 1997). Additionally, there are insufficient data to determine the population trend for the northern Gulf of Mexico stock of Atlantic spotted dolphins (Waring et al., 2013) and for the Puerto Rico and U.S. Virgin Islands stock of Atlantic spotted dolphins (Waring et al., 2012).

3.7.2.3.12.4 Predator and Prey Interactions

Atlantic spotted dolphins feed on small cephalopods, fishes, and benthic invertebrates. Atlantic spotted dolphins in the Gulf of Mexico were observed feeding cooperatively on clupeid fishes and are known to feed in association with shrimp trawlers (Fertl & Würsig, 1995; Fertl & Leatherwood, 1997). In the Bahamas, this species was observed to chase and catch flying fish (MacLeod et al., 2004). The diet of the Atlantic spotted dolphin varies depending on its location (Jefferson et al., 2015). This species was documented to be prey for killer whales and sharks (Jefferson et al., 2015).

3.7.2.3.12.5 Species-Specific Threats

The northern Gulf of Mexico stock of Atlantic spotted dolphins was included as 1 of the 31 cetacean stocks impacted by the 2010 *Deepwater Horizon* oil spill in the Gulf of Mexico. Injury quantification was completed for continental shelf dolphins, which was a combination of shelf bottlenose dolphins and Atlantic spotted dolphins. It was determined that 13 percent of continental shelf dolphins, including Atlantic spotted dolphins in the Gulf of Mexico were exposed to oil, resulting in 4 percent excess mortality above baseline conditions, 6 percent excess failed pregnancies, and 5 percent higher likelihood for other adverse health effects. The maximum reduction of combined Atlantic spotted dolphins and bottlenose dolphins was only 3 percent, therefore the Trustees were not able to calculate the number of years it would take for these stocks to recover (Deepwater Horizon Natural Resource Damage

Assessment Trustees, 2016). Refer to Section 3.7.2.1.5.1 (Water Quality) for additional information on the *Deepwater Horizon* oil spill. Section 3.7.2.1.5 (General Threats) discusses other threats to marine mammals.

3.7.2.3.13 Spinner Dolphin (*Stenella longirostris*)

3.7.2.3.13.1 Status and Management

For management purposes, the western North Atlantic and Gulf of Mexico populations of spinner dolphins are considered separate stocks, although there is currently insufficient data to differentiate them (Waring et al., 2014).

3.7.2.3.13.2 Habitat and Geographic Range

This is presumably an offshore, deep-water species (Perrin & Gilpatrick, 1994) and its distribution in the Atlantic is very poorly known. Spinner dolphins likely occur in the Gulf Stream and North Atlantic Gyre open ocean areas, based on their preference for waters greater than 2,000 m deep.

In the western North Atlantic, these dolphins occur in deep water along most of the United States coast south to the West Indies and Venezuela, including the Gulf of Mexico (Waring et al., 2014). Spinner dolphin sightings have occurred exclusively in deeper (greater than 2,000 m) oceanic waters of the northeast U.S. coast (Cetacean and Turtle Assessment Program, 1982; Waring et al., 1992). Stranding records exist from North Carolina, South Carolina, Florida, and Puerto Rico in the Atlantic and in Texas and Florida in the Gulf of Mexico, and there was one recent sighting during summer 2011 in oceanic waters off North Carolina (Waring et al., 2014). Monthly aerial surveys offshore of Cape Hatteras conducted since May 2011 have only resulted in one sighting of spinner dolphins in a mixed group of Clymene dolphins within the northern offshore waters of the survey area (U.S. Department of the Navy, 2012). Although spinner dolphins were sighted and stranded off the southeastern U.S. coast, they are not common in those waters, except perhaps off southern Florida (Waring et al., 2010). In the northern Gulf of Mexico, spinner dolphins are found mostly in offshore waters beyond the edge of the continental shelf and primarily east of the Mississippi River (Waring et al., 2013). This species was seen during all seasons in the northern Gulf of Mexico during aerial surveys between 1992 and 1998 (Waring et al., 2013).

3.7.2.3.13.3 Population Trends

Due to imprecise abundance estimates and long periods of time between surveys, a trend analysis has not been conducted for the western North Atlantic stock of spinner dolphins (Waring et al., 2014).

Further analysis of northern Gulf of Mexico spinner dolphin survey data from 1991 to 2009 is required in order to determine whether changes in abundance have occurred over this period (Waring et al., 2013). Additionally, a Gulf-wide assessment of spinner dolphin abundance has not been made (Waring et al., 2013).

There are insufficient data to determine the population trends for the Puerto Rico and U.S. Virgin Islands stock of spinner dolphins (Waring et al., 2012).

3.7.2.3.13.4 Predator and Prey Interactions

Spinner dolphins feed primarily on small mid-water fishes, squids, and shrimp and dive to at least 1,300 ft. (400 m) (Perrin & Gilpatrick, 1994). Studies of spinner dolphins in the Pacific suggest they forage primarily at night, when the mid-water community migrates toward the surface and the shore (Benoit-Bird et al., 2001; Benoit-Bird, 2004). Spinner dolphins track the horizontal migrations of their prey

(Benoit-Bird & Au, 2003), allowing foraging efficiencies (Benoit-Bird & Au, 2003; Benoit-Bird, 2004). Foraging behavior was also linked to lunar phases in scattering layers off the island of Hawaii (Benoit-Bird & Au, 2004). Similar foraging behavior is expected for spinner dolphins that occur in the AFTT Study Area.

Spinner dolphins may be preyed on by sharks, killer whales, pygmy killer whales, and short-finned pilot whales (Perrin, 2008b).

3.7.2.3.13.5 Species-Specific Threats

The northern Gulf of Mexico stock of spinner dolphins was 1 of the 31 cetacean stocks impacted by the 2010 *Deepwater Horizon* oil spill in the Gulf of Mexico. Injury quantification determined that 47 percent of spinner dolphins in the Gulf of Mexico were exposed to oil, resulting in 16 percent excess mortality above baseline conditions, 21 percent excess failed pregnancies, and 17 percent higher likelihood for other adverse health effects. Spinner dolphins were determined to take the longest to recover, compared to all cetacean stocks impacted by the oil spill, because this species resulted in the highest maximum reduction in population size. Without active restoration efforts, recovery of the northern Gulf of Mexico spinner dolphin stock will take an estimated 105 years (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016). Refer to Section 3.7.2.1.5.1 (Water Quality) for additional information on the *Deepwater Horizon* oil spill. Section 3.7.2.1.5 (General Threats) discusses other threats to marine mammals.

3.7.2.3.14 Clymene Dolphin (*Stenella clymene*)

3.7.2.3.14.1 Status and Management

The Clymene dolphin has an extensive range in the tropical Atlantic Ocean. For management purposes, the western North Atlantic and northern Gulf of Mexico populations are considered separate stocks.

3.7.2.3.14.2 Habitat and Geographic Range

Clymene dolphins are a tropical to subtropical species, primarily sighted in deep waters well beyond the edge of the continental shelf (Fertl et al., 2003). Clymene dolphins likely occur in the Gulf Stream open ocean area.

In the western North Atlantic, Clymene dolphins were observed as far north as New Jersey, although sightings were primarily in offshore waters east of Cape Hatteras over the continental slope and are likely to be strongly influenced by oceanographic features of the Gulf Stream (Fertl et al., 2003; Moreno et al., 2005; Mullin & Fulling, 2003). Monthly aerial surveys conducted offshore of Cape Hatteras since May 2011 have resulted in 10 total Clymene dolphin sightings, including one sighting of Clymene dolphins in a mixed group of spinner dolphins within the northern offshore waters of the survey area in 2011 (U.S. Department of the Navy, 2013c). All Clymene dolphin sightings were documented primarily during the summer and fall months.

Clymene dolphins in the Gulf of Mexico are observed most frequently on the lower slope and deepwater areas, primarily west of the Mississippi River, in regions of cyclonic or confluent circulation (Davis et al., 2002; Mullin et al., 1994a). Clymene dolphins were seen in the winter, spring and summer during GulfCet aerial surveys of the northern Gulf of Mexico during 1992 to 1998 (Hansen et al., 1996; Mullin & Hoggard, 2000).

3.7.2.3.14.3 Population Trends

There are insufficient data to determine population trends for the western North Atlantic stock of Clymene dolphins (Waring et al., 2013, 2014). Further analysis of northern Gulf of Mexico Clymene dolphin survey data from 1991 to 2009 is required in order to determine whether changes in abundance have occurred over this period (Waring et al., 2013). Additionally, a Gulf-wide assessment of Clymene dolphin abundance has not been made (Waring et al., 2013).

3.7.2.3.14.4 Predator and Prey Interactions

Available information on feeding habits is very limited. This species preys on small fish and squid at moderate depths and feeds primarily at night (Fertl et al., 1997; Jefferson et al., 2015; Perrin et al., 1981).

This species is possibly preyed on by killer whales and large sharks, as evidenced by scars observed on their bodies, although actual predation was not observed (Jefferson, 2008b; Jefferson et al., 2008b; Jefferson et al., 2015).

3.7.2.3.14.5 Species-Specific Threats

The northern Gulf of Mexico stock of Clymene dolphins was 1 of the 31 cetacean stocks impacted by the 2010 *Deepwater Horizon* oil spill in the Gulf of Mexico. Injury quantification determined that 7 percent of Clymene dolphins in the Gulf of Mexico were exposed to oil, resulting in 2 percent excess mortality above baseline conditions, 3 percent excess failed pregnancies, and 3 percent higher likelihood for other adverse health effects. The maximum reduction of the Clymene dolphin population was only 3 percent, therefore the Trustees were not able to calculate the number of years it would take for this stock to recover (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016). Refer to Section 3.7.2.1.5.1 (Water Quality) for additional information on the *Deepwater Horizon* oil spill. Section 3.7.2.1.5 (General Threats) discusses other threats to marine mammals.

3.7.2.3.15 Striped Dolphin (*Stenella coeruleoalba*)

3.7.2.3.15.1 Status and Management

For management purposes, the Gulf of Mexico population of striped dolphin is provisionally considered a separate stock, although there are not sufficient genetic data to differentiate the Gulf of Mexico stock from the western North Atlantic stock (Waring et al., 2010). There is very little information on stock structure in the western North Atlantic and insufficient data to assess population trends of this species (Waring et al., 2010).

3.7.2.3.15.2 Habitat and Geographic Range

The striped dolphin is one of the most common and abundant dolphin species, with a worldwide range that includes both tropical and temperate waters (Waring et al., 2014). 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* (spotted, spinner, Clymene, and striped dolphins). Striped dolphins are found in the western North Atlantic from Nova Scotia south to at least Jamaica as well as in the Gulf of Mexico. In general, striped dolphins appear to prefer continental slope waters offshore to the Gulf Stream (Leatherwood et al., 1976; Perrin et al., 1994b; Schmidly, 1981).

Striped dolphins are relatively common in the cooler offshore waters of the U.S. East Coast. Along the mid-Atlantic ridge in oceanic waters of the North Atlantic Ocean, striped dolphins are sighted in significant numbers south of 50° N (Waring et al., 2010). In waters off the northeastern U.S. coast, striped dolphins are distributed along the continental shelf edge from Cape Hatteras to the southern margin of Georges Bank and also occur offshore over the continental slope and rise in the mid-Atlantic region (Cetacean and Turtle Assessment Program, 1982; Mullin & Fulling, 2003). Continental shelf edge sightings in the Cetacean and Turtle Assessment Program (1982) were generally centered along the 1,000-m depth contour in all seasons. During 1990 and 1991 cetacean habitat-use surveys, striped dolphins were associated with the Gulf Stream north wall and warm-core ring features (Waring et al., 1992). Striped dolphins seen in a survey of the New England Sea Mounts (Palka, 1997) were in waters that were between 20 degrees Celsius (°C) and 27°C and deeper than about 3,000 ft. (900 m).

In January 2015, monthly aerial surveys began in the offshore area near Norfolk Canyon and to date six striped dolphin sightings have been recorded during these efforts (McAlarney et al., 2016). Monthly aerial surveys have been ongoing offshore of Cape Hatteras since May 2011, which have resulted in a total of five striped dolphin sightings, primarily in late winter and early spring.

Striped dolphins are also found throughout the deep, offshore waters of the northern Gulf of Mexico. Sightings of striped dolphins in the northern Gulf of Mexico typically occur in oceanic waters and during all seasons (Waring et al., 2010).

3.7.2.3.15.3 Population Trends

Due to imprecise abundance estimates and long periods of time between surveys, a trend analysis has not been conducted for the western North Atlantic stock of striped dolphins (Waring et al., 2014).

Further analysis of northern Gulf of Mexico striped dolphin survey data from 1991 to 2009 is required in order to determine whether changes in abundance have occurred over this period (Waring et al., 2013). Additionally, a Gulf-wide assessment of striped dolphin abundance has not been made (Waring et al., 2013).

3.7.2.3.15.4 Predator and Prey Interactions

Striped dolphins often feed in open sea or sea bottom zones along the continental slope or just beyond it in oceanic waters. Most of their prey possess light-emitting organs, suggesting that striped dolphins may be feeding at great depths, possibly diving to 655 to 2,295 ft. (200 to 700 m) (Archer & Perrin, 1999). Striped dolphins may feed at night to take advantage of the deep scattering layer's diurnal vertical movements. Small mid-water fishes (in particular lanternfishes) and squids are the predominant prey (Perrin et al., 1994b).

This species was documented to be preyed on by sharks (Ross & Bass, 1971). It may also be subject to predation by killer whales.

3.7.2.3.15.5 Species-Specific Threats

The northern Gulf of Mexico stock of striped dolphins was 1 of the 31 cetacean stocks impacted by the 2010 *Deepwater Horizon* oil spill in the Gulf of Mexico. Injury quantification determined that 13 percent of striped dolphins in the Gulf of Mexico were exposed to oil, resulting in 5 percent excess mortality above baseline conditions, 6 percent excess failed pregnancies, and 5 percent higher likelihood for other adverse health effects. Without active restoration efforts, recovery of the northern Gulf of Mexico striped dolphin stock will take an estimated 14 years (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016). Section 3.7.2.1.5 (General Threats) discusses other threats to marine mammals.

3.7.2.3.16 Fraser's Dolphin (*Lagenodelphis hosei*)

3.7.2.3.16.1 Status and Management

The Gulf of Mexico population of Fraser's dolphin is provisionally being considered a separate stock for management purposes, although there are no genetic data to differentiate this stock from the western North Atlantic stock (Waring et al., 2013).

3.7.2.3.16.2 Habitat and Geographic Range

Fraser's dolphin is a tropical, oceanic species, except where deep water approaches the coast (Dolar, 2008). Frasier's dolphins likely occur in the Gulf Stream open ocean area.

This species is assumed to occur in the tropical western North Atlantic, although only a single sighting of approximately 250 individuals was recorded in waters 3,300 m deep in the waters off Cape Hatteras during a 1999 vessel survey. Monthly aerial surveys offshore of Cape Hatteras since May 2011 have resulted in only one sighting of Fraser's dolphins offshore of the 1,500 m isobaths (U.S. Department of the Navy, 2013c). The first record for the Gulf of Mexico was a mass stranding in the Florida Keys in 1981 (Hersh & Odell, 1986; Leatherwood et al., 1993). Since then, there have been documented strandings on the west coast of Florida and in southern Texas (Yoshida et al., 2010). Sightings of Fraser's dolphin in the northern Gulf of Mexico typically occur in oceanic waters greater than 200 m. This species was observed in the northern Gulf of Mexico during all seasons.

3.7.2.3.16.3 Population Trends

There are insufficient data to determine population trends for the western North Atlantic stock of Fraser's dolphins (Waring et al., 2007).

There are also insufficient data to determine population trends for the northern Gulf of Mexico stock of Fraser's dolphins. The large relative changes in the total abundances of Fraser's dolphin are probably due to a number of factors. Fraser's dolphin is most certainly a resident species in the Gulf of Mexico but probably occurs in low numbers, and the survey effort is not sufficient to estimate the abundance of uncommon or rare species with precision. Also, these temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of Fraser's dolphin abundance. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance (Waring et al., 2013).

3.7.2.3.16.4 Predator and Prey Interactions

Fraser's dolphin feeds on mid-water fishes, squids, and shrimps and has not been documented to be prey to any other species (Jefferson & Leatherwood, 1994; Perrin et al., 1994a). However, this species may be subject to predation by killer whales.

3.7.2.3.16.5 Species-Specific Threats

There are no significant species-specific threats to Fraser's dolphins in the northwest Atlantic or Gulf of Mexico. Section 3.7.2.1.5 (General Threats) discusses threats to marine mammals.

3.7.2.3.17 Risso's Dolphin (*Grampus griseus*)

3.7.2.3.17.1 Status and Management

For management purposes, Risso's dolphins in the Gulf of Mexico and the Atlantic Ocean are currently considered two separate stocks (Hayes et al., 2018; Waring et al., 2016).

3.7.2.3.17.2 Habitat and Geographic Range

Risso's dolphins are distributed worldwide in tropical and temperate waters along the continental shelf break and over the continental slope and 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). Risso's dolphins were also found in association with submarine canyons (Mussi et al., 2004). The range of the Risso's dolphin distribution in open-ocean waters of the North Atlantic is known to include the Gulf Stream and the southwestern portions of the North Atlantic Gyre.

In the northwest Atlantic, Risso's dolphins occur from Florida to eastern Newfoundland (Baird & Stacey, 1991; Leatherwood et al., 1976). Off the northeast U.S. coast, Risso's dolphins are distributed along the continental shelf edge from Cape Hatteras northward to Georges Bank during spring, summer, and autumn (Cetacean and Turtle Assessment Program, 1982; Payne et al., 1984). In winter, the range is in the mid-Atlantic Bight and extends outward into oceanic waters. In general, the population occupies the mid-Atlantic continental shelf edge year-round and is rarely seen in the Gulf of Maine. During 1990, 1991, and 1993, spring/summer surveys conducted along the continental shelf edge and in deeper oceanic waters sighted Risso's dolphins associated with strong bathymetric features, Gulf Stream warm core rings, and the Gulf Stream north wall (Hamazaki, 2002; Waring et al., 1992, 1993).

Monthly aerial survey efforts began in January 2015 in the offshore area near Norfolk Canyon and have resulted in seven Risso's dolphin sightings to date.

Monthly aerial surveys offshore of Cape Hatteras since May 2011 have documented 24 Risso's dolphin sightings, primarily during the summer months. Vessel surveys conducted offshore of Cape Hatteras, North Carolina from January 2009 to December 2014 also resulted in regular sightings of Risso's dolphins (Foley et al., 2015; U.S. Department of the Navy, 2013c). Risso's dolphins were also sighted from inside the 100 m isobath out to 2,000 m water depth during aerial surveys conducted between January to December 2014 (McAlarney et al., 2014).

Risso's dolphins were also one of the most commonly encountered pelagic dolphins found during surveys conducted in Onslow Bay, North Carolina and offshore of Jacksonville, Florida (U.S. Department of the Navy, 2013c). Risso's dolphins observed during aerial and vessel surveys conducted monthly between June 2007 and June 2010 offshore of Onslow Bay, North Carolina were exclusively found over the continental shelf break and in deeper waters of the survey area (Read et al., 2014; U.S. Department of the Navy, 2013c). Passive acoustic monitoring in Onslow Bay preliminarily indicated that Risso's dolphins are present in that area throughout the year (Hodge, 2011). High-frequency acoustic recording packages were deployed from July 2010 through March 2011 and showed an increase in nocturnal increases in Risso's dolphin click occurrences (Hodge & Read, 2013). Additional deployments of high-frequency acoustic recording packages from October 2012 through June 2013 at water depth of 853 m detected calls of Risso's dolphins mainly during spring and summer months (April to June) and no detections were recorded during fall and winter (October through late February) (Hodge & Read, 2015).

Vessel surveys conducted offshore of Jacksonville, Florida between July 2009 and December 2014 have resulted in a few Risso's dolphin sightings including two sightings in 2010, one sighting in May 2013 (Swaim et al., 2014) and one sighting in October 2014 (Swaim et al., 2015). Aerial surveys conducted between July 2010 and December 2011 documented higher numbers of Risso's dolphin encounters, with 16 sightings occurring within deeper waters of the survey area (U.S. Department of the Navy, 2013c).

Risso's dolphins in the northern Gulf of Mexico occur throughout oceanic waters but are concentrated in continental slope waters (Baumgartner, 1997; Maze-Foley & Mullin, 2006). Risso's dolphins were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen et al., 1996; Mullin & Hoggard, 2000).

3.7.2.3.17.3 Population Trends

Due to imprecise abundance estimates and long periods of time between surveys, a trend analysis has not been conducted for the western North Atlantic stock or for the Gulf of Mexico stock of Risso's dolphins (Hayes et al., 2018; Waring et al., 2016).

Further analysis of northern Gulf of Mexico Risso's dolphin survey data from 1991 to 2009 is required in order to determine whether changes in abundance have occurred over this period (Waring et al., 2015). Additionally, since this is a transboundary stock and abundance estimates are for U.S. waters, it is difficult to interpret any detected trends (Waring et al., 2016).

3.7.2.3.17.4 Predator and Prey Interactions

Cephalopods and crustaceans are the primary prey for the Risso's dolphins (Clarke, 1996), with feeding occurring mainly at night (Jefferson et al., 2015).

This dolphin may be preyed on by both killer whales and sharks, although there is no documented report of predation by either species (Weller, 2008).

3.7.2.3.17.5 Species-Specific Threats

Risso's dolphins were included in the Atlantic Pelagic Longline Take Reduction Plan to reduce bycatch associated with Atlantic pelagic longline fishery to a level approaching a zero mortality and serious injury rate within 5 years of implementation (74 *Federal Register* 23351–23351, May 19, 2009). The total annual estimated average fishery-related mortality or serious injury to this stock from 2011 to 2015 was 43.2 Risso's dolphins per year (Hayes et al., 2018).

The northern Gulf of Mexico stock of Risso's dolphin was 1 of the 31 cetacean stocks impacted by the 2010 *Deepwater Horizon* oil spill in the Gulf of Mexico. Injury quantification determined that 8 percent of Risso's dolphins in the Gulf of Mexico were exposed to oil, resulting in 3 percent excess mortality above baseline conditions, 3 percent excess failed pregnancies, and 3 percent higher likelihood for other adverse health effects. The maximum reduction of the Risso's dolphin northern Gulf of Mexico population was only 3 percent, therefore the Trustees were not able to calculate the number of years it would take for this stock to recover (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016). Refer to Section 3.7.2.1.5.1 (Water Quality) for additional information on the *Deepwater Horizon* oil spill. Section 3.7.2.1.5 (General Threats) discusses other threats to marine mammals.

3.7.2.3.18 Atlantic White-Sided Dolphin (*Lagenorhynchus acutus*)

3.7.2.3.18.1 Status and Management

Three stocks of the Atlantic white-sided dolphin in the western North Atlantic Ocean were suggested for conservation management: Gulf of Maine, Gulf of St. Lawrence, and Labrador Sea (Palka et al., 1997; Waring et al., 2004). Evidence for a separation between the population in the southern Gulf of Maine and the Gulf of St. Lawrence populations comes from reduced density of summer sightings along the Atlantic side of Nova Scotia (Hayes et al., 2018). The species is considered abundant in the North Atlantic (Jefferson et al., 2015; Waring et al., 2013).

3.7.2.3.18.2 Habitat and Geographic Range

This species is found primarily in cold temperate to subpolar continental shelf waters to the 328 ft. (100 m) depth contour (Cetacean and Turtle Assessment Program, 1982; Mate et al., 1994; Selzer & Payne, 1988). Occurrence of Atlantic white-sided dolphins in the northeastern United States probably reflects fluctuations in food availability as well as oceanographic conditions (Palka et al., 1997; Selzer & Payne, 1988). Before the 1970s, Atlantic white-sided dolphins were found primarily offshore in waters over the continental slope; however, since then, they occur primarily in waters over the continental shelf, replacing white-beaked dolphins, which were previously sighted in the area. This shift may have been the result of an increase in sand lance and a decline in herring in continental shelf waters (Payne et al., 1990). Areas of feeding importance are around Cape Cod and on the northwest edge of Georges Bank, in an area defined as the Great South Channel-Jeffreys Ledge corridor (Cetacean and Turtle Assessment Program, 1982; Palka et al., 1997). Selzer and Payne (1988) sighted white-sided dolphins more frequently in areas of high seafloor relief and where sea surface temperatures and salinities were low, although these environmental conditions might be only secondarily influencing dolphin distribution; seasonal variation in sea surface temperature and salinity and local nutrient upwelling in areas of high seafloor relief may affect preferred prey abundances, which in turn might affect dolphin distribution (Selzer & Payne, 1988).

Atlantic white-sided dolphins would be expected to occur in the Labrador Current and possibly in the northern extent of the Gulf Stream open ocean area. Atlantic white-sided dolphins are common in waters of the continental slope from New England to southern Greenland (Cipriano, 2008; Jefferson et al., 2015). The Gulf of Maine population is most common in continental shelf waters from Hudson Canyon to Georges Bank and in the Gulf of Maine and lower Bay of Fundy (Hayes et al., 2018; Palka et al., 1997). From January to May, low numbers of white-sided dolphins may be found from Georges Bank to Jeffreys Ledge. Even lower numbers are found south of Georges Bank (Palka et al., 1997; Payne et al., 1990; Waring et al., 2004). From June through September, large numbers of white-sided dolphins are found from Georges Bank to the lower Bay of Fundy (Payne et al., 1990; Waring et al., 2004). During this time, strandings occur from New Brunswick to New York (Palka et al., 1997). From October to December, white-sided dolphins occur at intermediate densities from southern Georges Bank to the southern Gulf of Maine. Sightings occur year-round south of Georges Bank, particularly around Hudson Canyon, but in low densities (Cetacean and Turtle Assessment Program, 1982; Palka, 1997; Payne et al., 1990; Waring et al., 2004). A few strandings were collected on Virginia and North Carolina beaches, which appear to represent the southern edge of the range for this species (Cipriano, 2008; Testaverde & Mead, 1980).

3.7.2.3.18.3 Population Trends

Due to imprecise abundance estimates and long periods of time between surveys, a trend analysis has not been conducted for the western North Atlantic stock of Atlantic white-sided dolphins (Hayes et al., 2018).

3.7.2.3.18.4 Predator and Prey Interactions

The stomach contents of Atlantic white-sided dolphins caught through fishing bycatch, as well as those stranded off of the coast of New England, have included at least 26 fish species and three cephalopod species. The most prominent species were the silver hake, spoonarm octopus, and haddock. Sand lances were found in the stomach of one stranded white-sided dolphin (Hayes et al., 2018). There is seasonal variation in the diet; Atlantic herring was found in more dolphins during the summer than in winter

(Craddock et al., 2009). This species is known to feed in association with other delphinid (dolphin-like) and large whale species (Jefferson et al., 2015; Palka, 1997).

This species was not documented to be prey for any other species (Jefferson et al., 2015).

3.7.2.3.18.5 Species-Specific Threats

The total annual estimated average fishery-related mortality of serious injury to this stock from 2011 to 2015 was 56 (CV = 0.15) white-sided dolphins per year (Hayes et al., 2018). A review of 405 cases of marine mammal mortalities on Cape Cod and southeastern Massachusetts from 2000 to 2006 concluded that mass strandings were the main cause of mortality for 69 percent of Atlantic white-sided dolphins (Bogomolni et al., 2010).

3.7.2.3.19 White-Beaked Dolphin (*Lagenorhynchus albirostris*)

3.7.2.3.19.1 Status and Management

There are at least two separate stocks of the white-beaked dolphin in the North Atlantic: one in the eastern and another in the western North Atlantic.

3.7.2.3.19.2 Habitat and Geographic Range

White-beaked dolphins are found in cold-temperate and subarctic waters of the North Atlantic (Waring et al., 2007). In the western North Atlantic Ocean, the white-beaked dolphin occurs throughout northern waters of the U.S. East Coast and eastern Canada, from eastern Greenland through the Davis Strait and south to Massachusetts (Lien et al., 2001). White-beaked dolphins would be expected to occur in the Labrador Current.

Within the Study Area, white-beaked dolphins are concentrated in the western Gulf of Maine and around Cape Cod (Cetacean and Turtle Assessment Program, 1982; Palka et al., 1997). Before the 1970s, these dolphins were found primarily in waters over the continental shelf of the Gulf of Maine and Georges Bank. Since then, they occur mainly in waters over the continental slope and are replaced by large numbers of Atlantic white-sided dolphins (Katona et al., 1993; Palka et al., 1997). This habitat shift might be a result of an increase in sand lance and a decline in herring in continental shelf waters (Payne et al., 1990). Sightings are common in nearshore waters of Newfoundland and Labrador (Lien et al., 2001). They also occur in the Gulf of St. Lawrence (Waring et al., 2010). During Cetacean and Turtle Assessment Program (1982) surveys, white-beaked dolphins were typically sighted in shallow coastal waters near Cape Cod and along Stellwagen Bank, with a bottom depth ranging from 43 to 2,454 ft. (Palka et al., 1997).

3.7.2.3.19.3 Population Trends

Abundance has declined in some areas, such as the Gulf of Maine, but this may be more closely related to habitat shifts than to direct changes in population size. However, there are insufficient data to determine population trends for this species (Waring et al., 2007).

3.7.2.3.19.4 Predator and Prey Interactions

This species preys on small mid-water and schooling fish, such as herring and haddock, and squid and crustaceans (Jefferson et al., 2008b). Cooperative feeding was observed (Jefferson et al., 2008b).

The white-beaked dolphin is possibly preyed on by killer whales and sharks. Although no attacks were documented, groups of white-beaked dolphin were observed fleeing from killer whales (Kinze, 2008).

3.7.2.3.19.5 Species-Specific Threats

There are no significant species-specific threats to white-beaked dolphins in the northwest Atlantic. Section 3.7.2.1.5 (General Threats) discusses threats to marine mammals.

3.7.2.3.20 Common Dolphin (*Delphinus delphis*)

3.7.2.3.20.1 Status and Management

Only the short-beaked common dolphin is found within the Study Area: the western North Atlantic stock (Hayes et al., 2018; Jefferson et al., 2015) . A discrete population of long-beaked common dolphins is known from the east coast of South America in the western Atlantic (Jefferson et al., 2015); however, they are outside of the Study Area and not discussed further.

3.7.2.3.20.2 Habitat and Geographic Range

In the North Atlantic, common dolphins occur over the continental shelf along the 100- to 2,000-m isobaths and over prominent underwater topography and east to the mid-Atlantic Ridge (29°W) (Doksaeter et al., 2008; Hayes et al., 2018; Waring et al., 2008). There is a well-studied population of short-beaked common dolphins in the western North Atlantic associated with the Gulf Stream (Jefferson et al., 2015). It occurs mainly in offshore waters, ranging from Canada maritime provinces to the Florida/Georgia border (Waring et al., 2010).

In waters off the northeastern U.S. coast, common dolphins are distributed along the continental slope and are associated with Gulf Stream features (Cetacean and Turtle Assessment Program, 1982; Hamazaki, 2002; Selzer & Payne, 1988; Stone et al., 1992). They primarily occur from Cape Hatteras northeast to Georges Bank (35° to 42°N) during mid-January to May (Cetacean and Turtle Assessment Program, 1982; Hain et al., 1981; Payne et al., 1984). Common dolphins move onto Georges Bank and the Scotian Shelf from mid-summer to autumn. Selzer and Payne (1988) reported very large aggregations (greater than 3,000 animals) on Georges Bank in autumn. Common dolphins are occasionally found in the Gulf of Maine (Selzer & Payne, 1988). Migration onto the Scotian Shelf and continental shelf off Newfoundland occurs during summer and autumn when water temperatures exceed 11°C (Gowans & Whitehead, 1995; Sergeant et al., 1970). The species is less common south of Cape Hatteras, although schools were reported as far south as the Georgia/South Carolina border (32° N) (Jefferson et al., 2009).

The short-beaked common dolphin was one of the many species sighted in more than 5 years of aerial and vessel monitoring of waters off Cape Hatteras, North Carolina and Jacksonville, Florida. Aerial surveys offshore of Cape Hatteras conducted between August 2011 through July 2012 resulted in eight sightings of 675 common dolphins just beyond the 100 m isobath (U.S. Department of the Navy, 2013c), three sightings in March and May 2013 between the 100 m and 1,000 m isobaths (McAlarney et al., 2014). From January 2009 through December 2014, common dolphin sightings have occurred each year between 2011 through 2014 (Foley et al., 2015). A single location-only tag was deployed on a short-beaked common dolphin offshore of Cape Hatteras in June 2014, and location data were obtained over a 40-day period. This individual was observed to remain primarily over the continental shelf break and continental slope, and traveled north away from the tagging location to shallower continental shelf waters off New England during the mid-summer (Baird et al., 2015). The median depth of tagged animal locations over the 40-day span was 297 m (Baird et al., 2015).

3.7.2.3.20.3 Population Trends

Due to imprecise abundance estimates and long periods of time between surveys, a trend analysis has not been conducted for the western North Atlantic stock of common dolphins (Hayes et al., 2018).

3.7.2.3.20.4 Predator and Prey Interactions

Common dolphins feed primarily on organisms in the vertically migrating deep scattering layer, including fish and squid (dos Santos & Haimovici, 2001; Meynier et al., 2008; Overholtz & Waring, 1991; Pusineri et al., 2007). Diel (a 24-hour cycle that often involves a day and the adjoining night) fluctuations in vocal activity, with more vocal activity during late evening and early morning, appear to be linked to feeding in the deep scattering layer, which rises in this same time frame (Goold, 2000). In the western North Atlantic, oceanic dolphins feed more on squid than those in more nearshore waters (Perrin, 2008a).

Short-beaked common dolphins are known to be preyed on by killer whales (Visser, 1999) and large sharks (Leatherwood et al., 1973), although little is known about the impact of this predation on populations.

3.7.2.3.20.5 Species-Specific Threats

Average annual estimated fishery-related mortality or serious injury to this stock from 2011 to 2015 was 437 (CV = 0.10) common dolphins per year (Hayes et al., 2018). There are no major known sources of unquantifiable human-caused mortality or serious injury for this stock. Section 3.7.2.1.5 (General Threats) discusses threats to marine mammals.

3.7.2.3.21 Melon-Headed Whale (*Peponocephala electra*)

3.7.2.3.21.1 Status and Management

For management purposes, the western North Atlantic population and Gulf of Mexico population of melon-headed whales are considered separate stocks, although genetic data that differentiate these two stocks is lacking (Waring et al., 2007; Waring et al., 2010, 2013).

3.7.2.3.21.2 Habitat and Geographic Range

Melon-headed whales are found worldwide in tropical and subtropical waters. They are occasionally reported at higher latitudes, but these movements are considered to be beyond their typical range because the records indicate these movements occurred during incursions of warm water currents (Perryman et al., 1994). Melon-headed whales are most often found in offshore deep waters, and could occur in the southern parts of the Gulf Stream and North Atlantic Gyre open ocean areas.

Sightings of whales from the western North Atlantic stock are rare, but a group of 20 whales was sighted during surveys in 1999 offshore of Cape Hatteras, and a group of 80 whales was also sighted off Cape Hatteras, in 2002, in waters greater than 2,500 m deep (Waring et al., 2013).

Deployment of high-frequency acoustic recording packages offshore of Cape Hatteras, Onslow Bay, Jacksonville and the offshore areas near Norfolk Canyon from 2009 through 2015 have resulted in zero melon-headed whale detections. However, passive acoustic data were collected from marine autonomous recording units deployed on the continental shelf, just beyond the shelf, and offshore from the shelf break off Jacksonville, Florida in late 2009 and early 2010. These deployments resulted in detections of the melon-headed whales, pygmy killer whales, false killer whales, killer whales, and short-finned pilot whales. These species were detected every day during deployments but there were no obvious or consistent differences in the occurrence of vocalizations relative to water depth or time of day (Oswald et al., 2016). The grouping of these five species into the same category may have masked any patterns in vocal behaviors (Oswald et al., 2016).

This species was observed in deep waters of the Gulf of Mexico, well beyond the edge of the continental shelf and in waters over the abyssal plain, primarily west of Mobile Bay, Alabama (Davis & Fargion, 1996; Mullin et al., 1994b; Waring et al., 2010, 2013). Sightings of melon-headed whales in the northern Gulf of Mexico were documented in all seasons during GulfCet aerial surveys 1992 and 1998 (Hansen et al., 1996; Mullin & Hoggard, 2000).

3.7.2.3.21.3 Population Trends

There are insufficient data to determine the population trends for the western North Atlantic stock of melon-headed whales (Waring et al., 2007). A trend analysis has not been conducted for the northern Gulf of Mexico stock of melon-headed whales (Waring et al., 2013). Further analysis of northern Gulf of Mexico melon-headed whale survey data from 1991 to 2009 is required in order to determine whether changes in abundance have occurred over this period. Additionally, a Gulf-wide assessment of melon-headed whale abundance has not been made (Waring et al., 2013).

3.7.2.3.21.4 Predator and Prey Interactions

Little is known on predators of melon-headed whales in the Atlantic, therefore information from other geographic areas is likely applicable to the AFTT Study Area. Melon-headed whales are believed to be preyed on by killer whales and were observed fleeing from killer whales in Hawaiian waters (Baird et al., 2006).

Melon-headed whales prey on squid, pelagic fishes, and occasionally crustaceans (Jefferson & Barros, 1997; Perryman, 2008). Most of the fish and squid families eaten by this species consist of mid-water forms found in waters up to 1,500 m deep, suggesting that feeding takes place deep in the water column (Jefferson & Barros, 1997).

3.7.2.3.21.5 Species-Specific Threats

The northern Gulf of Mexico stock of melon-headed whales was 1 of the 31 cetacean stocks impacted by the 2010 *Deepwater Horizon* oil spill in the Gulf of Mexico. Injury quantification determined that 15 percent of melon-headed whales in the Gulf of Mexico were exposed to oil, resulting in 5 percent excess mortality above baseline conditions, 7 percent excess failed pregnancies, and 6 percent higher likelihood for other adverse health effects. Without active restoration efforts, recovery of the northern Gulf of Mexico melon-headed whale stock will take an estimated 29 years (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016). Refer to Section 3.7.2.1.5.1 (Water Quality) for additional information on the *Deepwater Horizon* oil spill. Section 3.7.2.1.5 (General Threats) discusses other threats to marine mammals.

3.7.2.3.22 Pygmy Killer Whale (*Feresa attenuata*)

3.7.2.3.22.1 Status and Management

For management purposes, the Gulf of Mexico population of pygmy killer whale is considered a separate stock although there is not yet sufficient genetic information to differentiate this stock from the western North Atlantic stocks (Waring et al., 2007; Waring et al., 2013).

3.7.2.3.22.2 Habitat and Geographic Range

Although the pygmy killer whale has an extensive global distribution, it is not known to occur in high densities in any region and is, therefore, probably one of the least abundant pantropical delphinids

(Waring et al., 2013). The pygmy killer whale is generally an open ocean deepwater species (Davis et al., 2000; Würsig et al., 2000). This species has a worldwide distribution in tropical and subtropical oceans. Pygmy killer whales generally do not range poleward of 40° N or of 35° S (Donahue & Perryman, 2008; Jefferson et al., 2015). This species occurs in the North Atlantic Gyre and the Gulfstream, although sightings are rare. Most observations outside the tropics are associated with strong, warm western boundary currents that effectively extend tropical conditions into higher latitudes (Ross & Leatherwood, 1994).

A group of 6 pygmy killer whales was sighted during a 1992 vessel survey of the western North Atlantic off of Cape Hatteras, North Carolina, in waters greater than 1,500 m deep, but this species was not sighted during subsequent surveys (Waring et al., 2007).

Deployment of high-frequency acoustic recording packages offshore of Cape Hatteras, Onslow Bay, Jacksonville and the offshore areas near Norfolk Canyon from 2009 through 2015 have resulted in zero pygmy killer whale detections. However, passive acoustic monitoring data was collected from marine autonomous recording units deployed on the continental shelf, just beyond the shelf, and offshore from the shelf break off Jacksonville, Florida in late 2009 and early 2010. Recordings included detections of pygmy killer whales, along with melon-headed whales, false killer whales, killer whales, and short-finned pilot whales. These species were detected every day during monitoring but there were no obvious diel patterns or differences in the occurrence of blackfish vocalizations relative to water depth (Oswald et al., 2016). Since these five species are combined into the same category, patterns in pygmy killer whale vocal behaviors may have masked by the presence of other species (Oswald et al., 2016).

In the northern Gulf of Mexico, the pygmy killer whale is found primarily in deeper waters off the continental shelf and in waters over the abyssal plain (Davis et al., 2000; Würsig et al., 2000). The majority of sightings are in the eastern oceanic Gulf of Mexico.

3.7.2.3.22.3 Population Trends

There are insufficient data to determine population trends for the western North Atlantic stock of pygmy killer whales (Waring et al., 2007).

A trend analysis has not been conducted for the northern Gulf of Mexico stock of pygmy killer whales (Waring et al., 2013). Further analysis of northern Gulf of Mexico pygmy killer whale survey data from 1991 to 2009 is required in order to determine whether changes in abundance have occurred over this period. Additionally, a Gulf-wide assessment of pygmy killer whale abundance has not been made (Waring et al., 2013).

3.7.2.3.22.4 Predator and Prey Interactions

The pygmy killer whale has no documented predators in the Atlantic of Gulf of Mexico; however, it may be subject to predation by killer whales and large sharks. Pygmy killer whales feed predominantly on fish and squid (Clarke, 1986; Donahue & Perryman, 2008; dos Santos & Haimovici, 2001). They are known to attack other dolphin species, apparently as prey, although this is not common (Jefferson et al., 2015; Perryman & Foster, 1980; Ross & Leatherwood, 1994).

3.7.2.3.22.5 Species-Specific Threats

The northern Gulf of Mexico stock of pygmy killer whales was 1 of the 31 cetacean stocks impacted by the 2010 *Deepwater Horizon* oil spill in the Gulf of Mexico. Injury quantification determined that 15 percent of pygmy killer whales in the Gulf of Mexico were exposed to oil, resulting in 5 percent excess mortality above baseline conditions, 7 percent excess failed pregnancies, and 6 percent higher likelihood for other adverse health effects. Without active restoration efforts, recovery of the northern Gulf of Mexico pygmy killer whale stock will take an estimated 29 years (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016). Refer to Section 3.7.2.1.5.1 (Water Quality) for additional information on the *Deepwater Horizon* oil spill. Section 3.7.2.1.5 (General Threats) discusses other threats to marine mammals.

3.7.2.3.23 False Killer Whale (*Pseudorca crassidens*)

3.7.2.3.23.1 Status and Management

Little is known of the status of most false killer whale populations around the world. While the species is not considered rare, few areas of high density are known. The population found in the Gulf of Mexico is considered a separate stock from the western North Atlantic stock for management purposes; however, there are no genetic data to differentiate between the two stocks (Waring et al., 2013).

3.7.2.3.23.2 Habitat and Geographic Range

False killer whales occur worldwide throughout warm temperate and tropical oceans in deep open-ocean waters and around oceanic islands and only rarely come into shallow coastal waters (Baird et al., 2008; Leatherwood & Reeves, 1983; Odell & McClune, 1999). Occasional inshore movements are associated with movements of prey and shoreward flooding of warm ocean currents. False killer whales are unlikely to be found in any open ocean area.

False killer whales have been sighted in U.S. Atlantic waters from southern Florida to Maine (Schmidly, 1981). There are periodic records (primarily stranding) from southern Florida to Cape Hatteras dating back to 1920 (Schmidly, 1981). Few false killer whales have been sighted during shipboard or aerial surveys, but one sighting of 11 animals occurred during a shipboard survey conducted in summer 2011 (Waring et al., 2016).

Deployment of high-frequency acoustic recording packages offshore of Cape Hatteras, Onslow Bay, Jacksonville and the offshore areas near Norfolk Canyon from 2009 through 2015 have resulted in zero false killer whale detections. However, deployments of marine autonomous recording units on the continental shelf, just beyond the shelf, and offshore from the shelf break off Jacksonville, Florida occurred in late 2009 and early 2010. Recordings included detections of false killer whales, along with melon-headed whales, pygmy killer whales, killer whales, and short-finned pilot whales. These species were detected every day during monitoring but there were no obvious differences in the occurrence of vocalizations relative to water depth and no diel patterns were evident (Oswald et al., 2016). Since these five species are combined into the same category, false killer whale vocalization patterns and behaviors may have masked by the presence of other species (Oswald et al., 2016).

Sightings of this species in the northern Gulf of Mexico (i.e., U.S. Gulf of Mexico) occur in oceanic waters, primarily in the eastern Gulf (Maze-Foley & Mullin, 2006; Mullin & Fulling, 2004). False killer whales were seen only in the spring and summer during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen et al., 1996; Mullin & Hoggard, 2000) and in the spring during vessel surveys (Mullin et al., 2004).

3.7.2.3.23.3 Population Trends

There are insufficient data to determine population trends for the western North Atlantic stock of false killer whales (Waring et al., 2016). A trend analysis has not been conducted for the northern Gulf of Mexico stock of false killer whales (Waring et al., 2013). Further analysis of northern Gulf of Mexico false killer whale survey data from 1991 to 2004 is required in order to determine whether changes in abundance have occurred over this period. Additionally, a Gulf-wide assessment of false killer whale abundance has not been made (Waring et al., 2013).

3.7.2.3.23.4 Predator and Prey Interactions

False killer whales feed primarily on deep-sea cephalopods and fish (Odell & McClune, 1999). They may prefer large fish species, such as mahi mahi and tuna. Twenty-five false killer whales that stranded off the coast of the Strait of Magellan (outside of the Study Area) were examined and found to feed primarily on cephalopods and fish. Squid beaks were found in nearly half of the stranded animals. The most important prey species were found to be squid, followed by Patagonian grenadier, a coastal fish (Koen-Alonso et al., 1999).

False killer whales were observed attacking dolphins and large whales, such as humpback and sperm whales (Hooker et al., 2009). They are known to behave aggressively toward small cetaceans in tuna purse seine nets. Unlike other whales or dolphins, false killer whales frequently pass prey back and forth among individuals before they start to eat the fish, in what appears to be a way of affirming social bonds (Baird et al., 2010). This species is believed to be preyed on by large sharks and killer whales (Baird, 2009).

3.7.2.3.23.5 Species-Specific Threats

The northern Gulf of Mexico stock of false killer whales was 1 of the 31 cetacean stocks impacted by the 2010 *Deepwater Horizon* oil spill in the Gulf of Mexico. Injury quantification determined that 18 percent of false killer whales in the Gulf of Mexico were exposed to oil, resulting in 6 percent excess mortality above baseline conditions, 8 percent excess failed pregnancies, and 7 percent higher likelihood for other adverse health effects. Without active restoration efforts, recovery of the northern Gulf of Mexico false killer whale stock will take an estimated 42 years (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016). Refer to Section 3.7.2.1.5.1 (Water Quality) for additional information on the *Deepwater Horizon* oil spill. Section 3.7.2.1.5 (General Threats) discusses other threats to marine mammals.

3.7.2.3.24 Killer Whale (*Orcinus orca*)

3.7.2.3.24.1 Status and Management

Although some populations of killer whales, particularly in the northwest Pacific, are extremely well studied, little is known about killer whale populations in most areas including the northwest Atlantic and Gulf of Mexico. Killer whales are apparently not highly abundant anywhere but are observed in higher concentration in Antarctic waters. For management purposes, the western North Atlantic population and Gulf of Mexico population are considered separate stocks (Waring et al., 2010, 2013; 2016).

3.7.2.3.24.2 Habitat and Geographic Range

Killer whales are found in all marine habitats, from the coastal zone (including most bays and inshore channels) to deep oceanic basins and from equatorial regions to the polar pack ice zones of both hemispheres. Although killer whales are also found in tropical waters and the open ocean, they are generally most numerous in coastal waters and at higher latitudes (Dahlheim & Heyning, 1999). Killer whales are likely found in Labrador Current, Gulf Stream, and North Atlantic Gyre open ocean areas.

Killer whales are considered rare and uncommon in waters of the U.S. Exclusive Economic Zone in the Atlantic Ocean (Katona et al., 1988; Waring et al., 2010, 2013). During the 1978 to 1981 Cetacean and Turtle Assessment Program surveys, there were 12 killer whale sightings, which made up 0.1 percent of the 11,156 cetacean sightings in the surveys (Cetacean and Turtle Assessment Program, 1982; Waring et al., 2010, 2013). Nearshore observations are rare. Forty animals were observed in the southern Gulf of Maine in September 1979 and 29 animals in Massachusetts Bay in August 1986 (Katona et al., 1988; Waring et al., 2010).

Deployment of high-frequency acoustic recording packages offshore of Cape Hatteras, Onslow Bay, Jacksonville and the offshore areas near Norfolk Canyon from 2009 through 2015 have resulted in zero killer whale detections. During the fall and winter of 2009 and 2010, passive acoustic monitoring was conducted by marine autonomous recording units deployed over the continental shelf, just beyond the shelf, and offshore from the shelf break off Jacksonville, Florida. Recordings included detections of the blackfish group of cetaceans, which includes killer whales, along with melon-headed whales, pygmy killer whales, false killer whales, and short-finned pilot whales. Blackfish were detected every day during monitoring but there were no obvious differences in the occurrence of blackfish vocalizations relative to water depth and diel patterns were not apparent (Oswald et al., 2016). Since five species are combined into the blackfish category, vocalization patterns and behaviors may have masked by the presence of other species (Oswald et al., 2016).

Sightings of killer whales in the Gulf of Mexico on surveys from 1921 to 1995 were in water depths ranging from 840 to 8,700 ft., with an average of 4,075 ft., and were most frequent in the north-central region of the Gulf of Mexico (Waring et al., 2013). Killer whales were seen only in the summer during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen et al., 1996; Mullin & Hoggard, 2000), were reported from May through June during vessel surveys (Maze-Foley & Mullin, 2006; Mullin & Fulling, 2004) and recorded in May, August, September and November by earlier opportunistic ship-based sources (O'Sullivan & Mullin, 1997).

3.7.2.3.24.3 Population Trends

There are insufficient data to determine population trends for the western North Atlantic and Gulf of Mexico stocks of killer whales (Waring et al., 2013).

3.7.2.3.24.4 Predator and Prey Interactions

Killer whales are apex predators and feed on a variety of prey, including bony fishes, elasmobranchs (a class of fish composed of sharks, skates, and rays), cephalopods, seabirds, sea turtles, and other marine mammals (Fertl et al., 1996; Jefferson et al., 2015). Some populations are known to specialize in specific types of prey (Jefferson et al., 2015; Krahn et al., 2004; Wade et al., 2009). The killer whale has no known natural predators; it is considered to be the top predator of the oceans (Ford et al., 2005).

3.7.2.3.24.5 Species-Specific Threats

There are no significant species-specific threats to killer whales in the northwest Atlantic or Gulf of Mexico. Section 3.7.2.1.5 (General Threats) discusses threats to marine mammals.

3.7.2.3.25 Long-Finned Pilot Whale (*Globicephala melas melas*)

There are two species of pilot whales in the western Atlantic: the long-finned pilot whale, *Globicephala melas melas*, and the short-finned pilot whale, *G. macrorhynchus*. These species are difficult to differentiate at sea; therefore, the ability to separately assess the two stocks in U.S. Atlantic waters is limited and requires additional information on seasonal spatial distribution (Hayes et al., 2017).

3.7.2.3.25.1 Status and Management

The structure of the western North Atlantic stock of long-finned pilot whales is uncertain (Fullard et al., 2000; International Council of the Exploration of the Sea, 1993). Morphometric (Bloch & Lastein, 1993) and genetic (Fullard et al., 2000) studies have provided little support for stock structure across the Atlantic (Fullard et al., 2000). However, Fullard et al. (2000) have proposed a stock structure that is related to sea-surface temperature: (1) a cold-water population west of the Labrador/North Atlantic Current and (2) a warm-water population that extends across the Atlantic in the Gulf Stream. The area of overlap between the long-finned and short-finned pilot whales occurs primarily along the shelf break off the coast of New Jersey between 38°N and 40°N latitude (Hayes et al., 2017).

3.7.2.3.25.2 Habitat and Geographic Range

Long-finned pilot whales occur along the continental shelf break, in continental slope waters, and in areas of high topographic relief, inhabiting temperate and subpolar zones from North Carolina to North Africa (and the Mediterranean) and north to Iceland, Greenland and the Barents Sea (Abend & Smith, 1999; Buckland et al., 1993; Leatherwood et al., 1976; Sergeant, 1962). Long-finned pilot whales are likely found in the Gulf Stream and Labrador Current open ocean areas, and might be found in the North Atlantic Gyre.

In U.S. Atlantic waters, pilot whales (*Globicephala* spp.) are distributed principally along the continental shelf edge off the northeastern U.S. coast in winter and early spring, moving onto Georges Bank and into the Gulf of Maine and more northern waters in late spring (Abend & Smith, 1999; Cetacean and Turtle Assessment Program, 1982; Hamazaki, 2002; Payne & Heinemann, 1993). They remain in these areas through late autumn (Cetacean and Turtle Assessment Program, 1982; Payne & Heinemann, 1993). Pilot whales tend to occupy areas of high relief or submerged banks. They are also associated with the Gulf Stream wall and thermal fronts along the continental shelf edge. Long- and short-finned pilot whales overlap spatially along the mid-Atlantic shelf break between Cape Hatteras, North Carolina, and New Jersey (Payne & Heinemann, 1993).

3.7.2.3.25.3 Population Trends

A trend analysis has not been conducted for the western North Atlantic stock of long-finned pilot whales (Hayes et al., 2017). There are two abundance estimates for *Globicephala spp*. from summer 1998 (14,909; CV=0.26) and summer 2004 surveys (31,139; CV=0.27) and one abundance estimate of *G. melas* from summer 2011 surveys (5,636; CV=0.63). Because the 1998 and 2004 surveys did not derive separate abundance estimates for each pilot whale species, comparisons to the 2011 estimate are inappropriate.

3.7.2.3.25.4 Predator and Prey Interactions

Both pilot whale species feed primarily on squid but also eat fish, including mackerel, cod, turbot, herring, hake, and dogfish (Bernard & Reilly, 1999). They are also known to feed on shrimp (Gannon et al., 1997; Jefferson et al., 2015). Feeding generally takes place at depths between 200 and 500 m (Jefferson et al., 2015), but dives may be as deep as 800 m (Heide-Jørgensen et al., 2002). Some accounts of pilot whale attacks on small marine mammals are known, but pilot whales generally are not known to prey on marine mammals (Weller et al., 1996). Killer whales are possible predators of long-finned pilot whales.

3.7.2.3.25.5 Species-Specific Threats

Long-finned pilot whales were included in the Atlantic Pelagic Longline Take Reduction Plan to reduce bycatch associated with Atlantic pelagic longline fishery to a level approaching a zero mortality and serious injury rate within 5 years of implementation (74 *Federal Register* 23351–23351, May 19, 2009). Section 3.7.2.1.5 (General Threats) discusses threats to marine mammals.

3.7.2.3.26 Short-Finned Pilot Whale (*Globicephala macrorhynchus*)

3.7.2.3.26.1 Status and Management

Studies are currently being conducted at the NMFS Southeast Fisheries Science Center to evaluate genetic population structure in short-finned pilot whales. Pending these results, short-finned pilot whales populations occupying U.S. Atlantic waters are managed as three separate stocks: the western North Atlantic stock that occupies the U.S. Atlantic waters, the northern Gulf of Mexico stock that occupies the Gulf, and the Puerto Rico and U.S. Virgin Islands stock that occupies Caribbean waters (Hayes et al., 2017; Waring et al., 2012; Waring et al., 2016). The Puerto Rico and U.S. Virgin Islands short-finned pilot whale population is provisionally considered a separate stock for management purposes although there is currently no information to differentiate this stock from the western North Atlantic stock or the northern Gulf of Mexico stock (Waring et al., 2012).

3.7.2.3.26.2 Habitat and Geographic Range

There are two species of pilot whales in the western Atlantic: the long-finned pilot whale, *Globicephala melas melas*, and the short-finned pilot whale, *G. macrorhynchus*. These species are difficult to differentiate at sea; therefore, the ability to separately assess the two stocks in U.S. Atlantic waters is limited (Hayes et al., 2017; Waring et al., 2016). Only the short-finned pilot whale occurs in the Gulf of Mexico and Caribbean.

Short-finned pilot whales range throughout warm temperate to tropical waters of the world, generally in deep offshore areas (Waring et al., 2016). Thus, the species occupies waters over the continental shelf break, in slope waters, and in areas of high topographic relief (Olson, 2008). While pilot whales are typically distributed along the continental shelf break, movements over the continental shelf are commonly observed in the northeastern United States. Sightings of pilot whales (*Globicephala* spp.) in the western North Atlantic occur primarily near the continental shelf break ranging from Florida to the Nova Scotian Shelf (Mullin & Fulling, 2003). Genetic analysis of stranded pilot whales, evaluated as a function of sea surface temperature and water depth, indicated that short-finned pilots whales were not likely to be found at water temperatures less than 22°C and highly likely to occur where water temperatures were greater than 25°C. Probability of a short-finned pilot whale also increased with increasing water depth. Short-finned and long-finned pilot whales overlap spatially along the mid-Atlantic shelf break between New Jersey and the southern flank of Georges Bank (Hayes et al., 2017). Short-finned pilot whales are likely found in the Gulf Stream open ocean area.

Pilot whales are one of the most common cetacean species observed off Cape Hatteras during aerial surveys, specifically from the 100 m isobaths out to water depths greater than 2,000 m (U.S. Department of the Navy, 2013c). Satellite tagging efforts were conducted in the summers of 2014 and 2015 in an area off Cape Hatteras. Twenty satellite tags were deployed on short-finned pilot whales in 2014 and 19 were deployed in 2015. The satellite tag study provided the first information on long-term and long-distance movements of short-finned pilot whales in the area, other than information obtained from tags on previously stranded and rehabilitated individuals. While photo-ID work suggests that short-finned pilot whales display a high degree of residence off Cape Hatteras, satellite tagging demonstrates that these animals cover a significant range up and down the continental slope, from Georges Bank in the north, down to Cape Lookout Shoals in the south, with movements at least occasionally into waters beyond the U.S. Exclusive Economic Zone (Baird et al., 2015, 2016a).

Deployment of high-frequency acoustic recording packages offshore of Cape Hatteras, Onslow Bay, Jacksonville and the offshore areas near Norfolk Canyon from 2009 through 2015 have resulted in zero short-finned pilot whale detections. Passive acoustic data were collected from marine autonomous recording units deployed on the continental shelf, just beyond the shelf, and offshore from the shelf break off Jacksonville, Florida in late 2009 and early 2010. These deployments resulted in detections of short-finned pilot whales, along with melon-headed whales, pygmy killer whales, false killer whales, and killer whales. These species were detected every day during deployments but there were no obvious or consistent differences in the occurrence of vocalizations relative to water depth or time of day (Oswald et al., 2016). The fact that five species are combined into the same category may have masked any patterns in vocal behaviors (Oswald et al., 2016).

Short-finned pilot whales are also documented along the continental shelf and continental slope in the northern Gulf of Mexico (Hansen et al., 1996; Mullin & Hoggard, 2000; Mullin & Fulling, 2003), and in the Caribbean. Short-finned pilot whales were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen et al., 1996; Mullin & Hoggard, 2000).

3.7.2.3.26.3 Population Trends

A trend analysis has not been conducted for the western North Atlantic stock of short-finned pilot whales (Hayes et al., 2017; Waring et al., 2016). There are two abundance estimates for *Globicephala spp*. from summer 1998 (14,909; CV=0.26) and summer 2004 surveys (31,139; CV=0.27) and one abundance estimate of *G. melas* from summer 2011 surveys (5,636; CV=0.63). Because the 1998 and 2004 surveys did not derive separate abundance estimates for each pilot whale species, comparisons to the 2011 estimate are inappropriate.

A trend analysis has not been conducted for the northern Gulf of Mexico stock of short-finned pilot whales (Waring et al., 2016). Further analysis of northern Gulf of Mexico short-finned pilot whale survey data from 1991 to 2004 is required in order to determine whether changes in abundance have occurred over this period. Additionally, a Gulf-wide assessment of short-finned pilot whale abundance has not been made (Waring et al., 2016).

There are insufficient data to determine population trends for the Puerto Rico and U.S. Virgin Islands stock (Waring et al., 2012).

3.7.2.3.26.4 Predator and Prey Interactions

Pilot whales feed primarily on squid, to which they are generally well adapted (Jefferson et al., 2008b; Werth, 2006), but they also take fish (Bernard & Reilly, 1999). Pilot whales are not generally known to prey on other marine mammals, but records from the eastern tropical Pacific suggest that the short-finned pilot whale does occasionally chase and attack, and may even eat, dolphins during fishery operations (Olson, 2008; Perryman & Foster, 1980). They were also observed harassing sperm whales in the Gulf of Mexico (Weller et al., 1996). This species is not known to have any predators (Weller, 2008), but it may be subject to predation by killer whales.

3.7.2.3.26.5 Species-Specific Threats

Short-finned pilot whales were included in the Atlantic Pelagic Longline Take Reduction Plan to reduce bycatch associated with Atlantic pelagic longline fishery to a level approaching a zero mortality and serious injury rate within 5 years of implementation (74 *Federal Register* 23351–23351, May 19, 2009).

The northern Gulf of Mexico stock of short-finned pilot whales was 1 of the 31 cetacean stocks impacted by the 2010 *Deepwater Horizon* oil spill in the Gulf of Mexico. Injury quantification determined that 6 percent of short-finned pilot whales in the Gulf of Mexico were exposed to oil, resulting in 2 percent excess mortality above baseline conditions, 3 percent excess failed pregnancies, and 2 percent higher likelihood for other adverse health effects. The maximum reduction of the short-finned pilot whale Gulf of Mexico population was only 3 percent, therefore the Trustees were not able to calculate the number of years it would take for this stock to recover (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016). Refer to Section 3.7.2.1.5.1 (Water Quality) for additional information on the *Deepwater Horizon* oil spill. Section 3.7.2.1.5 (General Threats) discusses other threats to marine mammals.

3.7.2.3.27 Harbor Porpoise (*Phocoena phocoena phocoena*)

3.7.2.3.27.1 Status and Management

The Gulf of Maine–Bay of Fundy stock is the only stock of harbor porpoise under NMFS management within the Study Area. There are three additional harbor porpoise populations that occur within the Study Area–Gulf of St. Lawrence, Newfoundland, and Greenland (Gaskin, 1992). The Gulf of Maine–Bay of Fundy stock is the largest contributor to the aggregation of harbor porpoises found off the mid-Atlantic states (Hayes et al., 2018).

3.7.2.3.27.2 Habitat and Geographic Range

Harbor porpoises inhabit cool temperate-to-subpolar waters, often where prey aggregations are concentrated (Watts & Gaskin, 1985). Thus, they are frequently found in shallow waters, most often near shore, but they sometimes move into deeper offshore waters. Harbor porpoises are rarely found in waters warmer than 63°F (17°C) (Read, 1999) and closely follow the movements of their primary prey, Atlantic herring (Gaskin, 1992).

Harbor porpoise would likely be found only in the Labrador Current open ocean area. In the western North Atlantic, harbor porpoise range from Cumberland Sound on the east coast of Baffin Island, south-east along the eastern coast of Labrador to Newfoundland and the Gulf of St. Lawrence, thence south-west to about 34°N on the coast of North Carolina (Waring et al., 2016). Harbor porpoise are also found in southwest Greenland. During summer (July to September), harbor porpoises are concentrated in the northern Gulf of Maine and southern Bay of Fundy region, generally in waters less than 150 m. deep (Gaskin, 1977; Kraus et al., 1983; Palka, 1995a; Palka, 1995b), with a few sightings in the upper Bay of Fundy and on the northern edge of Georges Bank (Palka, 2000).

They are seen from the coastline to deep waters (greater than 5,906 ft.) (Westgate et al., 1998), although most of the population is found over the continental shelf. During winter (January to March), intermediate densities of harbor porpoises can be found in waters off New Jersey to North Carolina, and lower densities are found in waters off New York to New Brunswick, Canada (Hayes et al., 2018). Harbor porpoises sighted off the mid-Atlantic states during winter include porpoises from other western North Atlantic populations (Rosel et al., 1999). There does not appear to be a temporally coordinated migration or a specific migratory route to and from the Bay of Fundy region (Hayes et al., 2018).

LaBrecque et al. (2015a) identified a small and resident population area for harbor porpoise in the Gulf of Maine (Figure 3.7-1) based on sightings documented by National Oceanic and Atmospheric Administration Fisheries ship and aerial surveys, strandings, and animals taken incidental to fishing reported by National Oceanic and Atmospheric Administration Fisheries observers. From July to September, harbor porpoises are concentrated in waters less than 150 m deep in the northern Gulf of Maine and southern Bay of Fundy. During fall (October to December) and spring (April to June), harbor porpoises are widely dispersed from New Jersey to Maine, with lower densities farther north and south (LaBrecque et al., 2015a).

3.7.2.3.27.3 Population Trends

Due to imprecise abundance estimates and long periods of time between surveys, a trend analysis has not been conducted for the Gulf of Maine/Bay of Fundy stock of harbor porpoises (Hayes et al., 2018).

3.7.2.3.27.4 Predator and Prey Interactions

This species preys on a variety of fish, especially high fat pelagic species such as herring, sprat and anchovy, and cephalopods (Berrow & Rogan, 1996; Bjorge & Tolley, 2009; Santos & Pierce, 2003). The harbor porpoise is known to be attacked and killed by killer whales and common bottlenose dolphins (Jefferson et al., 2015).

3.7.2.3.27.5 Species-Specific Threats

Harbor porpoises have been documented as bycatch in a variety of fisheries, including sink and drift gillnets, herring weirs, and pelagic long-lines (Hayes et al., 2018; Zollett, 2009). The total annual estimated human-caused mortality and serious injury is 307 harbor porpoises per year (CV = 0.16) from U.S. fisheries (Hayes et al., 2018).

3.7.2.3.28 Bearded Seal (*Erignathus barbatus*)

3.7.2.3.28.1 Status and Management

There are two generally accepted subspecies of bearded seal; *Erignathus barbatus barbatus* inhabits the North Atlantic Ocean, including Hudson Bay, and the Barents and Laptev Seas; *Erignathus barbatus nauticus* inhabits Arctic waters of eastern Russia, Alaska, the Bering Sea, the Sea of Okhotsk, and the central Canadian Arctic (Jefferson et al., 2015; Rice, 1998). The bearded seal does not occur within the Exclusive Economic Zone of the eastern United States and is not managed by NMFS in the Atlantic Ocean (Kovacs, 2008a). While bearded seals inhabiting the North Atlantic are not listed under the ESA, the Okhotsk distinct population segment is listed as threatened (Muto et al., 2017). However this distinct population segment does not occur in the AFTT Study Area, and is therefore not addressed. The population structure of bearded seals within the western North Atlantic is not well understood.

3.7.2.3.28.2 Habitat and Geographic Range

Bearded seals have a circumpolar distribution in the Arctic, generally south of 80° N latitude, and are subarctic in some areas, such as the western North Atlantic. The preferred habitat is drifting pack ice in shallow water (Cleator, 1996; Kovacs, 2008a). Bearded seals spend most of their time near where the coastal ice forms and in less than 200 m of water (Jefferson et al., 2008b; Jefferson et al., 2015; Kovacs, 2008a). While they are typically strongly tied to ice, bearded seals are known to haul out on land, swim up rivers, and live in open-ocean areas for extended periods (Cleator, 1996; Jefferson et al., 2008b).

In the western Atlantic bearded seals occur in the waters of Greenland, Northern Labrador, Baffin Bay-Davis Strait, and Hudson Complex. Sightings outside the species' typical range have been reported as far south as Cape Cod, Massachusetts (Sardi & Merigo, 2006), and Florida (National Marine Fisheries Service, 2016b).

3.7.2.3.28.3 Population Trends

Due to the patchy distribution of individuals moving with ice floes, it is difficult to make accurate abundance estimates for this species (Kovacs, 2008a); no estimates exist specifically for the western Atlantic. The global population is estimated at 450,000 to 500,000 seals but may be as large as 700,000; approximately half are thought to inhabit the Bering and Chukchi Seas (Jefferson et al., 2008b; Jefferson et al., 2015). The number inhabiting various regions of the Atlantic Ocean are mostly unknown (Jefferson et al., 2015). Rough estimates based on aerial surveys conducted over a 35-year period indicated densities in Canadian waters of approximately 0.24 seal per square kilometer (km^2) in preferred habitat; the population estimate for bearded seals in Canadian waters during the survey period was 190,000 (Cleator, 1996). Due to uncertainty associated with the population abundance, population trends are unknown.

3.7.2.3.28.4 Predator and Prey Interactions

The bearded seal diet is composed largely of demersal fish and benthic invertebrate species (Jefferson et al., 2015; Kovacs, 2008a). In Baffin Bay, sculpins and Arctic cod make up most of the diet in the summer, but eelpouts and polar cod are also taken; whelks and shrimp make up the majority of invertebrates consumed, but clams, sea cucumbers, anemones, cephalopods, and worms are also taken (Finley & Evans, 1983). Dominant prey items vary according to season, region, and ice cover (Hindell et al., 2012), as well as age (Jefferson et al., 2015).

Polar bears, killer whales, and Greenland sharks are known bearded seal predators (Kovacs, 2008a).

3.7.2.3.28.5 Species-Specific Threats

Loss of sea ice is a potentially significant threat to the habitat of bearded seals (Kovacs et al., 2011).

3.7.2.3.29 Hooded Seal (*Cystophora cristata*)

3.7.2.3.29.1 Status and Management

The International Council for the Exploration of the Sea/Northwest Atlantic Fisheries Organization Working Group on Harp and Hooded Seals currently recognizes two separate stocks of hooded seals: the Northwest Atlantic and Greenland Sea stocks (International Council for the Exploration of the Sea, 2014). The western North Atlantic stock (synonymous with the Northwest Atlantic stock) pups off the coast of eastern Canada; the whelping area for the Greenland Sea stock is in the "West Ice" near Jan Mayen Island, east of Greenland (Kovacs, 2008b).

3.7.2.3.29.2 Habitat and Geographic Range

Hooded seals are distributed in the Arctic and the cold temperate North Atlantic Ocean (Bellido et al., 2007). At sea, hooded seals stay primarily near continental coastlines but are known to wander widely. This species follows the seasonal movement of pack ice, on which it breeds. In the Study Area, its primary range is around the Newfoundland-Labrador, West Greenland, and Scotian Shelf.

Most hooded seals occur in the western Atlantic (Stenson et al., 1996). They migrate between winter/spring pupping areas along the Canadian coast, and summer and molting areas off Greenland. The western North Atlantic stock breeds and pups at three main areas around Canada, including the Gulf of St. Lawrence, north of Newfoundland in an area that is known as the Front, and Davis Strait (Hammill et al., 1997; Jefferson et al., 2008b; Kovacs, 2008b). Based on data from satellite relay data loggers deployed on hooded seals during 2004 to 2008, males appeared to prefer areas with complex seabed relief such as Davis Strait and the Flemish cap, whereas females preferred the Labrador Shelf (Andersen et al., 2013).

Hooded seals are highly migratory and may wander as far south as Puerto Rico (Mignucci-Giannoni & Odell, 2001), with increased occurrences from Maine to Florida. These appearances usually occur between January and May in New England waters, and in summer and autumn off the southeast U.S. coast and in the Caribbean (Harris et al., 2001; McAlpine et al., 1999; Mignucci-Giannoni & Odell, 2001). Six hooded seal strandings were also reported between 1975 and 1996 in North Carolina, Florida, Georgia, Puerto Rico, and the U.S. Virgin Islands (Mignucci-Giannoni & Odell, 2001).

3.7.2.3.29.3 Population Trends

The number of hooded seals in the western North Atlantic is relatively well known and is derived from pup production estimates produced from pack-ice whelping pack surveys. Available data are insufficient to determine a population estimate for U.S. waters (Waring et al., 2007); thus, population trends are also unknown.

3.7.2.3.29.4 Predator and Prey Interactions

The main prey species of hooded seals are redfish and cod, but they forage on squid and Greenland halibut as well (Hammill et al., 1997; Hauksson & Bogason, 1997). Some overlap and competition exists for prey between hooded and harp seals (Tucker et al., 2009). This species is preyed on by polar bears and killer whales (Kovacs, 2008a).

3.7.2.3.29.5 Species-Specific Threats

Although hooded seals are documented to be taken incidentally in commercial fishing gear, the level of take is very small compared to the size of the population. Hooded seals are also hunted commercially in Canada. The hooded seal is likely one of the most sensitive arctic marine mammal species to climate change due to its dependence on ice and specialized feeding habits (Laidre et al., 2008).

3.7.2.3.30 Harp Seal (*Pagophilus groenlandicus*)

3.7.2.3.30.1 Status and Management

Three distinct populations or stocks of harp seals are generally recognized, each identified with a specific pupping site on the pack ice. The western North Atlantic stock is the largest and is divided into two breeding herds: the Front herd, which breeds off the coast of Newfoundland and Labrador, and the Gulf herd, which breeds near the Magdalen Islands in the Gulf of St. Lawrence (Hayes et al., 2018; Reeves et al., 2002b; Waring et al., 2004; Waring et al., 2014). The other two stocks that breed on the West Ice off eastern Greenland and on the ice in the White Sea off the coast of Russia do not occur in the Study Area.

3.7.2.3.30.2 Habitat and Geographic Range

The primary range of harp seals is throughout the Arctic, but the secondary range includes the western waters of the Scotian Shelf and the Northeast U.S. Continental Shelf. Harp seals are closely associated with drifting pack ice, where they breed, molt, and forage in the surrounding waters (Lydersen & Kovacs, 1993; Ronald & Healey, 1981). Harp seals make extensive movements over much of the continental shelf within their winter range in the waters off Newfoundland (Bowen & Siniff, 1999).

Typically, harp seals are distributed in the pack ice of the North Atlantic segment of the Arctic Ocean and through Newfoundland and the Gulf of St. Lawrence (Reeves et al., 2002b). Most western North Atlantic harp seals congregate off the east coast of Newfoundland-Labrador (the Front) to pup and breed; the remainder (the Gulf herd) gathers to pup near the Magdalen Islands in the Gulf of St. Lawrence (Morissette et al., 2006; Ronald & Dougan, 1982).

The number of sightings and strandings of harp seals off the northeastern United States has been increasing since the 1990s, based on records from Maine to New Jersey, primarily during the months of January to May (Harris et al., 2002; McAlpine & Walker, 1999; Stevick & Fernald, 1998). A few sightings and strandings are also reported annually for Virginia and North Carolina (Lloyd, 2015; Soulen et al., 2013; Swingle et al., 2016). An increase in strandings along the U.S. East Coast has been correlated with poor ice conditions in the Gulf of St. Lawrence whelping area (Soulen et al., 2013). Harp seals occasionally enter the Bay of Fundy, but McAlpine and Walker (1999) suggested that winter ocean surface currents might limit the probability of occurrences in the Bay of Fundy.

3.7.2.3.30.3 Population Trends

Uncertainty in fecundity rates as well as uncertainties in ice conditions have potentially large impacts on population trends. Recent increases in strandings may not be indicative of population size. Therefore, the status of the population in U.S. waters is unknown (Hayes et al., 2018).

3.7.2.3.30.4 Predator and Prey Interactions

Harp seals feed on a variety of prey, which vary with age class, season, location, and year (Lavigne, 2008). Prey preference studies have revealed that harp seals prefer small fish to crustaceans (Lindstrom et al., 1998). The main prey species of harp seals are capelin, Greenland halibut, and Arctic and polar cod (Hauksson & Bogason, 1997; Lavigne, 2008; Morissette et al., 2006). Harp seals rarely eat commercially important Atlantic cod (Lavigne, 2008). Most foraging occurs at depths of less than 90 m, although dives as deep as 568 m have been recorded (Folkow et al., 2004; Lydersen & Kovacs, 1993). Harp seals feed intensively during the winter and summer and less so during the spring and fall migrations or during pupping and molting (Ronald & Healey, 1981). Some overlap and competition exists for prey between hooded and harp seals. This species is preyed on by polar bears, killer whales, and sharks (Lavigne, 2008).

3.7.2.3.30.5 Species-Specific Threats

Although harp seals are documented to be taken incidentally in commercial fishing gear, the level of take is small compared to the size of the population. Harp seals are also hunted commercially in Canada and Greenland. Climate change may also threaten whelping areas (Bajzak et al., 2011). For the period 2011 to 2015 the total estimated annual human cause mortality and serious injury to harp seals was 216,044 harp seals per year, which includes 215,998 seals from Canada and Greenland fishery bycatch, 43 seals (CV = 0.24) from observed U.S. fisheries, and 3 seals from non-fishing human interactions (Hayes et al., 2018).

3.7.2.3.31 Gray Seal (*Halichoerus grypus atlantica*)

3.7.2.3.31.1 Status and Management

There are three main populations of gray seal in the North Atlantic, including the Northeast Atlantic population, Northwest Atlantic, and the Baltic Sea (Haug et al., 2013; Hayes et al., 2018). The Northeast Atlantic and the Northwest Atlantic populations are classified as the subspecies *H. g. atlantica* (Olsen et al., 2016).

3.7.2.3.31.2 Habitat and Geographic Range

The western North Atlantic stock is equivalent to the Northwest Atlantic population, ranging from New Jersey to Labrador (Hayes et al., 2018). This gray seal population is centered in the Canadian Maritimes, including the Gulf of St. Lawrence and the Atlantic coasts of Nova Scotia, Newfoundland, and Labrador. In the Study Area, the primary range of this species includes the northwestern waters of the Newfoundland-Labrador Shelf, the Scotian Shelf, and the Northeast U.S. Continental Shelf (Davies, 1957; Hall & Thompson, 2009).

The gray seal is considered a coastal species and may forage far from shore but does not appear to leave the continental shelf regions (Lesage & Hammill, 2001). Gray seals haul out on land-fast ice, exposed reefs, or beaches of undisturbed islands (Hall & Thompson, 2009; Lesage & Hammill, 2001). Remote uninhabited islands tend to have the largest gray seal haul-outs (Reeves et al., 1992).

The Canadian population is divided into three groups for management purposes: Sable Island, Gulf of St. Lawrence, and Coastal Nova Scotia (Hammill et al., 2014a). The largest pupping site of gray seals in the world is located at Sable Island (Bowen et al., 2007). In the Gulf of St. Lawrence, gray seals pup on the pack-ice (Davies, 1957; Hammill & Gosselin, 1995; Hammill et al., 1998); this is second largest breeding colony in eastern Canada (Hammill et al., 2014a). Smaller numbers of seals pup on islands along the coast of Nova Scotia (Hammill et al., 2014a).

Gray seals range south into the northeastern United States, with strandings and sightings as far south as North Carolina (Hammill et al., 1998; Waring et al., 2004). Gray seal distribution along the U.S. Atlantic coast has shifted in recent years, with an increased number of seals reported in southern New England (Kenney, 2014; Waring et al., 2016). Recent sightings included a gray seal in lower Chesapeake Bay during the winter of 2014 to 2015 (Rees et al., 2016). Along the coast of the United States, gray seals are known to pup at three or more colonies, including Muskeget Island, Massachusetts, which is the southernmost breeding site (Andrews & Mott, 1967; Rough, 1995; Waring et al., 2004), and Green and Seal Islands, Maine (Hayes et al., 2018). Pupping has also been reported at Matinicus Rock and Mount Desert Rock in Maine (Waring et al., 2016). Gray seals are observed in New England outside of the pupping season on Muskeget Island and Monomoy and locations along the shoreline between southern Maine and Woods Hole, Massachusetts.

3.7.2.3.31.3 Population Trends

Gray seal abundance is likely increasing in the U.S. waters, but the rate of increase is unknown (Hayes et al., 2018). The increasing trend is supported by analysis of trends in gray seal strandings and bycatch records from the northeastern United States (Johnston et al., 2015). Single-day pup counts at three U.S.-established colonies detected an increase from the 2001 to 2002 through the 2007 to 2008 pupping season (Wood LaFond, 2009).

3.7.2.3.31.4 Predator and Prey Interactions

Gray seals prey on a variety of demersal and bottom-dwelling organisms, as well as schooling fish, cephalopods and other mollusks, and occasionally sea birds (Jefferson et al., 2015). Atlantic cod, Atlantic herring, sandlance, mackerel, flatfish, and white hake were the most prominent types of fish in the diet of gray seals off Nova Scotia, Canada (Hammill et al., 2014b). They also likely prey on harbor porpoise (Haelters et al., 2012; Leopold et al., 2015) and harbor seals (van Neer et al., 2015). Feeding during the breeding season is minimal (Hauksson & Bogason, 1997).

This species is preyed on by sharks (Jefferson et al., 2015). They are also probably prey of killer whales (Weller, 2008).

3.7.2.3.31.5 Species-Specific Threats

A review of 405 cases of marine mammal mortalities on Cape Cod and southeastern Massachusetts from 2000 to 2006 concluded that gray seals are highly susceptible to human interaction; 45 percent of gray seal deaths were due to interactions with humans (Bogomolni et al., 2010). Stranding and bycatch data from Cape Cod, Connecticut, Rhode Island and New York coasts between 1990 through 2012 were collected and analyzed to identify changes in stranding and by catch trends for gray seals. The analysis suggests that gray seal strandings and bycatch are increasing at rates between 18 and 22 percent since the early 1990s in the southern New England region (Johnston et al., 2015). The researchers note that beach counts of gray seals are also increasing in this area and it is possible the increase in stranding and bycatch rates is attributable to the growth in population. For the period 2011 to 2015, the total estimated human caused mortality and serious injury to gray seals was 5,207 per year (Hayes et al., 2018). The average was derived from six components: (1) 1,088 (CV = 0.09) from the U.S. observed fishery; (2) 7.8 from non-fishery related, human interaction stranding mortalities; (3) 308 from the Canadian commercial harvest; (4) 132 from Fisheries and Oceans Canada scientific collections; and (5) 3,674 removals of nuisance animals in Canada; and (6) 0.2 from U.S. research mortalities.

3.7.2.3.32 Ringed Seal (*Phoca hispida*)

3.7.2.3.32.1 Status and Management

The Arctic subspecies of ringed seal (*Phoca hispida hispida*) was listed as threatened under the ESA in 2012; but in 2016, the U.S. District Court for the District of Alaska issued a decision vacating National Oceanic and Atmospheric Administration Fisheries' December 28, 2012 listing of the Arctic ringed seal as threatened. On February 12, 2018, the U.S. Court of Appeals for the Ninth Circuit reversed the district court's decision and upheld the National Ocean and Atmospheric Administration Fisheries' decision to list Arctic ringed seals as threatened. Consequently, the listing of Arctic ringed seals as threatened will be reinstated once the Ninth Circuit issues its mandate to the district court and the district court then enters final judgment in this case. However, at the time of writing this document, Arctic ringed seals are not listed as a threatened species under the ESA. This species does not occur within the Exclusive Economic Zone of the eastern United States and is not managed by NMFS in the Atlantic. Although there is no genetic evidence or other data to differentiate stocks of ringed seals, the North Atlantic Marine Mammal Commission Scientific Committee recognizes three stock areas in the North Atlantic based on the low probability of mixing between areas: Area 1 includes Baffin Bay, northeastern Canada, and West Greenland and coincides with the northern extreme of the Study Area; Area 2 encompasses the Greenland Sea; and Area 3 comprises the Barents and Kara Seas (North Atlantic Marine Mammal Commission, 1997).

3.7.2.3.32.2 Habitat and Geographic Range

Ringed seals have a circumpolar distribution throughout the Arctic basin, Hudson Complex, and the Bering, Okhotsk, and Baltic Seas. The distribution of ringed seals is strongly correlated with pack and land-fast ice (Born et al., 2002; Jefferson et al., 2015) in areas over virtually any water depth (Reeves, 1998). Although they are generally not considered migratory, ringed seals are known to make long-distance movements (Teilmann et al., 1999).

In the western Atlantic, ringed seals occur as far south as northern Newfoundland, northward to the pole, and throughout the Canadian Arctic. They also occur throughout the Greenland Large Marine

Ecosystem and can be found as far south as Labrador off the Canadian east coast in the Newfoundland-Labrador Shelf Large Marine Ecosystem (Hammill, 2009).

3.7.2.3.32.3 Population Trend

Abundance of ringed seals is difficult to estimate because of their inaccessible habitat and tendency to spend much of the breeding season, when many pinniped estimates are made, hidden from view in dens or snow caves. Therefore, any estimates are of questionable accuracy and are probably underestimates. The North Atlantic Marine Mammal Commission Scientific Committee derived a rough estimate of the abundance of ringed seals in Area 1 (coincident with the northern extreme of the Study Area) of approximately 1.3 million seals (North Atlantic Marine Mammal Commission, 1997). Due to uncertainty associated with the abundance estimate, population trends are unknown.

3.7.2.3.32.4 Predator and Prey Interactions

Ringed seals are opportunistic feeders and consume a wide variety of prey, including fish and invertebrates (Hammill, 2009). They mostly forage solitarily or in small groups typically in deep water, under ice floes, and in the benthic communities of shallower water. The amphipod *Themisto libellula* is known to be the dominant prey type in the diet of immature ringed seals from Grise Fiord, whereas Arctic and polar cod compose the diet of adult ringed seals (Holst et al., 2001; Jefferson et al., 2015). Arctic cod was also important in the diet of ringed seals in other parts of the eastern Canadian Arctic (Matley et al., 2015). There are seasonal changes in the diet (Chambellant et al., 2013; Young & Ferguson, 2013).

Polar bears are the primary ringed seal predator, but some may also be taken by killer whales, Greenland sharks, and walruses (Hammill, 2009).

3.7.2.3.32.5 Species-Specific Threats

Ringed seals are harvested for subsistence use in the Arctic and are also caught incidentally in fishing gear. Climate change is potentially the most serious threat to ringed seal populations since much of their habitat depends on seasonal ice coverage (Kovacs et al., 2011).

3.7.2.3.33 Harbor Seal (*Phoca vitulina*)

3.7.2.3.33.1 Status and Management

Although the stock structure of the western North Atlantic harbor seals (*P. v. concolor*) is unknown, harbor seals that occur along the coasts of the eastern United States and Canada represent a single population (Hayes et al., 2018; Temte et al., 1991).

3.7.2.3.33.2 Habitat and Geographic Range

The harbor seal is one of the most widely distributed seals, found in temperate to polar coastal waters of the northern hemisphere (Jefferson et al., 2015). Harbor seals occur in nearshore waters and are rarely found more than 20 km from shore; they frequently occupy bays, estuaries, and inlets (Baird, 2001). Individual seals have been observed several kilometers upstream in coastal rivers (Baird, 2001). Haul-out sites vary but include intertidal and subtidal rock outcrops, sandbars, sandy beaches, and even peat banks in salt marshes (Burns, 2008; Gilbert & Guldager, 1998; Prescott, 1982; Schneider & Payne, 1983; Wilson, 1978). In the Study Area, their approximate year-round coastal range includes the Gulf of St. Lawrence, Scotian Shelf, Gulf of Maine, Bay of Fundy, and northeast U.S. continental shelf down to the Virginia/North Carolina border.

Harbor seals are found year-round in the coastal waters of eastern Canada and Maine; from September to May they also occur from southern New England to New Jersey (Hayes et al., 2018; Katona et al., 1993). A general southward movement from the Bay of Fundy to southern New England waters occurs in autumn and early winter (Barlas, 1999; Jacobs & Terhune, 2000; Rosenfeld et al., 1988; Whitman & Payne, 1990). A northward movement from southern New England to Maine and eastern Canada occurs before the pupping season, which takes place from mid-May through June along the Maine coast (DeHart, 2002; Kenney, 1994; Richardson et al., 1995b; Whitman & Payne, 1990; Wilson, 1978). Anecdotal reports suggest that some pupping is occurring at high-use haulout sites off Manomet, Massachusetts, and the Isles of Shoals, Maine (Hayes et al., 2018).

Harbor seal distribution along the U.S. Atlantic coast has shifted in recent years, with an increased number of seals reported in southern New England to the mid-Atlantic region (Hayes et al., 2018; Kenney, 2014). During systematic land-based counts by the U.S. Navy during 2014 to 2015 near Naval Station Newport, Narragansett Bay, harbor seals were observed on 24 out of 46 survey days; the average number hauled out was 15, but as many as 44 seals were hauled out on April 16, 2015 (Rees et al., 2016). In addition, 112 locations with harbor seal occurrences were recorded for Rhode Island during 1992 to 2013 by Save the Bay (Rees et al., 2016). Winter haul-out sites for a small number of seals (less than 50) have also been reported for Chesapeake Bay and near Oregon Inlet, North Carolina (Waring et al., 2016). During land-based counts in lower Chesapeake Bay from November 2014 to May 2015, 112 occurrences were recorded at four different haul-out sites during 12 survey days; peak numbers were recorded during March (Rees et al., 2016). Follow-up surveys in the lower Chesapeake Bay were conducted between October 2015 to May 2016 and resulted in 184 harbor seal sightings between December 2015 and April 2016; similar to the 2014 to 2015 season, the highest counts were recorded in the months of February and March (Rees et al., 2016). Surveys were also conducted in Narragansett Bay between November 2015 and April 2016 and similar to the 2014 to 2015 season, the highest counts were recorded in the months of February and March with peak numbers observed in March (Rees et al., 2016). Many strandings were reported for the coast of Virginia (Swingle et al., 2016). Rare sightings have occurred south of Oregon Inlet, North Carolina, and strandings have been recorded as far south as Florida (Hayes et al., 2018).

3.7.2.3.33.3 Population Trends

A trend analysis has not been conducted for this stock (Hayes et al., 2018). The number of harbor seals in U.S. Atlantic waters increased since the 1980s to 2010 (Waring et al., 2010); however, 2012 population estimates were lower than previous estimates. This lower estimate was not considered a population decline because surveys efforts did not cover the entire population area in coastal Maine, therefore a portion of the population was not included in the survey counts (Hayes et al., 2018).

3.7.2.3.33.4 Predator and Prey Interactions

The main prey species of the harbor seal are cod, hake, mackerel, herring, salmon, sardines, smelt, shad, capelin, sand eels, sculpins, and flatfish (Burns, 2008). Sand eels are the main prey for individuals foraging in the southern portion of their range, while cod is the main prey in other geographic areas. Harbor seals are also known to feed on cephalopods and crustaceans (Burns, 2008). Shrimp appears to be important in the diet of newly weaned pups (Burns, 2008). Off Massachusetts, harbor seals are known to depredate monkfish, skate, and flounder from gillnets (Rafferty et al., 2012). There is no seasonal variation in prey species, but capelin and herring are more numerous in the fall and winter (Hauksson & Bogason, 1997; Jefferson et al., 2015; Reeves et al., 1992). Killer whales and sharks are known to prey on adult harbor seals and pups may be preyed on by eagles, ravens, gulls, and coyotes (Burns, 2008; Weller, 2008).

3.7.2.3.33.5 Species-Specific Threats

There are no significant species-specific threats for harbor seals in the western North Atlantic, although some animals are bycaught in commercial fisheries (Hammill et al., 2010). From 2011 to 2015, the total human-caused mortality and serious injury to harbor seals was estimated to be 368 per year, 356 (CV = 0.11) of which were from observed fisheries and 12 of which were from non-fishery-related activities (Hayes et al., 2018). Section 3.7.2.1.43.7.2.1.5 (General Threats) discusses threats to marine mammals.

3.7.2.3.34 Walrus (*Odobenus rosmarus*)

3.7.2.3.34.1 Status and Management

The walrus is managed by the USFWS under the Department of the Interior, but does not occur in U.S. East Coast waters. Five subpopulations of the Atlantic subspecies (*Odobenus rosmarus rosmarus*) are suggested, based on genetic analysis. These subpopulations inhabit Hudson Strait, West Greenland, Northwest Greenland, East Greenland, and Franz Josef Land-Svalbard (Andersen et al., 2009). The Hudson Strait subpopulation occurs within the northern extreme of the Study Area. The Hudson Strait subpopulation proposed by Andersen et al. (2009) corresponds to the Hudson Bay-Davis Strait stock identified by the North Atlantic Marine Mammal Commission (2017), which recognizes nine stocks in the Atlantic.

3.7.2.3.34.2 Habitat and Geographic Range

In the Atlantic, walruses occur from the central Canadian Arctic through Greenland, Svalbard and Franz Josef Land, to the Barents, White, and Kara seas (Kastelein, 2008). Walruses occur in shallow, continental shelf areas and are seldom found in deep waters. They haul out on ice floes and sandy beaches or rocky shores, along remote stretches of mainland coastlines or islands (Jefferson et al., 2008b; Jefferson et al., 2015).

Walruses are found along the coast of Greenland, Labrador, Baffin Bay, Davis Strait, and the Hudson Complex (Jefferson et al., 2008b; Jefferson et al., 2015). Migration of the subpopulations between Hudson Strait and west Greenland suggests that there is a perennial migration in the Baffin Bay region for the Atlantic subspecies (Andersen et al., 2009). Walruses may migrate northward with ice break-up along the western coast of Greenland, when warm water is brought in by the Irminger Current from the south.

3.7.2.3.34.3 Population Trends

Abundance estimates are difficult to derive as walruses have clumped distributions, occur on ice as well as in water, and have variable group sizes (Heide-Jørgensen et al., 2014). The (North Atlantic Marine Mammal Commission, 2017) recognizes nine stocks in the Atlantic with variable population trends. Surveys were conducted in summer 2007 in Hoare Bay, Baffin Island on the Hudson Bay-Davis Strait stock but a population trend could not be determined (Stewart et al., 2014). In 2008, surveys of the West Greenland/Baffin Island population suggested this population may be increasing (Witting & Born, 2013).

3.7.2.3.34.4 Predator and Prey Interactions

Walruses are likely preyed on by killer whales and polar bears. Walruses are primarily benthic feeders, with a large proportion of their prey consisting of molluscs (Andersen et al., 2009; Kastelein & Wiepkema, 1989; Stewart et al., 2003). They use their snouts to plow through the bottom sediments and dig up prey, most of which they find in the upper few centimeters of sediment or on or just above the bottom. Walrus diet consists of snails, soft-shell crabs, amphipods, shrimp, sea cucumbers, tunicates, and slow-moving fish; some prey on seals, small whales, and seabirds and may occasionally scavenge marine mammal carcasses (Kastelein, 2008).

3.7.2.3.34.5 Species-Specific Threats

Over-hunting, pollutants, and human disturbance near haul-outs pose potentially significant threats to walrus (Kastelein, 2008). Laidre et al. (2008) suggested that walruses may be sensitive to climate change, based on their dependence on haul-out sites (such as sea ice) in proximity to shallow foraging areas.

3.7.3 Environmental Consequences

This section evaluates how and to what degree the activities described in Chapter 2 (Description of Proposed Action and Alternatives) potentially impact marine mammals known to occur within the Study Area. Table 2.6-1 (Proposed Training Activities per Alternative) through Table 2.6-4 (Office of Naval Research Proposed Testing Activities per Alternative) present the proposed training and testing activity locations for Alternatives 1 and 2. The stressors vary in intensity, frequency, duration, and location within the Study Area. General characteristics of all Navy stressors were introduced in Section 3.0.3.3 (Identifying Stressors for Analysis), and living resources' general susceptibilities to stressors were introduced in Section 3.0.3.6 (Biological Resource Methods). The stressors analyzed for marine mammals are:

- **Acoustic** (sonar and other transducers; air guns; pile driving; vessel noise; aircraft noise; and weapons noise)
- **Explosives** (explosions in-air; explosions in-water)
- **Energy** (in-water electromagnetic devices; 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 this analysis, marine mammal species are grouped together based on similar biology (e.g., hearing) or behaviors (e.g., feeding or expected reaction to stressors) when most appropriate for the discussion. In addition, for some stressors species are grouped based on their taxonomic relationship and discussed as follows: mysticetes (baleen whales), odontocetes (toothed whales), pinnipeds (seals and the walrus), the polar bear, and the West Indian manatee.

When impacts are expected to be similar to all species or when it is determined there is no impact on any species, the discussion will be general and not species-specific. However, when impacts are not the same to certain species or groups of species, the discussion will be as specific as the best available data allow. In addition, if activities only occur in or will be concentrated in certain areas, the discussion will be geographically specific. Based on acoustic thresholds and criteria developed with NMFS, impacts from sound sources as acoustic stressors will be quantified at the species or stock level as is required pursuant to authorization of the proposed actions under the MMPA.

The analysis includes consideration of the mitigation that the Navy will implement to avoid or reduce potential impacts on marine mammals from acoustics, explosives, and physical disturbance and strike stressors. Mitigation for marine mammals has been coordinated with NMFS and the USFWS through the consultation processes.

3.7.3.1 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). Furthermore, 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 the Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities (Section 3.0.3.6.1). 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 3.7.3.1.1.1, Injury). Hearing loss (Section 3.7.3.1.1.2, Hearing Loss) is a noise-induced decrease in hearing sensitivity, which can either be temporary or permanent. Masking (Section 3.7.3.1.1.4, Masking) can occur when the perception of a biologically important sound (i.e., signal) is interfered with by a second sound (i.e., noise). Physiological stress (Section 3.7.3.1.1.3, Physiological Stress) is an adaptive process that helps an animal cope with changing conditions; however, too much stress can potentially result in additional physiological effects. Behavioral response (Section 3.7.3.1.1.5, 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 3.7.3.1.1.6, Stranding). Long-term consequences (Section 3.7.3.1.1.7, 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).

The use of any acoustic stressor during training and testing activities would have no effect on bowhead whales or ringed seals due to the lack in overlap of habitat and areas where acoustic stressors are used and the impacts on bowhead whales and ringed seals will not be analyzed further.

3.7.3.1.1 Background

3.7.3.1.1.1 Injury

Injury (i.e., physical trauma) refers to the effects on the tissues or organs of an animal due to exposure to pressure waves. Injury due to exposure to non-explosive acoustic stressors such as sonar is discussed below. Moderate- to low-level sound sources, including vessel and aircraft noise, would not cause any injury. The Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities (see

Section 3.0.3.6.1) 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 utilized 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 an 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 realistic conditions during training and testing activities, and this type of impact is not considered further in this analysis.

Nitrogen Decompression

Marine mammals 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 (Hooker et al., 2012).

Although not a direct injury, variations in marine mammal diving behavior or avoidance responses have been hypothesized to result in nitrogen off-gassing in 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"). The process has been under debate in the scientific community (Hooker et al., 2012; Saunders et al., 2008), although analyses of by-caught and drowned animals has demonstrated that nitrogen bubble formation can occur in animals that no longer exchange gas with the lungs (drowned) and which are brought to the surface where tissues become supersaturated with nitrogen due to the reduction in hydrostatic pressure (Bernaldo de Quiros et al., 2013b; Moore et al., 2009). Deep diving whales, such as beaked whales, have been predicted to have higher nitrogen loads in body tissues for certain modeled changes in dive behavior, which might make them more susceptible to decompression (Fahlman et al., 2014b; Fernandez et al., 2005; Hooker et al., 2012; Jepson et al., 2003).

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). To examine the potential for gas bubble formation, a bottlenose dolphin was trained to dive repetitively to depths shallower than lung collapse to elevate nitrogen saturation to the point that asymptomatic nitrogen bubble formation was predicted to occur. However, inspection of the vascular system of the dolphin via ultrasound did not demonstrate the formation of any nitrogen gas bubbles (Houser et al., 2009). 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 indicated that venous supersaturation was within the normal range for these species, which have naturally high levels of nitrogen loading.

Still, little is known about respiratory physiology of deep-diving breath-hold animals. Costidis and Rommel (Costidis & Rommel, 2016) suggest 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, contributing to tissue gas loads. Researchers have also considered the role of carbon dioxide accumulation 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, may facilitate the formation of bubbles in nitrogen-saturated tissues (Bernaldo de Quiros et al., 2012; Fahlman et al., 2014b). Parraga et al. (2018) suggest that diving marine mammals have physiological and anatomical adaptations to control gas uptake above the depth of lung collapse, favoring oxygen uptake while minimizing nitrogen uptake. Under the hypothesis of Parraga et al. (2018), elevated activity due to a strong evasive response could lead to increased uptake of nitrogen, resulting in an increased risk of nitrogen decompression.

Modeling has 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). The presence of osteonecrosis (bone death due to reduced blood flow) in deep diving sperm whales has been offered as evidence of chronic supersaturation (Moore & Early, 2004). Proposed adaptations for prevention of bubble formation under conditions of persistent tissue saturation have been suggested (Fahlman et al., 2006; Hooker et al., 2009), while the condition of supersaturation required for bubble formation in these tissues has been demonstrated in marine mammals drowned at depth as fisheries bycatch and brought to the surface (Moore et al., 2009). For beaked whale strandings associated with sonar use, one theory is that observed bubble formation might be caused by long periods of compromised blood flow caused by the stranding itself (which reduces ability to remove nitrogen from tissues) following rapid ascent dive behavior that does not allow for typical management of nitrogen in supersaturated, long-halftime tissues (Houser et al., 2009).

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. Although rare, similar findings have been found in the Risso's dolphin, another deep diving species, but with presumably non-anthropogenic causes (Fernandez et al., 2017).

Dennison et al. (2012) reported on investigations of dolphins stranded in 2009 to 2010 and, using ultrasound, identified gas bubbles in kidneys of 21 of the 22 live-stranded dolphins and in the liver of 2 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. The researchers concluded that the minor bubble formation observed could be tolerated since the majority of stranded dolphins released did not re-strand.

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," 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 that 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 to 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 level would only occur in very close proximity to the most powerful sonars. 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).

3.7.3.1.1.2 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 will vary depending on the frequency of the fatiguing noise, with frequencies at and above the noise 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.

The Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities (see Section 3.0.3.6.1) 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 (i.e., 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 3.7-4 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 2 minutes after exposure; if the TTS is 20 dB after 24 hours, the TTS measured after 2 minutes would have likely been much higher. Conversely, if 20 dB of TTS was measured after 2 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.

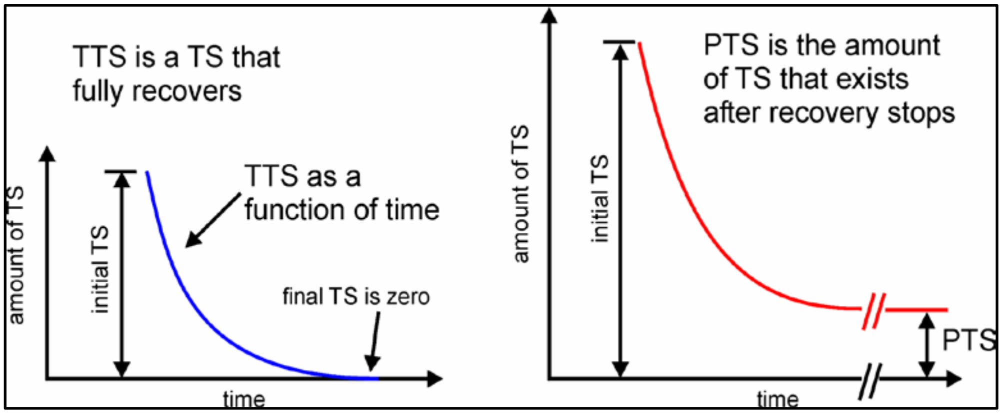


Figure 3.7-4: Two Hypothetical Threshold Shifts

TTS: temporary threshold shift; TS: threshold shift; PTS: permanent threshold shift

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 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 4 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 4 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 measures producing larger amounts of TTS compared to psychophysical 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., 2010a, 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., 2010a; 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; 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).

Due to the higher exposure levels or longer exposure durations required to induce hearing loss, only a few types of man-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.

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., 2010b; 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., 2012b) 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, and the major findings are summarized above.

Threshold Shift due to Impulsive Sound Sources

Marine mammal TTS data from impulsive sources are limited to two studies with measured TTS of 6 dB or more: 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 AEP-measured TTS of 7 to 20 dB in a harbor porpoise exposed to single impulses from a seismic air gun.

In addition to these data, Kastelein et al. (2015a) reported behaviorally-measured mean TTS of 4 dB at 8 kHz and 2 dB at 4 kHz after a harbor porpoise was exposed to a series of impulsive sounds produced by broadcasting underwater recordings of impact pile driving strikes through underwater sound projectors. The cumulative SEL was approximately 180 dB re 1 $\mu Pa^2 s$. The pressure waveforms for the simulated pile strikes exhibited significant "ringing" not present in the original recordings, and most of the energy in the broadcasts was between 500 and 800 Hz. As a result, some questions exist regarding whether the fatiguing signals were representative of underwater pressure signatures from impact pile driving.

Several impulsive noise exposure studies have also been conducted without behaviorally measurable TTS. 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 $\mu Pa^2 s$, 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^2s, peak SPL = 183 dB re 1 μPa).

3.7.3.1.1.3 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; New et al., 2013b; 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 effects 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, 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 might 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 pronounced increase in 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). 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 acclimated 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 vs. 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 gray 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 dive bradycardia persists during diving and might 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 affect 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 prohibited 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., 2013; Williams et al., 2014). 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 measurements 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, 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 (King et al., 2015; e.g., New et al., 2013a; New et al., 2013b; 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).

3.7.3.1.1.4 Masking

Masking occurs when one sound, distinguished as the "noise," interferes with the detection or recognition of another sound. The quantitative definition of masking is the amount in decibels an auditory detection or discrimination threshold is raised in the presence of a masker (Erbe et al., 2016). As discussed in Section 3.0.3.6.1 (Conceptual Framework for Assessing Effects from Acoustic and Explosive 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 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 (Figure 3.7-5) (Au & Moore, 1990; Johnson et al., 1989; Kastelein & Wensveen, 2008; Lemonds et al., 2011; Thomas et al., 1990a), manatees (Gaspard et al., 2012), and sea otters (Ghoul & Reichmuth, 2014). 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. Although critical ratios are typically estimated in controlled laboratory conditions using Gaussian (white) noise, critical ratios can vary considerably depending on the noise type (Branstetter et al., 2013; Trickey et al., 2010).

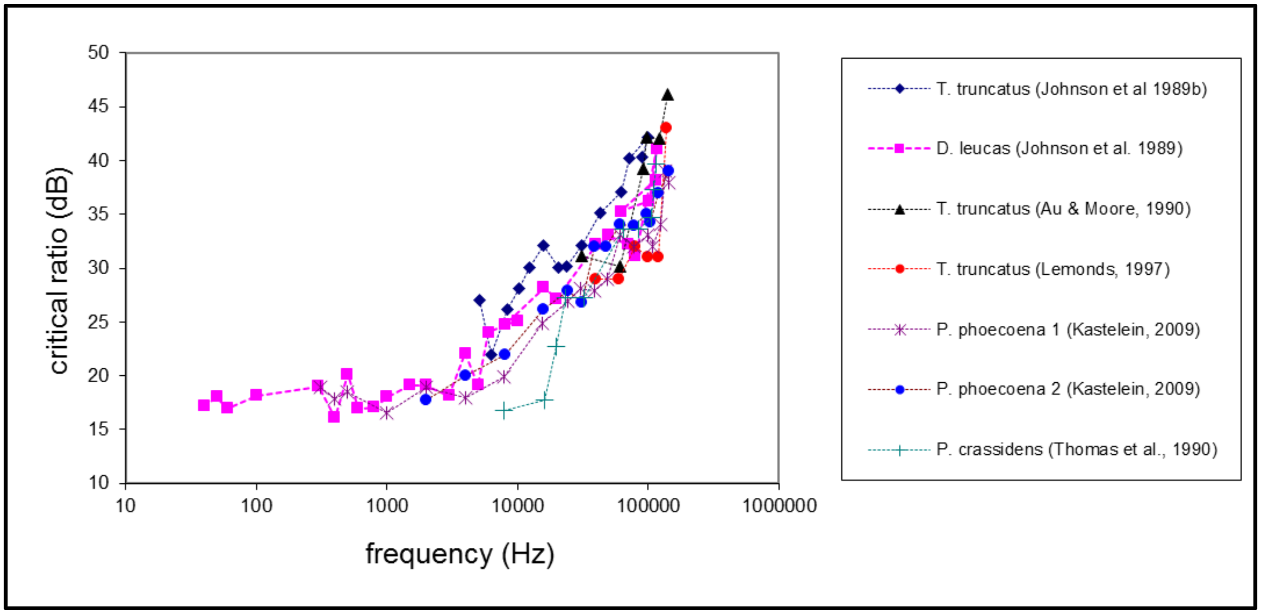


Figure 3.7-5: Critical Ratios (in dB) Measured in Different Odontocetes Species (from Finneran & Branstetter, 2013)

Clark et al. (2009) developed a method for estimating masking effects on communication signals for low-frequency cetaceans, including calculating the cumulative impact of multiple noise sources. For example, their technique calculates 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 may result from a need to compete with an increase in background noise and 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 permanent, as seen in the increase in starting frequency for the North Atlantic right whale upcall over the last 50 years (Tennessen & Parks, 2016). This shift in frequency was modeled, and it was found that it led to 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 different location to improve binaural cues (time or intensity differences between the ears due to a sound source's location relative to the animal's head), or going still to reduce noise associated with hydrodynamic flow. The structure of some noises (e.g., amplitude modulation) may also provide some release from masking through comodulation masking release (the difference in masking when a noise is broadband versus having the same bandwidth as the signal) (Branstetter & Finneran, 2008; Branstetter et al., 2013). Signal characteristics (e.g., whether the signal has harmonics, or is frequency modulated) may further enhance the detectability of a signal in noise (Cunningham et al., 2014).

Evidence suggests that at least some marine mammals have the ability to acoustically identify potential predators (Allen et al., 2014; Cummings & Thompson, 1971; Curé et al., 2015; Fish & Vania, 1971), which 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 identification of predator cues are impeded. For example, harbor seals that reside in the coastal waters off British Columbia are frequently targeted by certain groups of killer whales. The seals discriminate between the calls of threatening and non-threatening 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 indicate that some recognition of predator cues could be missed if the killer whale vocalizations were masked.

Masking as a Result of Impulsive Noise

Masking could occur in mysticetes due to the overlap between their low-frequency vocalizations and the dominant frequencies of air gun pulses; 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 (Dilorio & 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^{2}s cumulative SEL), but once the received level rose above 127 dB re 1 μPa^{2}s cumulative SEL the call rate began decreasing, and stopped altogether once received levels reached 170 dB re 1 μPa^{2}s 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 (less than 40 m) water. They were then tested on their ability to detect a 500 millisecond (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 to 5 m, and would not be detected above a survey 30 km away beyond 46 m (Sills et al., 2017).

Masking as a Result of Sonar and Other Transducers

Masking as a result of duty-cycled low-frequency or mid-frequency active sonar with relatively low duty cycles is unlikely for most marine mammals as sonar tones occur over a relatively short duration and narrow bandwidth that does not overlap with vocalizations for most species. While dolphin vocalizations can occur in the same bandwidth as mid-frequency active sonar, the duty cycle of most low-frequency and mid-frequency active sonars are low enough that delphinid whistles might be masked only a small percentage of the time they are whistling, and so masking by sonar would not likely have any short- or long-term consequences. 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 also 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 to 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 of these systems limits the range of impact compared to more 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 a number of 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 as a Result of Vessel and Vibratory Pile Driving Noise

Masking is more likely to occur in the presence of broadband, relatively continuous noise sources such as vessels and vibratory pile driving. 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). Although humpback whales 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. (2013) found that in median noise conditions in Haro Strait, killer whales lose 62 percent of their acoustic communication space due to vessel traffic noise, and in peak traffic hours lose up to 97 percent of that space. 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 so 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. Dugong vocalizations were recorded in the presence of passing boats, and although the call rate, intensity or frequency of the calls did not change, the duration of the vocalizations was increased, as was the presence of harmonics. This may indicate more energy was being used to vocalize in order to maintain the same received level (Ando-Mizobata et al., 2014). Gervaise et al. (2012) estimated that beluga whales in the St. Lawrence Marine Park had their estimated communication space under typical background noise conditions already reduced to 30 percent due to vessel traffic, which was further reduced to only 15 percent of their communication space during peak vessel traffic hours coinciding with the arrival and departure of whale watching vessels. Lesage et al. (1999) found belugas in the St. Lawrence River estuary to reduce overall call rates but increase the production of certain call types when ferry and small outboard motor boats were approaching, and to increase 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 to 3 km, and masking of echolocation clicks within 0.5 to 1.5 km.

Vibratory pile driving noise is a continuous, broadband noise source similar to vessel noise. Wang et al. (2014) found that whistles of humpback dolphins could be masked by a very large vibration pile driving hammer within 200 m, but clicks would not be masked.

3.7.3.1.1.5 Behavioral Reactions

As discussed in the Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities (Section 3.0.3.6.1), any stimulus in the environment can cause a behavioral response in marine mammals. These stimuli include noise from anthropogenic sources such as vessels, sonar, air guns, or pile driving, but could also include the physical presence of a vessel or aircraft. However, these stimuli could also influence how or if a marine mammal responds to a sound such as the presence of predators, prey, or conspecifics. 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 (Gomez et al., 2016; 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 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 (Harris et al., 2018; 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 (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, including impulsive sources such as explosives, air guns, and impact pile driving, and non-impulsive sources such as sonar and other transducers (e.g., pingers), and vessel and aircraft noise. For some of these noise sources numerous studies exist (e.g., sonar), whereas for others the data are sparse (e.g., pile driving), and surrogate sound sources must be relied upon to assess the potential for behavioral response. Similarly, 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 Impulsive Sound Sources

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. 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 manatees or polar bears. 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 Navy impulsive sources analyzed in this document such as single air guns and small, short-duration pile driving activities.

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., 1995b; 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. 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 to 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 to 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 $\mu Pa^2 s$ (Dilorio & 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 to 45 km) where median received levels were between 116 to 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 to 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., pile driving), short term (on the order of hours rather than days or weeks), and lower source level (e.g., swimmer defense air guns) 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 might 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, Florida 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 to 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 5 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 to 170 dB re 1 µPa (Finneran et al., 2003b). Harbor and gray 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 (Southall et al., 2007). Pinnipeds may even experience TTS (Section 3.7.3.1.1.2, Hearing Loss) before exhibiting a behavioral response (Southall et al., 2007).

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 to 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 3.0.3.6.1 (Conceptual Framework) and Section 3.7.3.1.1.5 (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 their potential impacts better. 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 to 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., 2015c; 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 (Campbell et al., 2010; Falcone et al., 2017; Farak et al., 2011; HDR, 2011; Henderson et al., 2016; Manzano-Roth et al., 2016; Norris et al., 2012; Smultea & Mobley, 2009; Smultea et al., 2009; Trickey et al., 2015; U.S. Department of the Navy, 2011c, 2013c, 2014a, 2015). 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 carcasses were observed but all were in an advanced state of decomposition and were therefore judged to have been deceased prior to the event) (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 & Thomas (2015) highlighted additional research approaches that may provide further information on behavioral responses to sonars and other transducers beyond behavioral response type studies or passive acoustic monitoring, including conducting controlled exposures on captive animals with scaled sources (smaller sized and deployed at closer proximity), 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. Likewise, there are no field or captive studies of active acoustic sources on sirenians, although several studies have used echosounders to detect manatees and characterize their habitat.

Mysticetes

As with impulsive sounds, 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., 2015c; 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., 2015). 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., 2004a). Although the animals' received SPL was similar in the latter two studies (133 to 150 dB re 1 µPa), 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 exercises 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, 2011b). 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 responsestudy 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. (2015c) 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, Florida were reduced or ceased altogether during periods of sonar use (Norris et al., 2012; U.S. Department of the Navy, 2013c) especially with an increased ping rate (Charif et al., 2015). Two minke whales also stranded in shallow water after the US 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 to 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 to 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); (2014b) 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 experiment. 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 the Ocean Acoustic Waveguide Remote Sensing experiment, 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., 2004a), 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, 2011c, 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., 2015; Henderson et al., 2016; Manzano-Roth et al., 2016; McCarthy et al., 2011; Moretti et al., 2009; Southall et al., 2011; Southall et al., 2012; 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; Falcone et al., 2017; 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 7 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 to 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 to 144 and 78 to 108 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 source level 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 to 25 km in this study). Watwood et al. (2017) 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) 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., 2015; 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 1 or more prior years, with re-sightings up to 7 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 four 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 1µPa) (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 to 2 kHz sonar (sweeping across frequencies), but did not change their dive behavior if they were deep diving during 6 to 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 to 7 kHz sonar, while during 1 to 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 to 7 kHz sonar exposures, but were more likely to respond at higher received levels when non-feeding during 1 to 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., 2013b), 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 to 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 exercises. 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 from 3.2 to 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 to 268 m) during a period of sonar exposure. Baird et al. (2016b) 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 island-associated population, leading Baird et al. (2016b) 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, 2005b; U.S. Department of the Navy, 2003) 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., 2014). 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 United States’ 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 (HDR, 2011; U.S. Department of the Navy, 2011b; Watwood et al., 2012). During small boat surveys near the Navy’s 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 a seasonal difference that was also observed in other years (Campbell et al., 2010). There were also fewer passive acoustic dolphin detections during and after longer sonar activities in the Marianas Islands Range Complex, with the post-activity absence lasting longer than the mean dolphin absence of 2 days when sonar was not present (Munger et al., 2014; Munger et al., 2015).

Acoustic harassment devices and acoustic deterrent devices 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 to 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 2 to 4 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 third and seventh 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 the 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., 2017). 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., 2013b), and in another study bottlenose dolphins and beluga whales were presented with 1-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 1-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., 2005b), and tones, including 1 to 2 kHz and 6 to 7 kHz sweeps with and without harmonics (Kastelein et al., 2014d), and 25 kHz with and without sidebands (Kastelein et al., 2015e; Kastelein et al., 2015f). 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 to 2 kHz upsweep at 123 dB re 1 μPa, but not to the downsweep or the 6 to 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 to 2 kHz and 6 to 7 kHz sweeps respectively when no harmonics were present, and decreased to 90 dB re 1 μPa for 1 to 2 kHz sweeps with harmonics present (Kastelein et al., 2014d). 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 (lowest and strongest) frequency of 18 kHz didn't 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 to 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 to 185 dB re 1 µPa) during a repetitive task (Houser et al., 2013a). 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 2 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 to 134 dB re 1 µPa and demonstrated minor responses by occasionally hauling out at 128 to 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 to 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.

Sirenians

Few data exist on manatee responses to sonar; however, there has been some work using side-scan and fish-finding sonar to detect manatees (Gonzalez-Socoloske et al., 2009; Gonzalez-Socoloske & Olivera-Gomez, 2012; Niezrecki, 2010). These are typically very-high-frequency systems, with frequencies over 200 kHz, although in some cases frequencies of 50 kHz were used. The response of the manatees to the sonar was not the focus of these studies, but, when reported, the authors stated that no response was observed. Studies have also been conducted on the efficacy of using pingers to warn manatees about the presence of vessels or fishing gear. Bowles et al. (2001) observed brief startle responses to pingers sweeping 10 to 80 kHz in two of nine manatees tested, but gear with pingers continued to be manipulated even in the presence of pingers. Dugongs in Australia were exposed to 3.5 and 10 kHz pingers with source levels around 133 dB re 1 µPa, with no significant responses observed and continued foraging throughout the experiment (Hodgson & Marsh, 2007). In contrast, wild dugongs in Thailand exposed to 3.5 kHz tones at 141 dB re 1 µPa did not approach the source within 100 m, while playbacks of dugong calls elicited approaches within 10 m (Ichikawa et al., 2009).

These limited data may indicate that sirenians are relatively robust to sonar and other active acoustic sources; however, with the lack of focused studies on these sound sources it is difficult to draw any conclusions.

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 $\mu Pa^2 s$, 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.

Cargo ships, bulk carriers and tankers account for almost two-thirds of commercial vessel traffic in the AFTT Study Area, which occurs throughout the Study Area but is heaviest along the U.S. East Coast and northern Gulf of Mexico (Mintz, 2012). Annual commercial vessel traffic in AFTT was estimated to be almost 10 million hours in 2009, compared to just over 70,000 hours for Navy vessel traffic, which was generally concentrated along the U. S. East Coast between Jacksonville and the Chesapeake Bay (Mintz, 2012).

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 (Aguilar de Soto et al., 2006; 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. Sirenians have also received direct attention relative to this stressor, as small boat strikes and increased traffic in manatee habitat has become a concern. 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. Information on the potential effects of vessel noise on polar bears is not available.

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; 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 to 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. 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., 2004a). 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., 2004a; 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 UK, 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., 2009). 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 3.7.3.1.1.7, 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 eight vessels observed within 400 m of one whale at the same time. This study found reduced surface time, fewer breaths at the surface, 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 to 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 (ignoring) reactions 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 3.7.3.4, Physical Disturbance and Strike Stressors).

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) showed 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; Gregory & Rowden, 2001; Janik & Thompson, 1996; Lusseau, 2004; Mattson et al., 2005; Scarpaci et al., 2000). Steckenreuter et al. (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 mile 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 and 116 dB re 1 µPa. While new regulations on the distance boats have 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. (2013) 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., 2013).

Sperm whales generally react only to vessels approaching within several hundred meters; 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 to 1 km away. Of the 26 percent of interactions in which there was an avoidance response, most were observed in groups of one to two 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).

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 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 bowride, indicating either that these species are less sensitive to vessels, or that the behavioral drive to bowride 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 gray 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 to 184 m) to the haul out sites than motorized vessels (55 to 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 United Kingdom, 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 any of these high overlap areas.

Sirenians

The West Indian manatee responds to vessel movement via acoustic and possibly visual cues by moving away from the approaching vessel, increasing its swimming speed, and moving toward deeper water (Miksis-Olds et al., 2007; Nowacek et al., 2004b). When vessels pass within 10 m, manatees respond by fluking, changing their heading or depth, or rolling (Rycyk et al., 2018). The degree of response varies with the individual manatee and may be more pronounced in deeper water, where they are more easily able to determine the direction of the approaching vessel (Nowacek et al., 2004b). Similar responses were observed for slow- and fast-moving vessels (Rycyk et al., 2018); however, they were more likely to change their behavior to boat passes of longer durations, and the longer they had to change their behavior (e.g., slower moving boats) that behavior change occurred earlier relative to the boat's closest approach. In other words, slower moving vessels allowed manatees a greater opportunity to move out of the way of the vessel. This disturbance is a temporary response to the approaching vessel. West Indian manatees have also been shown to seek out areas with a lower density of vessels (Buckingham et al., 1999). West Indian manatees exhibit a clear behavioral response to vessels within distances of 25 to 50 m, but it is unclear at what distance the manatees first detect the presence of vessels (Nowacek et al., 2004b). Vessel traffic and recreation activities that disturb West Indian manatees may cause them to leave preferred habitats and may alter biologically important behaviors, such as feeding, suckling, or resting (Haubold et al., 2006).

In manatees, call rates and call amplitude were affected by noise that shared dominant frequencies of watercraft, with call rates decreasing during feeding and socializing. Differential effects were also seen on call type based on the presence or absence of calves (Miksis-Olds & Tyack, 2009). Similarly, call rates in dugongs did not change in the presence of vessels, but call durations were longer and more harmonics were present when boats passed within 400 m (Ando-Mizobata et al., 2014). These changes in vocalizations varied with the frequency of the noise, the type of call being produced, and the behavioral or social context; taken together, these changes may indicate that responses to vessel noise are dependent on behavioral and environmental contexts.

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 helicopters, as well as unmanned aerial vehicles. 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 to 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. (304.8 m) above sea level, infrequently observed at 1,500 ft. (457.2 m), and not observed at all at 2,000 ft. (609.6 m) (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 vehicles 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 to 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-id 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., 2008a; 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., 2008b). 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). 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 (HDR, 2011).

Much like mysticetes, odontocetes have demonstrated no responses to unmanned aerial vehicles. For example, Durban et al. (2015) conducted photogrammetry studies of killer whales using a small hexacopter flown 35 to 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).

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 to 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 of 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 Nicholas Island were studied from August 2001 to October 2008 (Holst et al., 2011). California sea lions startled and increased vigilance for up to 2 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 haul-out 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 Nicholas Island (Holst et al., 2011).

Pinnipeds may be more sensitive to unmanned aerial vehicles, 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 vehicles, with some orienting towards the vehicle, other alerting behavior, or short-term flushing possible (Moreland et al., 2015; Sweeney et al., 2015).

Sirenians

There are few data on the effects of aircraft overflight on sirenians. Rathbun (1988) studied the reaction of West Indian manatees to both fixed-wing aircraft and helicopters used during census surveys. The manatees did not react to a fixed-wing aircraft moving at approximately 130 km per hour at 160 m altitude; however, animals did react to a helicopter below approximately 100 m moving at speeds of 0 (hovering) to 20 km per hour by startling from rest and diving to deeper waters. This again demonstrates that distance to the aircraft impacts if and how an animal may respond.

Hodgson et al. (2013) conducted a pilot study to conduct aerial surveys of dugongs using an unmanned aerial vehicle flown at altitudes of 500, 750 and 1,000 ft.; no behavioral responses were mentioned but noise levels were much lower than for a typical fixed-fixed wing aircraft. Similarly, manatees were not disturbed by a fixed-wing unmanned vehicle flying at 100 m (Jones IV et al., 2006; Smith et al., 2016).

3.7.3.1.1.6 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, wind speed, and topographic 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, 2016c). Several mass strandings (strandings that involve two or more cetaceans 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 on Marine Mammal Strandings Associated with U.S. Navy Sonar Activities (U.S. Department of the Navy, 2017b).

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, 2017b). These five mass strandings have resulted in about 40 known cetacean deaths consisting mostly of beaked whales and with potential linkages to mid-frequency active sonar activity. In these circumstances, exposure to non-impulsive acoustic energy was considered a possible 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 reviewed training requirements, standard operating procedures, and potential mitigation measures and implemented changes to avoid or reduce the potential for acoustic-related strandings to occur in the future. Discussions of the mitigation measures 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 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). For additional information on stranding please see the technical report entitled *Marine Mammal Standings Associated with U.S. Navy Sonar Activities* (U.S. Department of the Navy, 2017b).

3.7.3.1.1.7 Long-Term Consequences

Long-term consequences to a population are determined by examining changes in the population growth rate (Figure 3.0-16, Two Hypothetical Threshold Shifts). 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 measureable cost to the individual, or for very small populations to the population as a whole (e.g., North Atlantic right whales); 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 northwest Atlantic tended to adjust to vessel traffic over a number 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 to 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 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 7 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 on 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; New et al., 2013a; New et al., 2013b; New et al., 2014). 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 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 similar 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.

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 2 days, the presence of ships and wind turbines did not deplete the population. In contrast, Heinis and 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 in population size over 6 years, with an increased risk for further reduction with additional disturbance days.

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. 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). 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 the 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 the Southern California Offshore Range. 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.

3.7.3.1.2 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 3.0.3.3.1 (Acoustic Stressors).

Sonar induced acoustic resonance and bubble formation phenomena are very unlikely to occur under realistic conditions, as discussed in Section 3.7.3.1.1.1 (Injury). Non-auditory injury (i.e., other than PTS) and mortality from sonar and other transducers is so unlikely as to be discountable under normal conditions and is therefore not considered further in this analysis.

The most probable impacts from exposure to sonar and other transducers are PTS, TTS, behavioral reactions, masking, and physiological stress (Sections 3.7.3.1.1.2, Hearing Loss; 3.7.3.1.1.3, Physiological Stress; 3.7.3.1.1.4, Masking; and 3.7.3.1.1.5, Behavioral Reactions).

3.7.3.1.2.1 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 sea turtles and marine mammals uses the Navy Acoustic Effects Model to produce initial estimates of the number of animals that may experience these effects; these estimates are further refined by considering animal avoidance of sound-producing activities and implementation of 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

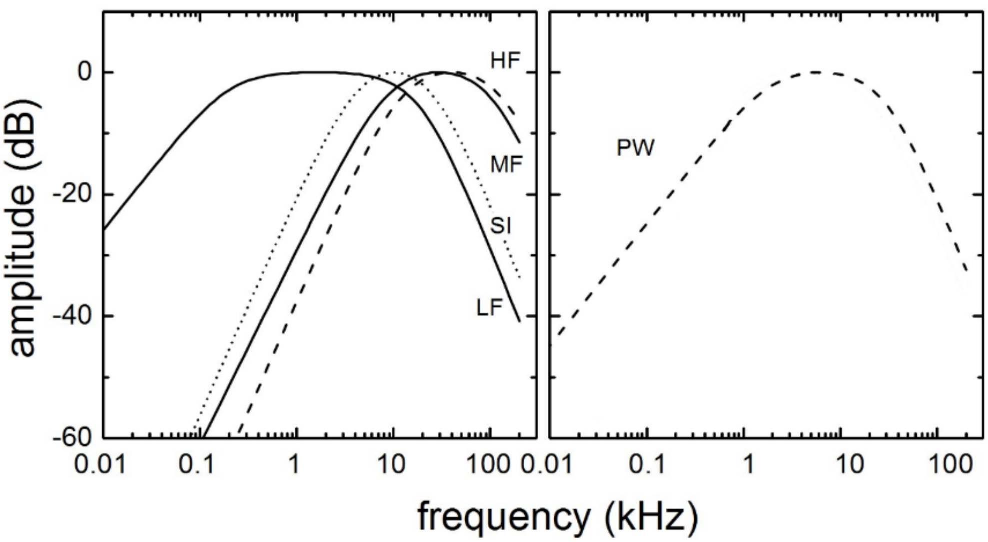
A detailed explanation of this analysis is provided in the technical report titled *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2018).

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

See 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) for detailed information on how the criteria and thresholds were derived.

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 3.7-6). 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.

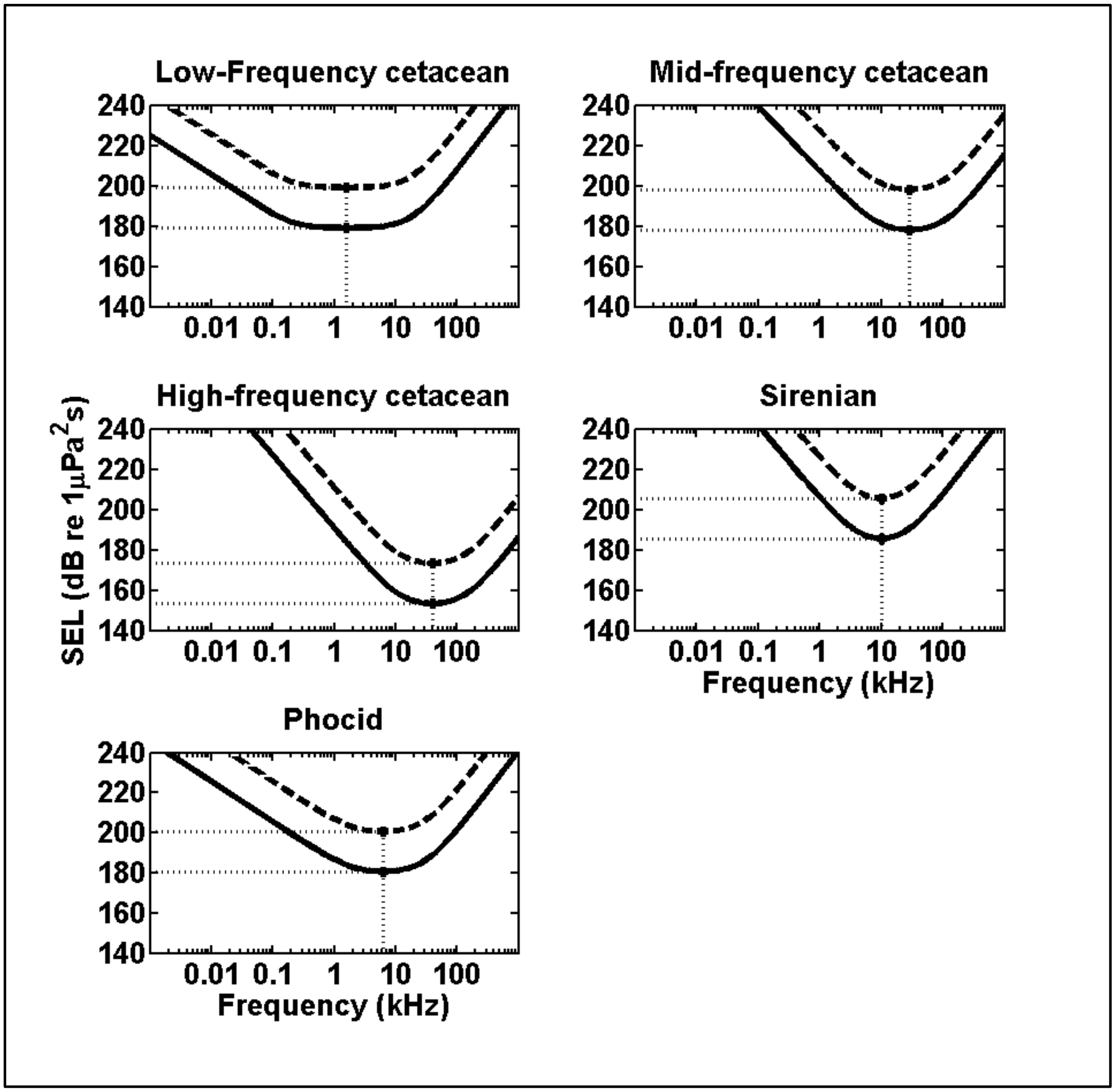


Note: HF = High-Frequency Cetacean, LF = Low-Frequency Cetacean, MF = Mid-Frequency Cetacean, PW = Phocid (In-water), and SI = Sirenian. For parameters used to generate the functions and more information on weighting function derivation see U.S. Department of the Navy (2017a).

Figure 3.7-6: Navy Auditory Weighting Functions for All Species Groups

Hearing Loss from Sonar and Other Transducers

Defining the TTS and PTS exposure functions (Figure 3.7-7) 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).



Note: 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 3.7-7: 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 (U.S. Department of the Navy, 2017a) for detailed information on how the Behavioral Response Functions were derived. 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, what the animal is being diverted from, 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 a few 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
- avoidance of 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 3.7-8 through Figure 3.7-11). In most cases, these divisions are driven by taxonomic classifications (e.g., mysticetes, pinnipeds). For groups that did not have adequate behavioral response data (i.e., sirenians), a surrogate behavioral risk function based on behavioral characteristics and taxonomy was assigned. 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.

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., 2005b) 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 3.7-3). 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 events that contain multiple platforms or tactical sonar sources that exceed 215 dB re 1 µPa @ 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.

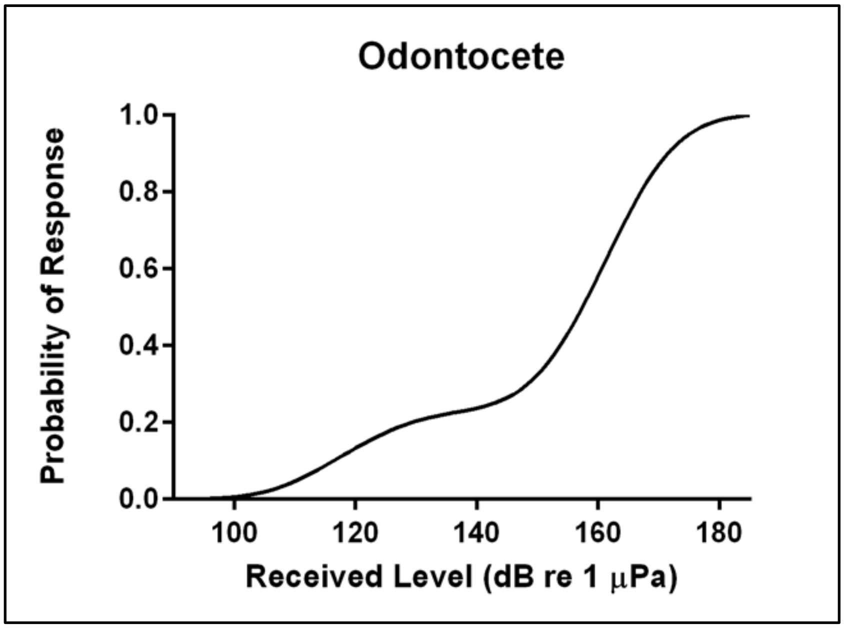


Figure 3.7-8: Behavioral Response Function for Odontocetes

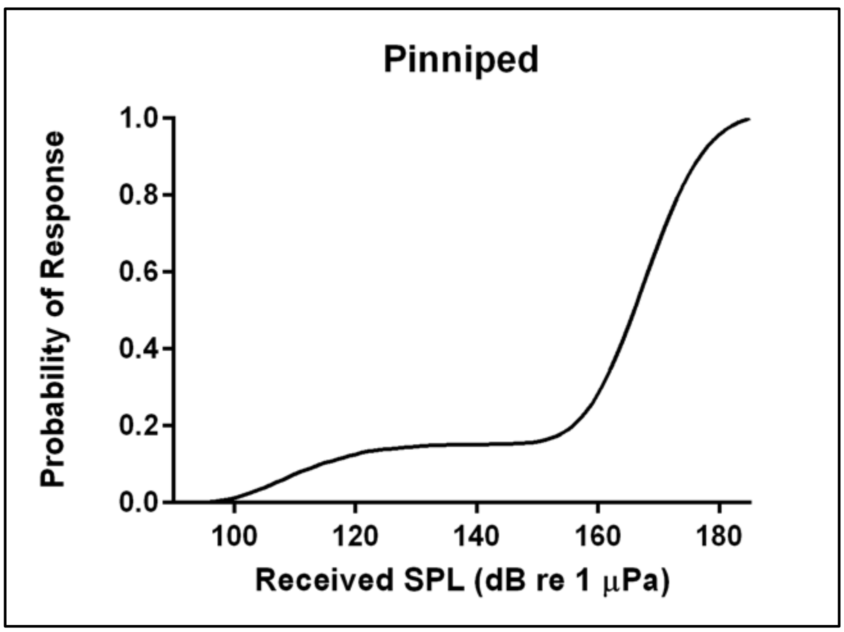


Figure 3.7-9: Behavioral Response Function for Pinnipeds

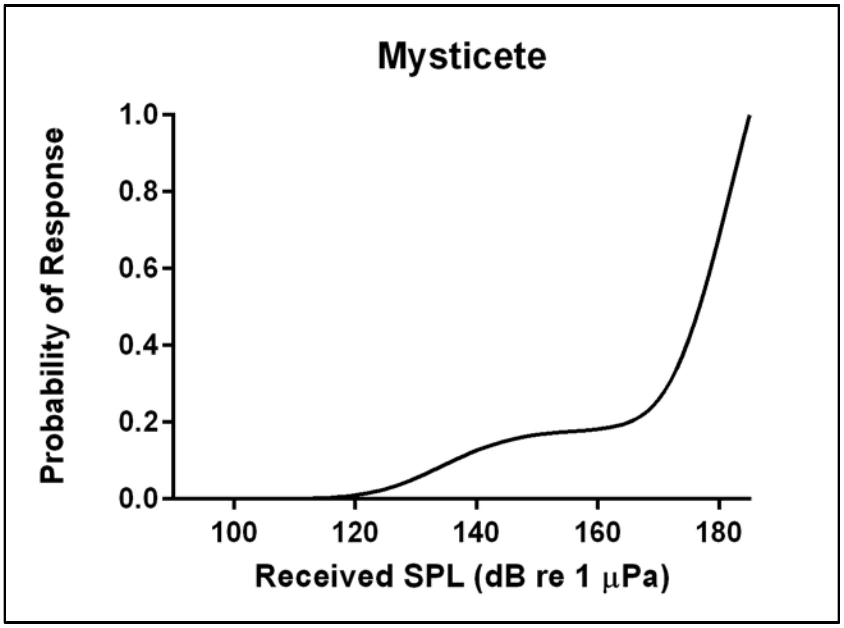


Figure 3.7-10: Behavioral Response Function for Mysticetes and Manatees

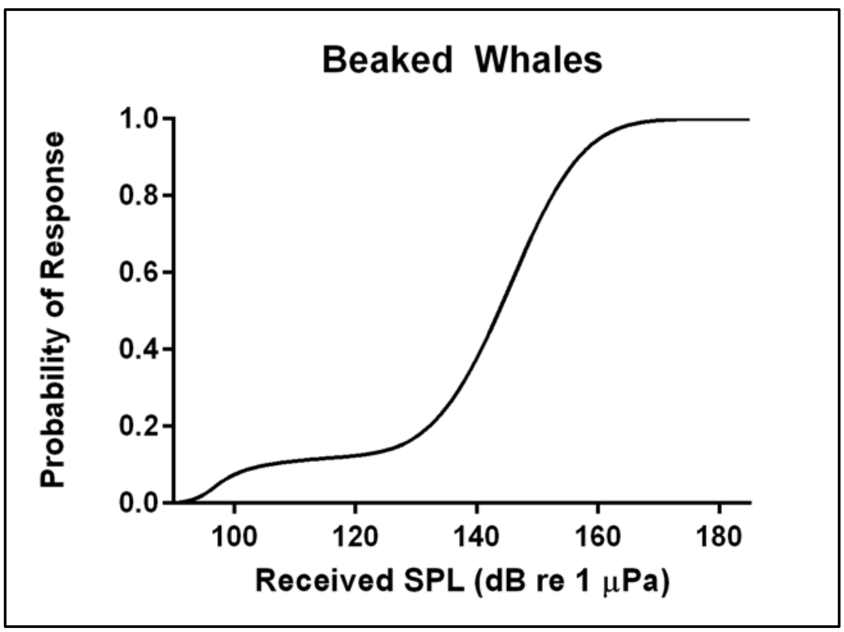


Figure 3.7-11: Behavioral Response Function for Beaked Whales

Table 3.7-3: 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	5 km	10 km
Mysticetes and Manatees	10 km	20 km
Beaked Whales	25 km	50 km
Harbor Porpoise	20 km	40 km

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 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 3.7-12).

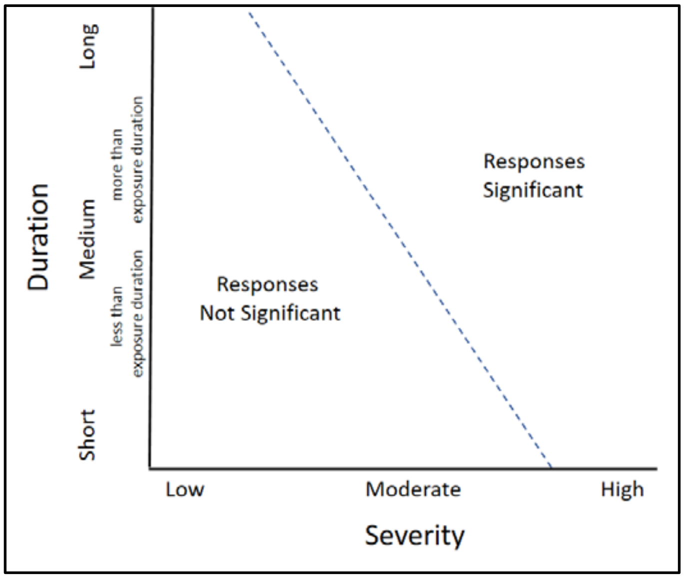


Figure 3.7-12: Relative Likelihood of a Response Being Significant Based on the Duration and Severity of Behavioral Reactions

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 3.7.3.1.1.6 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.

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), 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 procedural mitigation measures to avoid or reduce potential impacts from active sonar, as described in Section 5.3.2.1 (Active Sonar). 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, 2018).

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. 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.

The Navy also implements mitigation measures for certain active sonar activities within mitigation areas, as described in Section 5.4.2 (Mitigation Areas off the Northeastern United States), Section 5.4.3 (Mitigation Areas off the Mid-Atlantic and Southeastern United States), and Section 5.4.4 (Mitigation Areas in the Gulf of Mexico). 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.

3.7.3.1.2.2 Impact Ranges from Sonar and Other Transducers

The following section provides range to effects for sonar and other active acoustic sources 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 be mitigated within applicable mitigation zones.

The ranges to the PTS threshold for an exposure of 30 seconds are shown in Table 3.7-4 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. For a SQS-53C (i.e., bin MF1) sonar transmitting for 30 seconds at 3 kHz and a source level of 235 dB re 1 μPa^2-s at 1 m, the average range to PTS for the most sensitive species (the high-frequency cetaceans) extends from the source to a range of 192 m. PTS ranges for all other functional hearing groups, besides high-frequency cetaceans, are much shorter. Since any hull-mounted sonar, such as the SQS-53, engaged in anti-submarine warfare training would be moving at between 10 to 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, and sirenians), 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.

Table 3.7-4: Range to Permanent Threshold Shift for Five Representative Sonar Systems

Hearing Group	***Approximate PTS (30 seconds) Ranges (meters)1***				
	Sonar bin LF5M	***Sonar bin MF1***	***Sonar bin MF4***	***Sonar bin MF5***	***Sonar bin HF4***
Low-frequency Cetaceans	0 (0—0)	66 (65—80)	15 (15—18)	0 (0—0)	0 (0—0)
Mid-frequency Cetaceans	0 (0—0)	16 (16—16)	3 (3—3)	0 (0—0)	1 (0—2)
High-frequency Cetaceans	0 (0—0)	192 (170—270)	31 (30—40)	9 (8—13)	34 (20—85)
Phocid Seals	0 (0—0)	46 (45—55)	11 (11—13)	0 (0—0)	0 (0—0)
Sirenia	0 (0—0)	16 (16—16)	0 (0—0)	0 (0—0)	0 (0—0)

[1] PTS ranges extend from the sonar or other active acoustic 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. Where only one number is provided the average, minimum, and maximum ranges to PTS are the same.

Notes: ASW: anti-submarine warfare; HF: high frequency; LF: low frequency; MF: mid-frequency; MIW: mine warfare PTS: permanent threshold shift

The tables below illustrate the range to TTS for 1, 30, 60, and 120 seconds from five representative sonar systems (see Table 3.7-5 through Table 3.7-9). 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 3.7-5: Ranges to Temporary Threshold Shift for Sonar Bin LF5 over a Representative Range of Environments Within the Study Area

Hearing Group	*Approximate TTS Ranges (meters)*[1]			
	Sonar Bin LF5M			
	1 second	*30 seconds*	*60 seconds*	*120 seconds*
Low-frequency Cetaceans	4 (0—5)	4 (0—5)	4 (0—5)	4 (0—5)
Mid-frequency Cetaceans	0 (0—0)	0 (0—0)	0 (0—0)	0 (0—0)
High-frequency Cetaceans	0 (0—0)	0 (0—0)	0 (0—0)	0 (0—0)
Phocid Seals	0 (0—0)	0 (0—0)	0 (0—0)	0 (0—0)
Sirenia	0 (0—0)	0 (0—0)	0 (0—0)	0 (0—0)

[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-permanent threshold shift 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. Where only one number is provided the average, minimum, and maximum ranges to TTS are the same.

Notes: LF: low-frequency; TTS: temporary threshold shift

Table 3.7-6: Ranges to Temporary Threshold Shift for Sonar Bin MF1 over a Representative Range of Environments Within the Study Area

Functional Hearing Group	*Approximate TTS Ranges (meters)*[1]			
	Sonar Bin MF1 (e.g., SQS-53 ASW Hull Mounted Sonar)			
	1 second	*30 seconds*	*60 seconds*	*120 seconds*
Low-frequency Cetaceans	1,111 (650—2,775)	1,111 (650—2,775)	1,655 (800—3,775)	2,160 (900—6,525)
Mid-frequency Cetaceans	222 (200—310)	222 (200—310)	331 (280—525)	424 (340—800)
High-frequency Cetaceans	3,001 (1,275—8,275)	3001 (1,275—8,275)	4,803 (1,525—13,525)	6,016 (1,525—16,775)
Phocid Seals	784 (575—1,275)	784 (575—1,275)	1,211 (850—3,025)	1505 (1,025—3,775)
Sirenia	223 (200—310)	223 (200—310)	331 (270—525)	423 (330—800)

[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-permanent threshold shift 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.

ASW: anti-submarine warfare; MF: mid-frequency; TTS: temporary threshold shift

Note: Ranges for 1-sec and 30-sec periods are identical for Bin MF1 because this system nominally pings every 50 seconds, therefore these periods encompass only a single ping.

Table 3.7-7: 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*
Low-frequency Cetaceans	89 (85—120)	175 (160—280)	262 (220—575)	429 (330—875)
Mid-frequency Cetaceans	22 (22—25)	36 (35—45)	51 (45—60)	72 (70—95)
High-frequency Cetaceans	270 (220—575)	546 (410—1,025)	729 (525—1,525)	1107 (600—2,275)
Phocid Seals	67 (65—90)	119 (110—180)	171 (150—260)	296 (240—700)
Sirenia	0 (0—0)	0 (0—0)	0 (0—0)	0 (0—0)

[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-permanent threshold shift 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. Where only one number is provided the average, minimum, and maximum ranges to TTS are the same.

Notes: MF: mid-frequency; TTS: temporary threshold shift

Table 3.7-8: 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*
Low-frequency Cetaceans	11 (0—14)	11 (0—14)	16 (0—20)	23 (0—25)
Mid-frequency Cetaceans	5 (0—10)	5 (0—10)	12 (0—15)	17 (0—22)
High-frequency Cetaceans	122 (110—320)	122 (110—320)	187 (150—525)	286 (210—750)
Phocid Seals	9 (8—13)	9 (8—13)	15 (14—18)	22 (21—25)
Sirenia	0 (0—0)	0 (0—0)	0 (0—0)	0 (0—0)

[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-permanent threshold shift 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. Where only one number is provided the average, minimum, and maximum ranges to TTS are the same.

Notes: MF: mid-frequency; TTS: temporary threshold shift

Table 3.7-9: Ranges to Temporary Threshold Shift for Sonar BinHF4 over a Representative Range of Environments Within the Study Area

Functional Hearing Group	Approximate TTS Ranges (meters)[1]			
	Sonar Bin HF4 (e.g., SQS-20 Mine Hunting Sonar)			
	1 second	30 seconds	60 seconds	120 seconds
Low-frequency Cetaceans	1 (0—3)	3 (0—5)	5 (0—7)	7 (0—12)
Mid-frequency Cetaceans	10 (7—17)	19 (11—35)	27 (17—60)	39 (22—100)
High-frequency Cetaceans	242 (100—975)	395 (170—1,775)	524 (230—2,775)	655 (300—4,275)
Phocid Seals	2 (0—5)	5 (0—8)	8 (5—13)	12 (8—20)
Sirenia	0 (0—2)	1 (0—3)	1 (0—5)	2 (0—8)

[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-permanent threshold shift 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.
HF: high 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 3.7-10 through Table 3.7-14, respectively. See Section 3.7.3.1.2.1 (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 3.7-10: Ranges to a Potentially Significant Behavioral Response for Sonar Bin LF5 over a Representative Range of Environments Within the Study Area

Received Level (dB re 1 µPa)	Mean Range (m) with minimum to maximum values in parentheses	Probability of Behavioral Response				
		Odontocetes	Mysticetes	Pinnipeds	Beaked Whales	Harbor Porpoises
178	1 (0—1)	97%	59%	92%	100%	100%
172	2 (1—2)	91%	30%	76%	99%	100%
166	4 (1—6)	78%	20%	48%	97%	100%
160	10 (1—13)	58%	18%	27%	93%	100%
154	21 (1—25)	40%	17%	18%	83%	100%
148	46 (1—60)	29%	16%	16%	66%	100%
142	104 (1—140)	25%	13%	15%	45%	100%
136	242 (120—430)	23%	9%	15%	28%	100%
130	573 (320—1,275)	20%	5%	15%	18%	100%
124	1,268 (550—2,775)	17%	2%	14%	14%	100%
118	2,733 (800—6,525)	12%	1%	13%	12%	0%
112	5,820 (1,025—18,275)	6%	0%	9%	11%	0%
106	13,341 (1,275—54,525)	3%	0%	5%	11%	0%
100	31,026 (2,025—100,000*)	1%	0%	2%	8%	0%

* Indicates maximum range of acoustic model, a distance of approximately 100 kilometers from the sound source.
Note: 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 3.7-3 for behavioral cut-off distances).
dB re 1 µPa: decibels referenced to 1 micropascal; m: meters

Table 3.7-11: 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 (m) with minimum to maximum values in parentheses	Probability of Behavioral Response				
		Odontocetes	Mysticetes	Pinnipeds	Beaked Whales	Harbor Porpoises
196	109 (100—150)	100%	100%	100%	100%	100%
190	257 (220—370)	100%	98%	99%	100%	100%
184	573 (400—1,000)	99%	88%	98%	100%	100%
178	1,235 (725—3,525)	97%	59%	92%	100%	100%
172	3,007 (875—9,775)	91%	30%	76%	99%	100%
166	6,511 (925—19,525)	78%	20%	48%	97%	100%
160	11,644 (975—36,275)	58%	18%	27%	93%	100%
154	18,012 (975—60,775)	40%	17%	18%	83%	100%
148	26,037 (1,000—77,525)	29%	16%	16%	66%	100%
142	33,377 (1,000—100,000*)	25%	13%	15%	45%	100%
136	41,099 (1,025—100,000*)	23%	9%	15%	28%	100%
130	46,618 (3,275—100,000*)	20%	5%	15%	18%	100%
124	50,173 (3,525—100,000*)	17%	2%	14%	14%	100%
118	52,982 (3,775—100,000*)	12%	1%	13%	12%	0%
112	56,337 (4,275—100,000*)	6%	0%	9%	11%	0%
106	60,505 (4,275—100,000*)	3%	0%	5%	11%	0%
100	62,833 (4,525—100,000*)	1%	0%	2%	8%	0%

* Indicates maximum range of acoustic model, a distance of approximately 100 kilometers from the sound source.
Note: 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 3.7-3 for behavioral cut-off distances).
dB re 1 µPa: decibels referenced to 1 micropascal; m: meters

Table 3.7-12: 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 (m) with minimum to maximum values in parentheses	Probability of Behavioral Response				
		Odontocetes	Mysticetes	Pinnipeds	Beaked Whales	Harbor Porpoises
196	8 (1—10)	100%	100%	100%	100%	100%
190	17 (1—21)	100%	98%	99%	100%	100%
184	35 (1—40)	99%	88%	98%	100%	100%
178	71 (1—95)	97%	59%	92%	100%	100%
172	156 (110—410)	91%	30%	76%	99%	100%
166	431 (280—1,275)	78%	20%	48%	97%	100%
160	948 (490—3,525)	58%	18%	27%	93%	100%
154	1,937 (750—10,025)	40%	17%	18%	83%	100%
148	3,725 (1,025—20,525)	29%	16%	16%	66%	100%
142	7,084 (1,525—38,525)	25%	13%	15%	45%	100%
136	11,325 (1,775—56,275)	23%	9%	15%	28%	100%

Table 3.7-12: Ranges to a Potentially Significant Behavioral Response for Sonar Bin MF4 over a Representative Range of Environments Within the Study Area (continued)

Received Level (dB re 1 µPa)	*Mean Range (m) with minimum to maximum values in parentheses*	*Probability of Behavioral Response*				
		Odontocetes	*Mysticetes*	*Pinnipeds*	*Beaked Whales*	*Harbor Porpoises*
130	16,884 (1,775—74,275)	20%	5%	15%	18%	100%
124	24,033 (2,275—80,775)	17%	2%	14%	14%	100%
118	31,950 (2,275—100,000*)	12%	1%	13%	12%	0%
112	37,663 (2,525—100,000*)	6%	0%	9%	11%	0%
106	41,436 (2,775—100,000*)	3%	0%	5%	11%	0%
100	44,352 (2,775—100,000*)	1%	0%	2%	8%	0%

* Indicates maximum range of acoustic model, a distance of approximately 100 kilometers from the sound source.
Note: 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 3.7-3 for behavioral cut-off distances).
dB re 1 µPa: decibels referenced to 1 micropascal; m: meters

Table 3.7-13: 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 (m) with minimum to maximum values in parentheses*	*Probability of Behavioral Response*				
		Odontocetes	*Mysticetes*	*Pinnipeds*	*Beaked Whales*	*Harbor Porpoises*
190	2 (1—3)	100%	98%	99%	100%	100%
184	4 (1—9)	99%	88%	98%	100%	100%
178	14 (1—18)	97%	59%	92%	100%	100%
172	29 (1—35)	91%	30%	76%	99%	100%
166	61 (1—80)	78%	20%	48%	97%	100%
160	141 (1—400)	58%	18%	27%	93%	100%
154	346 (1—1,000)	40%	17%	18%	83%	100%
148	762 (420—2,525)	29%	16%	16%	66%	100%
142	1,561 (675—5,525)	25%	13%	15%	45%	100%
136	2,947 (1,025—10,775)	23%	9%	15%	28%	100%
130	5,035 (1,025—17,275)	20%	5%	15%	18%	100%
124	7,409 (1,275—22,525)	17%	2%	14%	14%	100%
118	10,340 (1,525—29,525)	12%	1%	13%	12%	0%
112	13,229 (1,525—38,025)	6%	0%	9%	11%	0%
106	16,487 (1,525—46,025)	3%	0%	5%	11%	0%
100	20,510 (1,775—60,525)	1%	0%	2%	8%	0%

Note: 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 3.7-3 for behavioral cut-off distances).
dB re 1 µPa: decibels referenced to 1 micropascal; m: meters

Table 3.7-14: 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 (m) with minimum to maximum values in parentheses*	*Probability of Behavioral Response*				
		Odontocetes	*Mysticetes*	*Pinnipeds*	*Beaked Whales*	*Harbor Porpoises*
196	3 (1—6)	100%	100%	100%	100%	100%
190	8 (1—14)	100%	98%	99%	100%	100%
184	18 (1—35)	99%	88%	98%	100%	100%
178	37 (1—100)	97%	59%	92%	100%	100%
172	78 (1—300)	91%	30%	76%	99%	100%
166	167 (1—725)	78%	20%	48%	97%	100%
160	322 (25—1,525)	58%	18%	27%	93%	100%
154	555 (45—3,775)	40%	17%	18%	83%	100%
148	867 (70—6,775)	29%	16%	16%	66%	100%
142	1,233 (150—12,775)	25%	13%	15%	45%	100%
136	1,695 (260—20,025)	23%	9%	15%	28%	100%
130	2,210 (470—29,275)	20%	5%	15%	18%	100%
124	2,792 (650—40,775)	17%	2%	14%	14%	100%
118	3,421 (950—49,775)	12%	1%	13%	12%	0%
112	4,109 (1,025—49,775)	6%	0%	9%	11%	0%
106	4,798 (1,275—49,775)	3%	0%	5%	11%	0%
100	5,540 (1,275—49,775)	1%	0%	2%	8%	0%

dB re 1 µPa: decibels referenced to 1 micropascal; m: meters

3.7.3.1.2.3 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 3.0.3.3.1 (Acoustic Stressors). Activities using sonars and other transducers would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). The major differences between the Action Alternatives for the purposes of analyzing impacts on marine mammals are:

- Under Alternative 1, for training, the number of major training exercises and Civilian Port Defense activities would fluctuate annually. In addition, Alternative 1 accounts for the portion of Unit Level Surface Ship ASW that is met during participation in other ASW exercises or through the use of synthetic trainers for very basic levels of training. Training activities using sonar and other transducers could occur throughout the Study Area, although use would generally occur within Navy range complexes, on Navy testing ranges, or around inshore locations identified in Chapter 2 (Description of Proposed Action and Alternatives). Use of sonars associated with Anti-Submarine Warfare would be greatest in the Jacksonville and Virginia Capes Range Complexes.

- Under Alternative 1, for testing, the number of testing activities would fluctuate annually. Testing activities using sonar and other transducers could occur throughout the Study Area, although use would generally occur within Navy range complexes, on Navy testing ranges, or around inshore locations identified in Chapter 2 (Description of Proposed Action and Alternatives).
- Under Alternative 2, for training, the maximum number of major training exercises could occur every year, an additional major training exercise would be conducted in the Gulf of Mexico Range Complex annually, and only the number of Civilian Port Defense activities would fluctuate annually. In addition, all unit level surface ship ASW training requirements would be completed through individual events conducted at sea, rather than through leveraging other ASW training exercises or the use of synthetic trainers. Training activities using sonar and other transducers could occur throughout the Study Area, although use would generally occur within Navy range complexes, on Navy testing ranges, or around inshore locations identified in Chapter 2 (Description of Proposed Action and Alternatives). Use of sonars associated with Anti-Submarine Warfare would be greatest in the Jacksonville and Virginia Capes Range Complexes.
- Under Alternative 2, for testing, the maximum number of nearly all testing activities would occur every year. This would result in an increase of sonar use compared to Alternative 1. Testing activities using sonar and other transducers could occur throughout the Study Area, although use would generally occur within Navy range complexes, on Navy testing ranges, or around inshore locations identified in Chapter 2 (Description of Proposed Action and Alternatives).

Major training exercises (Composite Training Unit Exercise, Fleet Exercise/Sustainment Exercise) are multi-day exercises that transition across large areas and involve multiple anti-submarine warfare assets. These exercises take place in the Virginia Capes, Navy Cherry Point, Jacksonville, or Gulf of Mexico (Alternative 2 only) Range Complexes. It is important to note that while major training exercises focus on anti-submarine warfare, there are significant periods when active anti-submarine warfare sonars are not in use. Nevertheless, behavioral reactions are assumed more likely to be significant than during other anti-submarine warfare activities due to the duration (i.e., multiple days) and scale (i.e., multiple sonar platforms) of the major training exercises. Although major training exercises tend to move to different locations as the event unfolds, some animals could be exposed multiple times over the course of a few days.

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. However, due to the shorter duration and smaller footprint compared to major training exercises, impacts from these activities are less likely to be significant with the possible exception of resident animals near homeports or Navy instrumented ranges that may incur some repeated exposures.

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 Section 3.7.3.1.2.3 (Impacts from Sonar and Other Transducers Under the Action Alternatives). 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.

Mine warfare testing activities typically involve a ship, helicopter, or unmanned vehicle testing a mine-hunting sonar system. Unmanned underwater vehicle testing also employs many of the same sonar systems as mine warfare testing and usually involves only a single sonar platform (i.e., unmanned underwater vehicle). Most of the sonar systems and other transducers used during these testing activities typically 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 these types of systems sonars. 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.

Navigation and object detection activities typically employ ship and submarine based sonar systems and other transducers to navigate and avoid underwater objects. Significant reactions in marine mammals have not been reported due to exposure to most of the sonars and other transducers typically used in these activities. Some hull-mounted anti-submarine warfare sonars (e.g., Bin MF1) have a mode to look for objects in the water such as mines, but this mode uses different source characteristics as compared to the anti-submarine warfare mode. Significant behavioral reactions have not been observed in relation to hull-mounted sonars using object-detection mode; however, significant reactions may be more likely than for all other sonar systems and transducers used within these activities due to the additional presence of a moving vessel and higher source levels. Individual animals could show short-term and minor to moderate responses to these systems, although 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 @ 1 m 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. Most anti-submarine warfare activities 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. 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 3.7.3.1.2.1, 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 Mammals 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. 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 to occur anywhere within the Study Area where sound from sonar and the species overlap, although only Regions or Activity Categories where 0.5 percent of the impacts or greater are estimated to occur are graphically represented below. All (i.e., grand total) estimated impacts for that species are included, regardless of region or category.

Note that the numbers of activities planned under Alternative 1 can vary from year-to-year. Results are presented for a “minimum 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 is described in Section 3.0.3.3.1 (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 3.7.3.1.1.5, 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 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 3.7.3.1.2.1 (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.

With the exception of Elevated Causeway construction, there is no Navy activity in the proposed action that is both long in duration (more than a day) and concentrated in the same location (e.g., within a few square miles), so there is a low likelihood that animals and Navy activities will co-occur for extended periods of time or repetitively over the duration of an activity.

Mysticetes

Mysticetes may be exposed to sound from sonar and other transducers associated with training activities throughout the year. Most low- (less than 1 kHz) and mid- (1 to 10 kHz) frequency sonars and other transducers produce sounds that are likely to be within the hearing range of mysticetes (Section 3.7.2.1.4, 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 3.7.3.1.2.2 (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.

Some mysticetes may avoid larger activities such as a major training exercise as it moves through an area, although these activities generally do not use the same training locations day-after-day during multi-day activities. Therefore, displaced animals could return quickly after the major training exercise finishes. It is unlikely that most mysticetes would encounter a major training exercise more than once per year. In the ocean, the use of sonar and other transducers is transient and is unlikely to expose the same population of animals repeatedly over a short period except around homeports and fixed instrumented ranges. Overall, a few behavioral reactions per year by a single individual are unlikely to produce long-term consequences for that individual.

Behavioral research indicates that mysticetes most likely avoid sound sources at levels that would cause any hearing loss (i.e., TTS) (Section 3.7.3.1.1.5, 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. 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 3.7.3.1.1.4 (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. 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 mysticetes. High-frequency (greater than 10 kHz) sonars fall outside of the best hearing and vocalization ranges of mysticetes (see Section 3.7.2.1.4, 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 a 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 3.7.2.1.4 (Hearing and Vocalization) discusses low-frequency cetacean (i.e., mysticetes) hearing abilities.

North Atlantic Right Whales (Endangered Species Act-Listed)

As discussed in Section 5.4.3 (Mitigation Areas off the Mid-Atlantic and Southeastern United States), in the Southeast North Atlantic Right Whale Mitigation Area from November 15 through April 15, the Navy will not conduct low-frequency, mid-frequency, or high-frequency active sonar, except for sources that will be minimized to the maximum extent practicable during helicopter dipping, navigation training, and object detection exercises. Within the Southeast North Atlantic Right Whale Mitigation Area, the Navy would conduct navigation training and object detection exercises when surface ships or submarines enter or exit ports located in Kings Bay, Georgia, and Mayport, Florida. In addition, training or testing activities involving helicopter dipping sonar would occur off Mayport, Florida. The Southeast North

Atlantic Right Whale Mitigation Area encompasses a portion of the North Atlantic right whale migration and calving areas identified by LaBrecque et al. (2015a) and a portion of the southeastern North Atlantic right whale critical habitat. Outside of the Southeast North Atlantic Right Whale Mitigation Area, active sonar would be used for anti-submarine warfare activities and for pierside sonar testing at Kings Bay, Georgia. As stated in 3.7.2.2.2 (North Atlantic Right Whale [*Eubalaena glacialis*]), the best available density data for the Study Area shows that the areas of highest density are off the southeastern United States in areas that coincide with the Southeast North Atlantic Right Whale Mitigation Area. Therefore, the majority of active sonar use would occur outside of the areas of highest seasonal North Atlantic right whale density off the southeastern United States. As discussed in detail in Chapter 5 (Mitigation), before transiting through or conducting training or testing activities within the Southeast North Atlantic Right Whale Mitigation Area during calving season (November 15 to April 15), the Navy will initiate communication with the Fleet Area Control and Surveillance Facility, Jacksonville to obtain Early Warning System North Atlantic right whale sightings data. When transiting within the mitigation area, vessels will use the sightings information to reduce potential interactions with North Atlantic right whales. In addition, Navy units conducting training or testing activities in the Jacksonville Operating Area will obtain and use Early Warning System North Atlantic right whale sightings data as they plan specific details of events to minimize potential interactions with North Atlantic right whales to the maximum extent practicable. The Navy will use the reported sightings information to assist their visual observation of applicable mitigation zones and to aid in the implementation of procedural mitigation.This high level of awareness will further enhance the Navy's mitigation effectiveness for reducing potential acoustic impacts on North Atlantic right whales off the southeastern United States.

The Navy will also minimize the use of active sonar to the maximum extent practicable year-round in the Northeast North Atlantic Right Whale Mitigation Area, which the Navy is expanding to cover the full extent of the northeastern North Atlantic right whale critical habitat as discussed in Section 5.4.2 (Mitigation Areas off the Northeastern United States). Before transiting through the mitigation area, the Navy will conduct a web query or email inquiry to the National Oceanographic and Atmospheric Administration Northeast Fisheries Science Center's North Atlantic Right Whale Sighting Advisory System to obtain the latest North Atlantic right whale sightings information. Vessels will use the sightings information to reduce potential interactions with North Atlantic right whales. This high level of awareness will further enhance the Navy's mitigation effectiveness for reducing potential acoustic impacts on North Atlantic right whales off the northeastern United States. A limited number of torpedo activities (non-explosive) would be conducted in August and September, after many North Atlantic right whales have migrated south out of the area. These torpedo areas were established during previous ESA consultations with NMFS. Under all alternatives, torpedo training or testing activities would not occur within 2.7 NM of the Stellwagen Bank National Marine Sanctuary.

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

North Atlantic right whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-13 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

As described for other 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

As previously described in 3.7.2.2.2 (North Atlantic Right Whale [*Eubalaena glacialis*]) a migratory corridor, a calving area, a mating area, and feeding areas for North Atlantic right whales have been identified by LaBrecque et al., (2015a) that seasonally overlap with Virginia Capes, Navy Cherry Point, Jacksonville, and the Northeast Range Complexes within the Study Area. Navy training activities that use sonar could occur in these range complexes year-round. Impacts on feeding and mating behaviors could occur due to sonar training activities on the feeding or mating areas identified by LaBrecque et al., (2015a). Impacts in this area are primarily due to navigation and object avoidance activities taking place at Groton, Connecticut, although impacts on feeding and mating behaviors from these activities are likely to be short term and minor to moderate within the feeding and mating areas identified by LaBrecque et al., (2015a). North Atlantic right whale migration behaviors could be impacted within the Virginia Capes, Navy Cherry Point, or Jacksonville Range Complex, which overlap the identified migration corridor. Mysticetes disturbed during migration have been observed pausing or rerouting around an activity using sonar only if it is directly on their path; therefore, impacts on migration behavior are likely to be short term and moderate if they were to occur within the migratory corridor identified by LaBrecque et al., (2015a). Impacts on North Atlantic right whales could occur within designated calving areas that overlap the Jacksonville and Navy Cherry Point Range Complexes. Impact in this area are primarily due to navigation and object avoidance activities taking place at Mayport, Florida and Port Canaveral, Florida, although impacts on calving behaviors from these activities are likely to be short term and minor to moderate within the calving area identified by LaBrecque et al. (2015a). In addition to procedural mitigation that is implemented whenever and wherever active sonar activities occur, the Navy will implement mitigation within mitigation areas off the northeastern, mid-Atlantic, and southeastern United States to further avoid or reduce potential impacts from active sonar activities on North Atlantic right whales in their important feeding, migration, and calving habitats (see Section 5.4.2, Mitigation Areas off the Northeastern United States, and Section 5.4.3, Mitigation Areas off the Mid-Atlantic and Southeastern United States).

As discussed above and in Section 3.7.2.2.2.1 (Status and Management), the Study Area does overlap North Atlantic right whale critical habitat and some limited use of sonar and other transducers does take place within these areas; however, the sound from sonar and other transducers would not affect the biological or physical features that are essential for the reproduction, rest and refuge, health, continued survival, conservation and recovery of the North Atlantic right whale population.

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 North Atlantic right whales incidental to those activities. The Navy has requested authorization from the NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 1 may affect ESA-listed North Atlantic right whales and would have no effect on North Atlantic right whale critical habitats. The Navy has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.

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

North Atlantic right whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-13 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

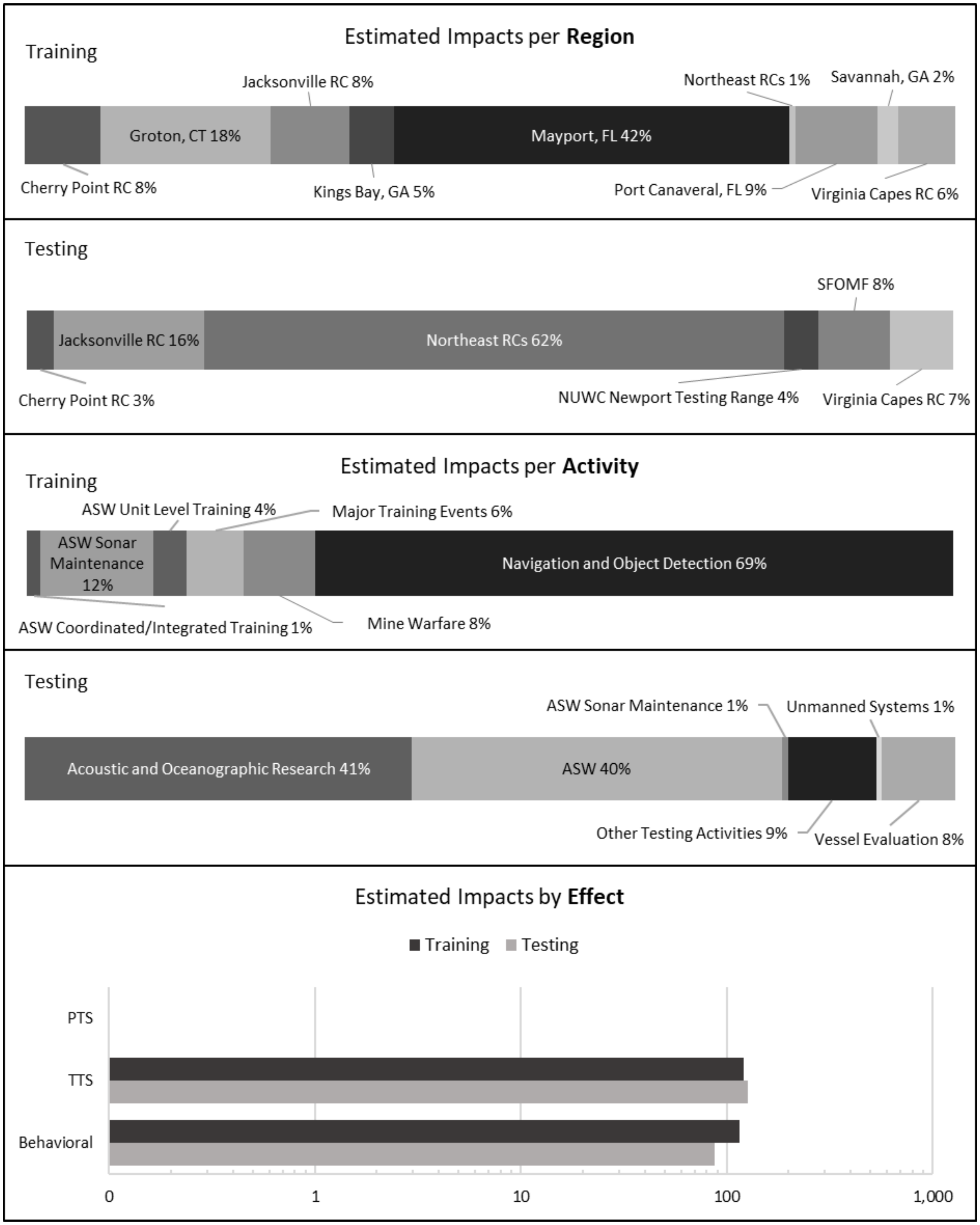
As described for other mysticetes above, even a few minor to moderate TTS and behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. Considering these factors and the mitigation measures that will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

As previously described in Sections 3.7.2.2.2 (North Atlantic Right Whale [*Eubalaena glacialis*]) a migratory corridor, a calving area, a mating area, and feeding areas for North Atlantic right whales have been identified by LaBrecque et al., (2015a) that seasonally overlap with Virginia Capes, Navy Cherry Point, Jacksonville, and the Northeast Range Complexes within the Study Area. Navy testing activities that use sonar could occur in these range complexes year-round. Impacts on feeding and mating behaviors could occur due to sonar testing activities on the feeding or mating areas identified by LaBrecque et al., (2015a). Impacts on feeding and mating behaviors from these activities are likely to be short term and minor to moderate within the feeding and mating areas identified by LaBrecque et al., (2015a). North Atlantic right whale migration behaviors could be impacted within the Virginia Capes, Navy Cherry Point, or Jacksonville Range Complex, which overlap the identified migration corridor. Mysticetes disturbed during migration have been observed pausing or rerouting around an activity using sonar only if it is directly on their path; therefore, impacts on migration behavior are likely to be short term and moderate if they were to occur within the migratory corridor identified by LaBrecque et al., (2015a). Impacts on North Atlantic right whales could occur within designated calving areas that overlap the Jacksonville and Navy Cherry Point Range Complexes. Impacts on calving behaviors from these activities are likely to be short term and minor to moderate within the calving area identified by LaBrecque et al., (2015a). In addition to procedural mitigation that is implemented whenever and wherever active sonar activities occur, the Navy will implement mitigation within mitigation areas off the northeastern, mid-Atlantic, and southeastern United States to further avoid or reduce potential impacts from active sonar activities on North Atlantic right whales in their important feeding, migration, and calving habitats (see Section 5.4.2, Mitigation Areas off the Northeastern United States, and Section 5.4.3, Mitigation Areas off the Mid-Atlantic and Southeastern United States).

As discussed above and in Section 3.7.2.2.2.1 (Status and Management), the Study Area does overlap North Atlantic right whale critical habitat and some limited use of sonar and other transducers does take place within these areas; however, the sound from sonar and other transducers would not affect the biological or physical features that are essential for the reproduction, rest and refuge, health, continued survival, conservation and recovery of the North Atlantic right whale population.

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 North Atlantic right whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 1 may affect ESA-listed North Atlantic right whales and will have no effect on North Atlantic right whale critical habitat. The Navy has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-13: North Atlantic Right Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

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

North Atlantic right whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-14 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

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 North Atlantic right 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 North Atlantic right whales and will have no effect on North Atlantic right whale critical habitat.

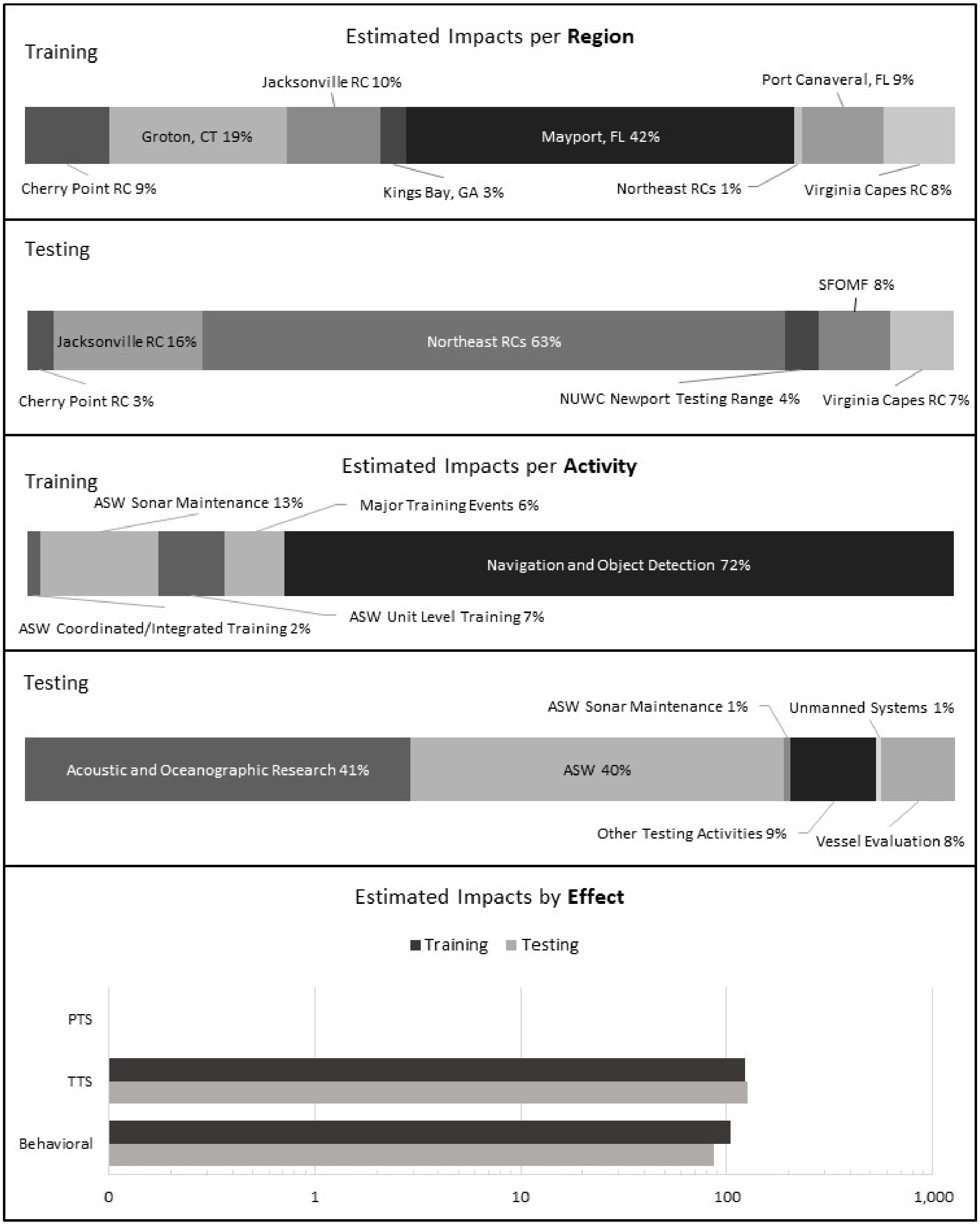
Impacts from Sonar and Other Transducers Under Alternative 2 for Testing Activities

North Atlantic right whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-14 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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 North Atlantic right 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 North Atlantic right whales and will have no effect on North Atlantic right whale critical habitat.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-14: North Atlantic Right Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Blue Whales (Endangered Species Act-Listed)

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

Blue whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-15 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

As described for other 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 will 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 blue whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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 has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.

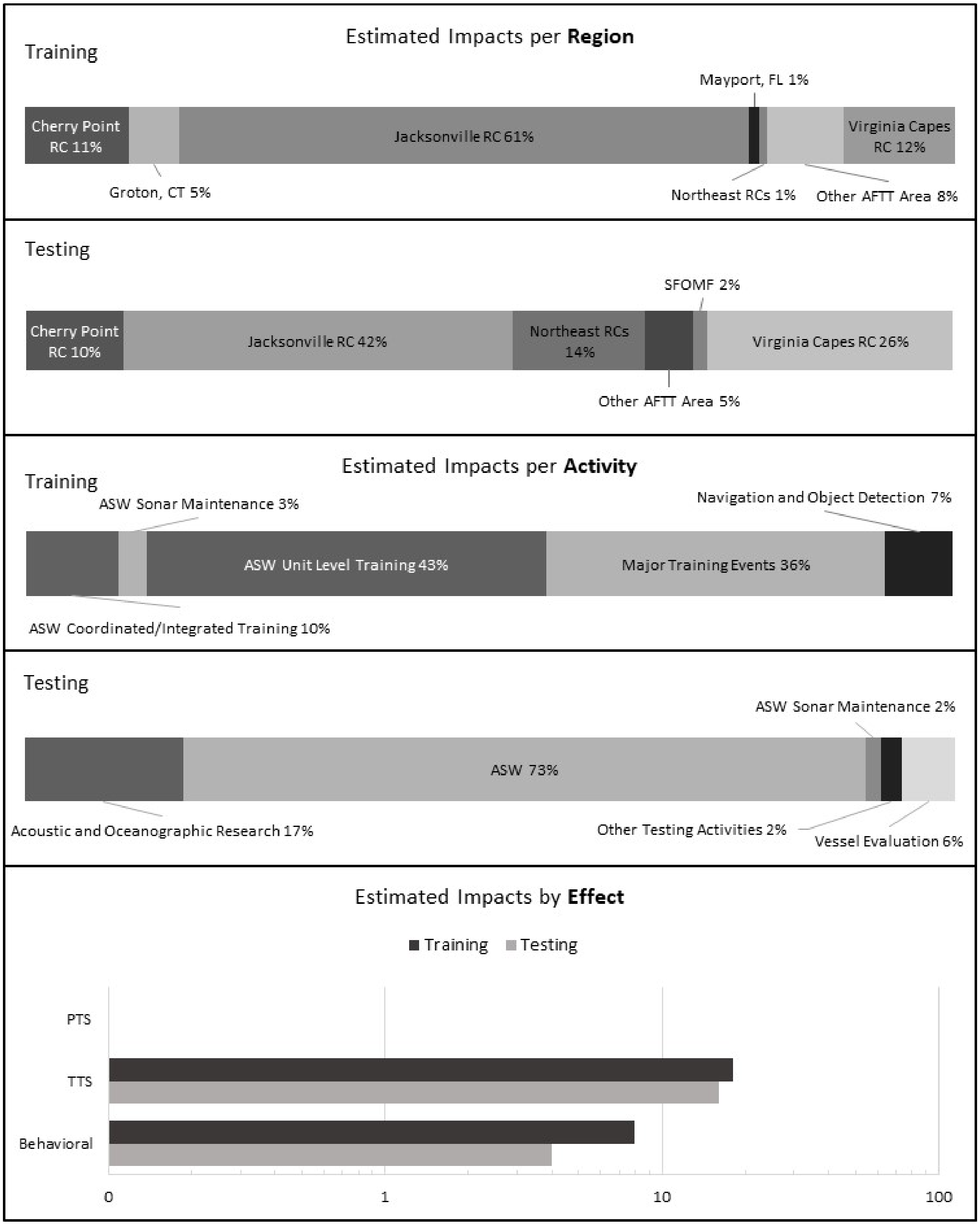
Impacts from Sonar and Other Transducers Under Alternative 1 for Testing Activities

Blue whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-15 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

As described for other 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 will 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 blue whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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 has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent western North Atlantic (Gulf of St. Lawrence) stock. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-15: Blue Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

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

Blue whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-16 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

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.

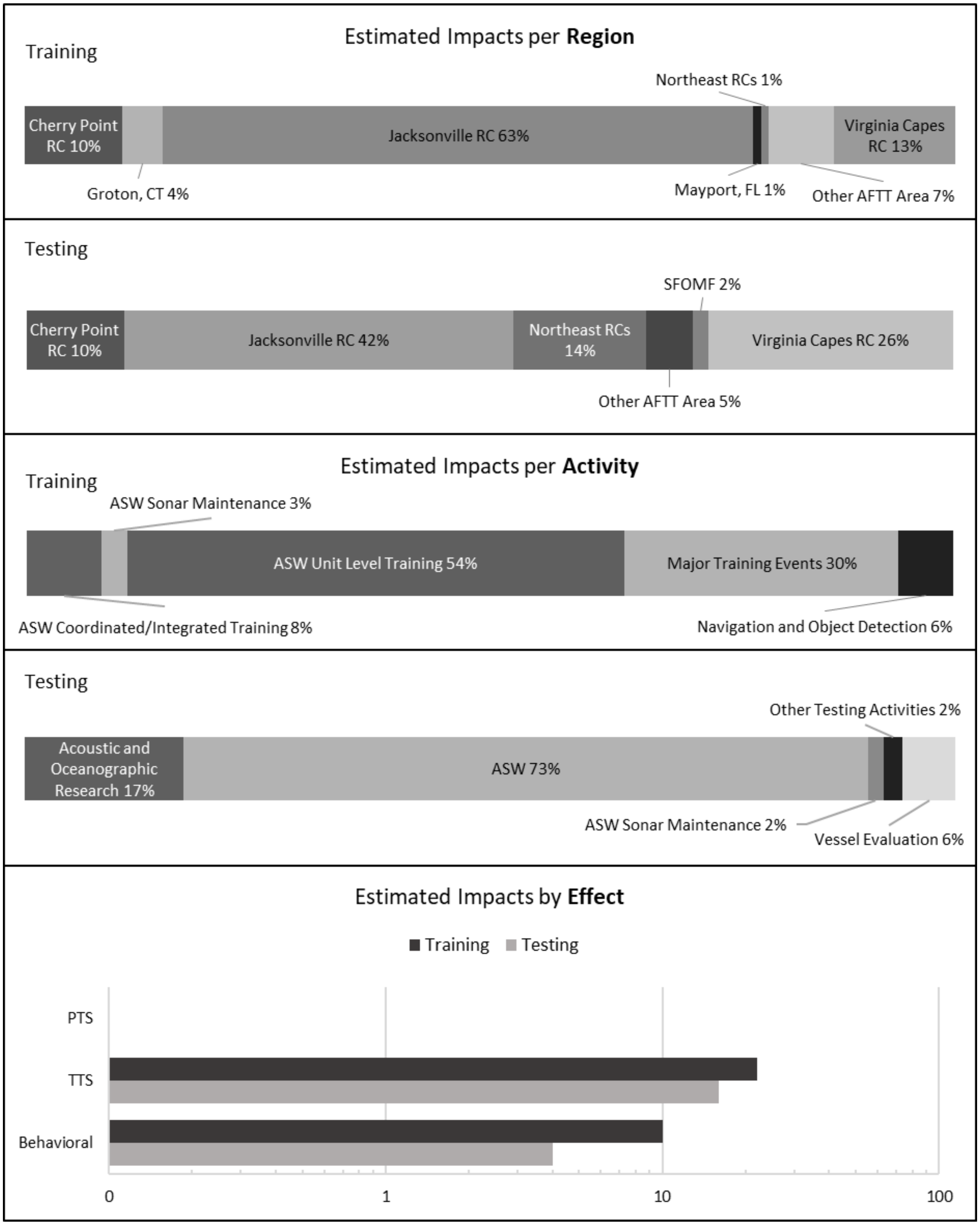
Impacts from Sonar and Other Transducers Under Alternative 2 for Testing Activities

Blue whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-16 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent western North Atlantic (Gulf of St. Lawrence) stock. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-16: Blue Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Bryde's Whales

For the purposes of this analysis, estimated impacts on Bryde's whales are broken out into two different groups: the ESA-listed northern Gulf of Mexico stock and a group with no stock designation. Estimated impacts on the northern Gulf of Mexico stock only occur in the Gulf of Mexico and surrounding Navy areas. Takes that occur in the Atlantic are considered to be part of the no stock designation group as it is not anticipated that whales from the Gulf of Mexico stock would occur on the east coast.

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

Bryde's whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-17 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple groups (see Table 3.7-15).

As described for other 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

A small and resident population area for Bryde's whales identified by LaBrecque et al. (2015b) overlaps the Gulf of Mexico Range Complex within the Study Area. Navy training activities that use sonar and other transducers could occur year-round within the Gulf of Mexico Range Complex Range Complex; however, the quantitative analysis indicates no impacts on Bryde's whales in the Gulf of Mexico. Bryde's whales residing in this area could be exposed to sound from sonar; however, impacts on natural behaviors or abandonment of the area would not be anticipated within Bryde's whale small and resident population area identified by LaBrecque et al. (2015b). In addition to procedural mitigation that is implemented whenever and wherever active sonar activities occur, the Navy will limit its annual hours of hull-mounted mid-frequency active sonar within the newly developed Bryde's Whale Mitigation Area to further avoid or reduce potential impacts on this small and resident population (see Section 5.4.4, Mitigation Areas in the Gulf of Mexico).

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 Bryde's whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 1 may affect ESA-listed Bryde's whales. The Navy has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.

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

Bryde's whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-17 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple groups (see Table 3.7-15).

As described for other 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

A small and resident population area for Bryde's whales identified by LaBrecque et al. (2015b) overlaps the Gulf of Mexico Range Complex within the Study Area. Navy testing activities that use sonar and other transducers could occur year-round within the Gulf of Mexico Range Complex; however, the quantitative analysis indicates no impacts on Bryde's whales within these areas. Impacts on natural behaviors or abandonment of the area would not be anticipated within Bryde's whale small and resident population area identified by LaBrecque et al. (2015b). In addition to procedural mitigation that is implemented whenever and wherever active sonar activities occur, the Navy will limit its annual hours of hull-mounted mid-frequency active sonar within the newly developed Bryde's Whale Mitigation Area to further avoid or reduce potential impacts on this small and resident population (see Section 5.4.4, Mitigation Areas in the Gulf of Mexico).

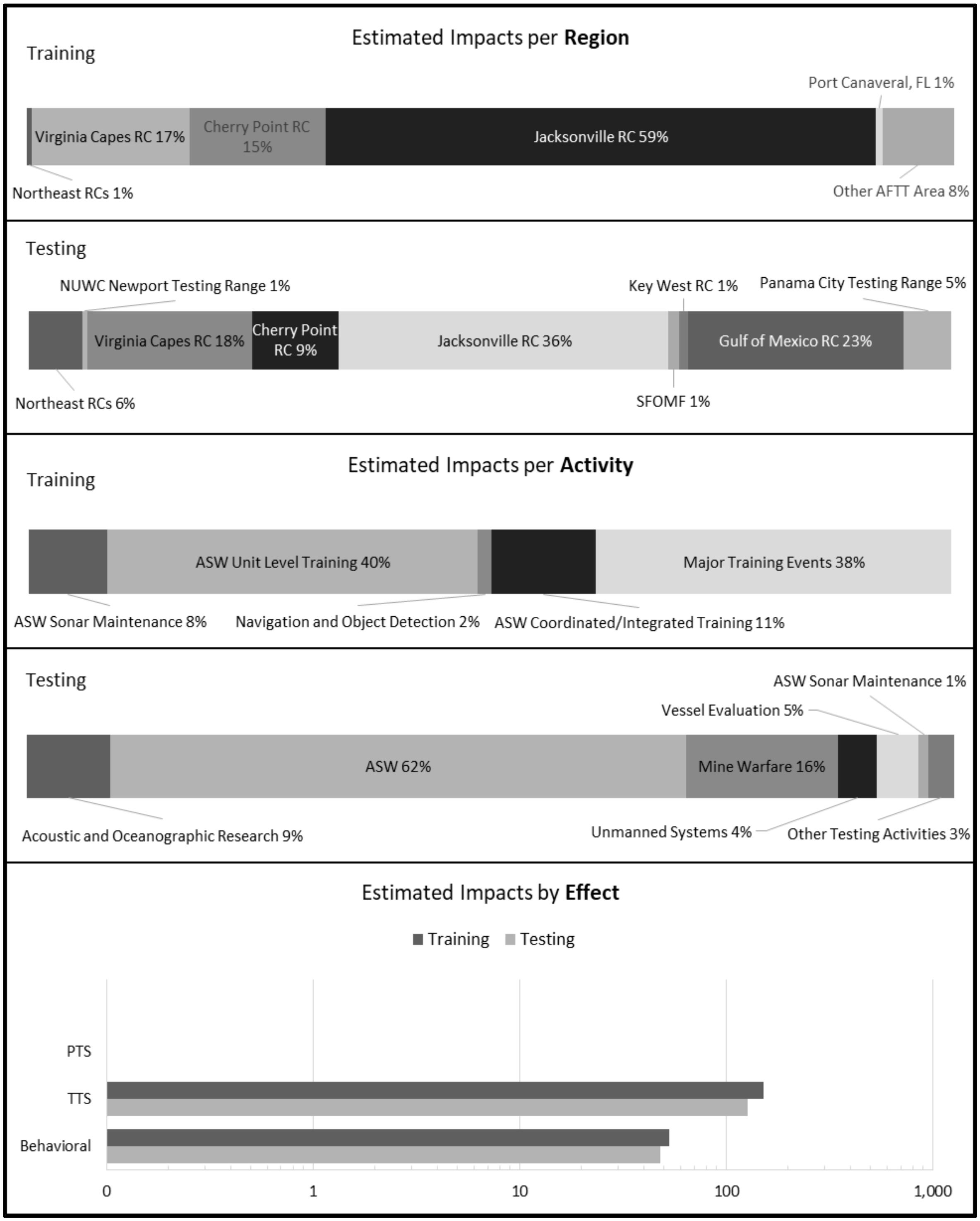
Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of Bryde's whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 1 may affect ESA-listed Bryde's whales. The Navy has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.

Table 3.7-15: Estimated Impacts on Individual Bryde's Whale Groups Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts per **Species' Group**		
Group	***Training***	***Testing***
Northern Gulf of Mexico	0%	29%
NSD	100%	71%

NSD: no stock designation



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-17: Bryde's Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

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

Bryde's whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-18 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple groups (see Table 3.7-16).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

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 Bryde's 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 Bryde's whales.

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

Bryde's whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-18 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple groups (see Table 3.7-16).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

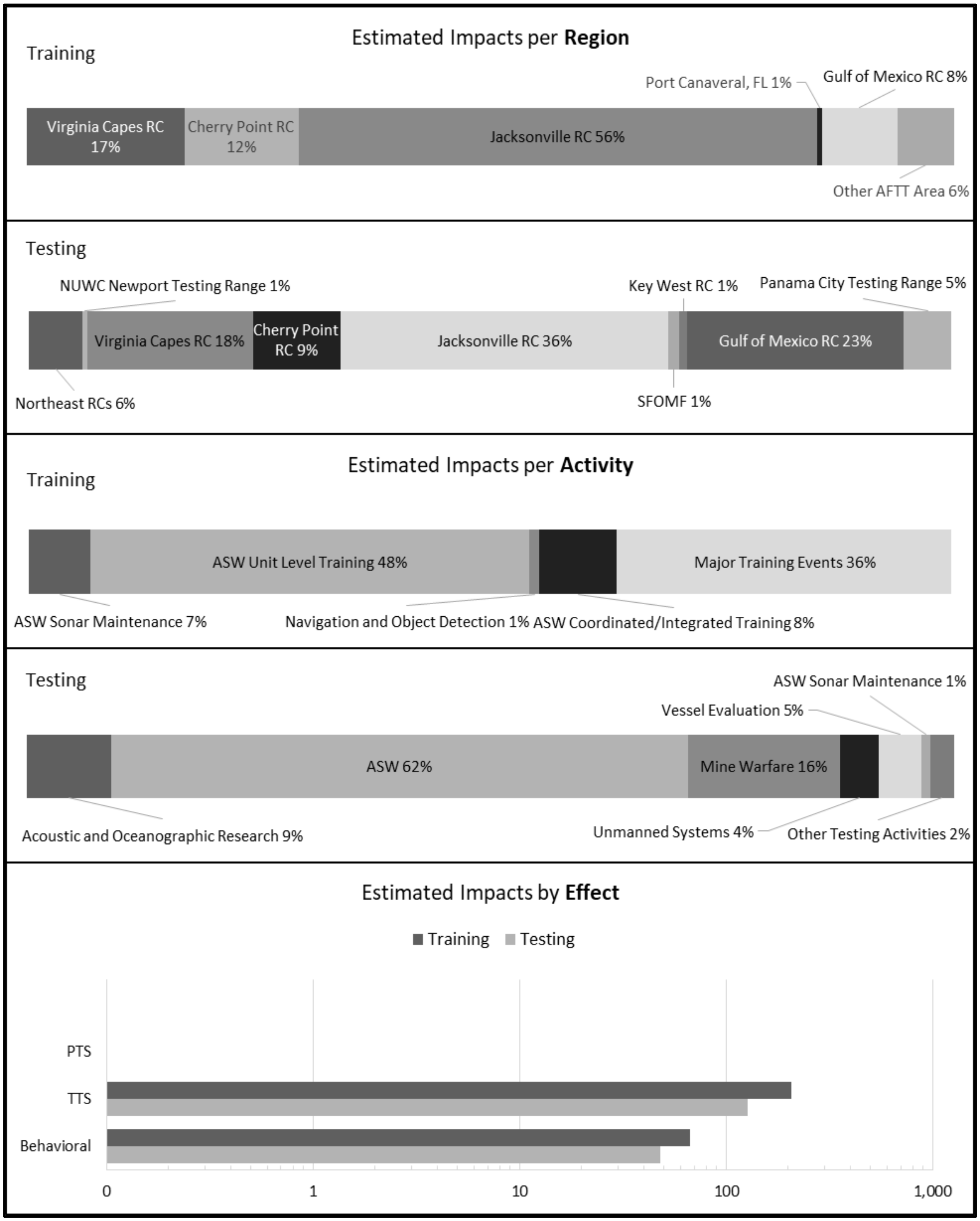
Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will result in the unintentional taking of Bryde's whales incidental to those activities.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 2 may affect ESA-listed Bryde's whales.

Table 3.7-16: Estimated Impacts on Individual Bryde's Whale Groups Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts per **Species' Group**		
Group	***Training***	***Testing***
Northern Gulf of Mexico	8%	29%
NSD	92%	71%

NSD: no stock designation



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-18: Bryde's Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing 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 sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-19 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

As described for other 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

The feeding areas for fin whales identified by LaBrecque et al. (2015a) overlap the Northeast Range Complexes within the Study Area. Navy training activities that use sonar and other transducers could occur year-round within the Northeast Range Complexes. Impacts on fin whale feeding behavior could occur in the fin whale feeding areas identified by LaBrecque et al. (2015a). As discussed above, fin whale reactions to sonar are most likely short term and mild to moderate; therefore, significant impacts on fin whale feeding behaviors are unlikely to occur within the feeding areas identified by LaBrecque et al. (2015a) from training with sonar and other transducers. In addition to procedural mitigation that is implemented whenever and wherever active sonar activities occur, the Navy will implement mitigation for active sonar within the Northeast North Atlantic Right Whale Mitigation Area. This will further avoid or reduce potential impacts on fin whale feeding behavior within two of the feeding areas identified by LaBrecque et al. (2015a) (see Section 5.4.2, Mitigation Areas off the Northeastern United States).

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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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 has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.

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

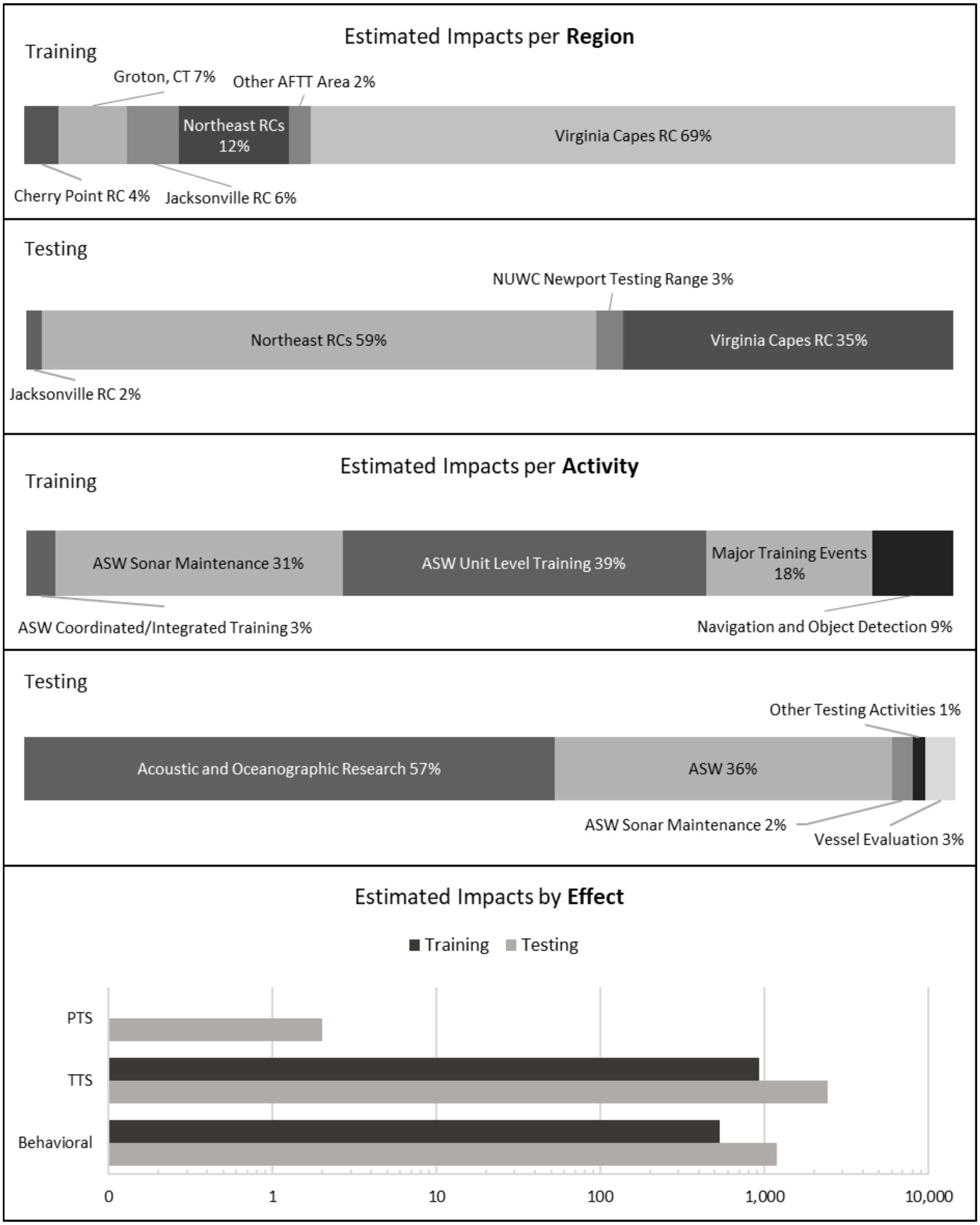
Fin whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions, TTS, and PTS under Alternative 1. See Figure 3.7-19 below or Appendix E (Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities) for tabular results. Impact ranges for this species are discussed in Section 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

As described for other 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. 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

The feeding areas for fin whales identified by LaBrecque et al. (2015a) overlap the Northeast Range Complexes within the Study Area. Navy testing activities that use sonar and other transducers could occur year-round within the Northeast Range Complexes. Impacts on fin whale feeding behavior could occur in the fin whale feeding areas identified by LaBrecque et al. (2015a). As discussed above, fin whale reactions to sonar reactions are most likely short term and mild to moderate to sonar; therefore, significant impacts on fin whale feeding behaviors are unlikely to occur within the feeding areas identified by LaBrecque et al. (2015a) from testing with sonar and other transducers. In addition to procedural mitigation that is implemented whenever and wherever active sonar activities occur, the Navy will implement mitigation for active sonar within the Northeast North Atlantic Right Whale Mitigation Area. This will further avoid or reduce potential impacts on fin whale feeding behavior within two of the feeding areas identified by LaBrecque et al. (2015a) (see Section 5.4.2, Mitigation Areas off the Northeastern United States).

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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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 has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. 100 percent western North Atlantic stock. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-19: Fin Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

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

Fin whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-20 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

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.

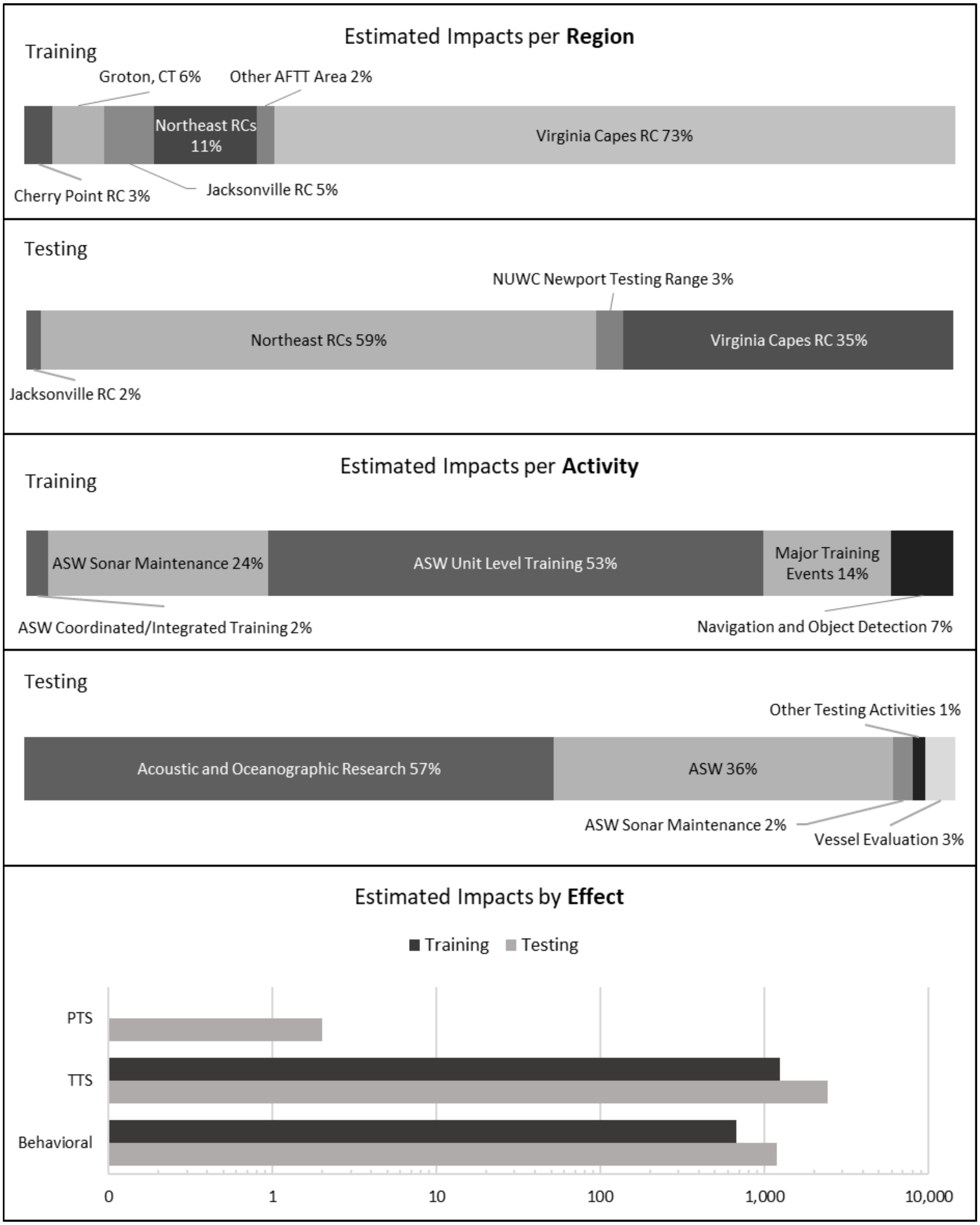
Impacts from Sonar and Other Transducers Under Alternative 2 for Testing Activities

Fin whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions, TTS, and PTS under Alternative 2. See Figure 3.7-20 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. 100 percent western North Atlantic stock. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-20: Fin Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Testing Under Alternative 2

Humpback Whales

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

Humpback whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-21 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the Gulf of Maine stock.

As described for other 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

The feeding area for humpback whales identified by LaBrecque et al. (2015a) overlaps the Northeast Range Complexes within the Study Area. Navy training activities that use sonar and other transducers could occur year-round within the Northeast Range Complexes. Impacts on humpback feeding behavior could occur in the humpback whale feeding area identified by LaBrecque et al. (2015a). As discussed above, humpback whale reactions to sonar are most likely short term and mild to moderate; therefore, significant impacts on humpback whale feeding behaviors are unlikely to occur within the feeding area identified by LaBrecque et al. (2015a) from training with sonar and other transducers. In addition to procedural mitigation that is implemented whenever and wherever active sonar activities occur, the Navy will implement mitigation for active sonar within the Northeast North Atlantic Right Whale Mitigation Area. This will further avoid or reduce potential impacts on humpback whale feeding behavior within the feeding area identified by LaBrecque et al. (2015a) (see Section 5.4.2, Mitigation Areas off the Northeastern United States).

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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Humpback whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-21 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the Gulf of Maine stock.

As described for other 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent Gulf of Maine stock. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-21: Humpback Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

The feeding area for humpback whales identified by LaBrecque et al. (2015a) overlaps the Northeast Range Complexes within the Study Area. Navy testing activities that use sonar and other transducers could occur year-round within the Northeast Range Complexes. Impacts on humpback feeding behavior could occur in the humpback whale feeding area identified by LaBrecque et al. (2015a). As discussed above, humpback whale reactions to sonar are most likely short term and mild to moderate; therefore, significant impacts on humpback whale feeding behaviors are unlikely to occur within the feeding area identified by LaBrecque et al. (2015a) from testing with sonar and other transducers. In addition to procedural mitigation that is implemented whenever and wherever active sonar activities occur, the Navy will implement mitigation for active sonar within the Northeast North Atlantic Right Whale Mitigation Area. This will further avoid or reduce potential impacts on humpback whale feeding behavior within the feeding area identified by LaBrecque et al. (2015a) (see Section 5.4.2, Mitigation Areas off the Northeastern United States).

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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Humpback whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-22 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the Gulf of Maine stock.

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

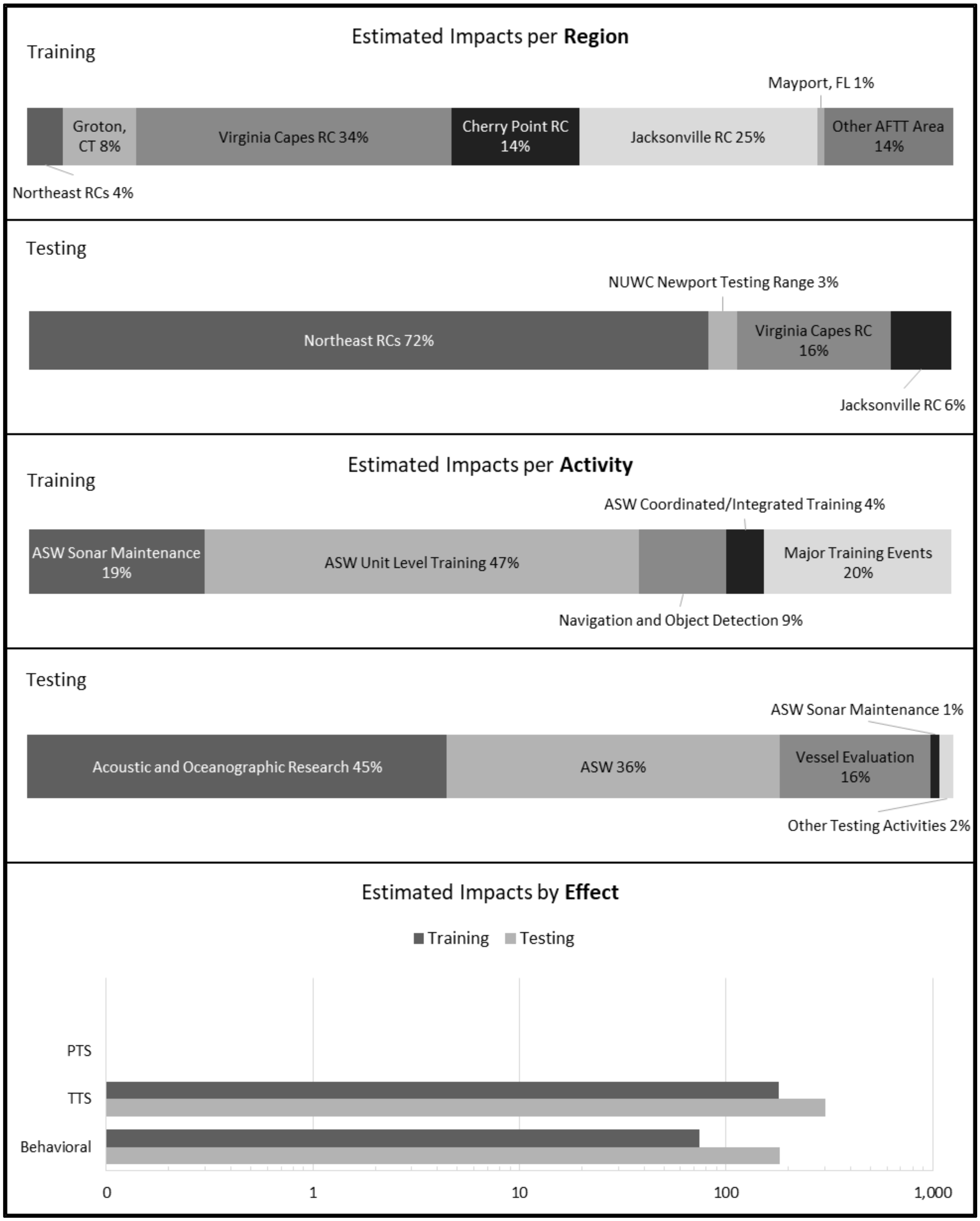
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of humpback whales incidental to those activities.

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

Humpback whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-22 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the Gulf of Maine stock.

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent Gulf of Maine stock. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-22: Humpback Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Minke Whales

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

Minke whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-23 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the Canadian East Coast stock.

As described for other 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

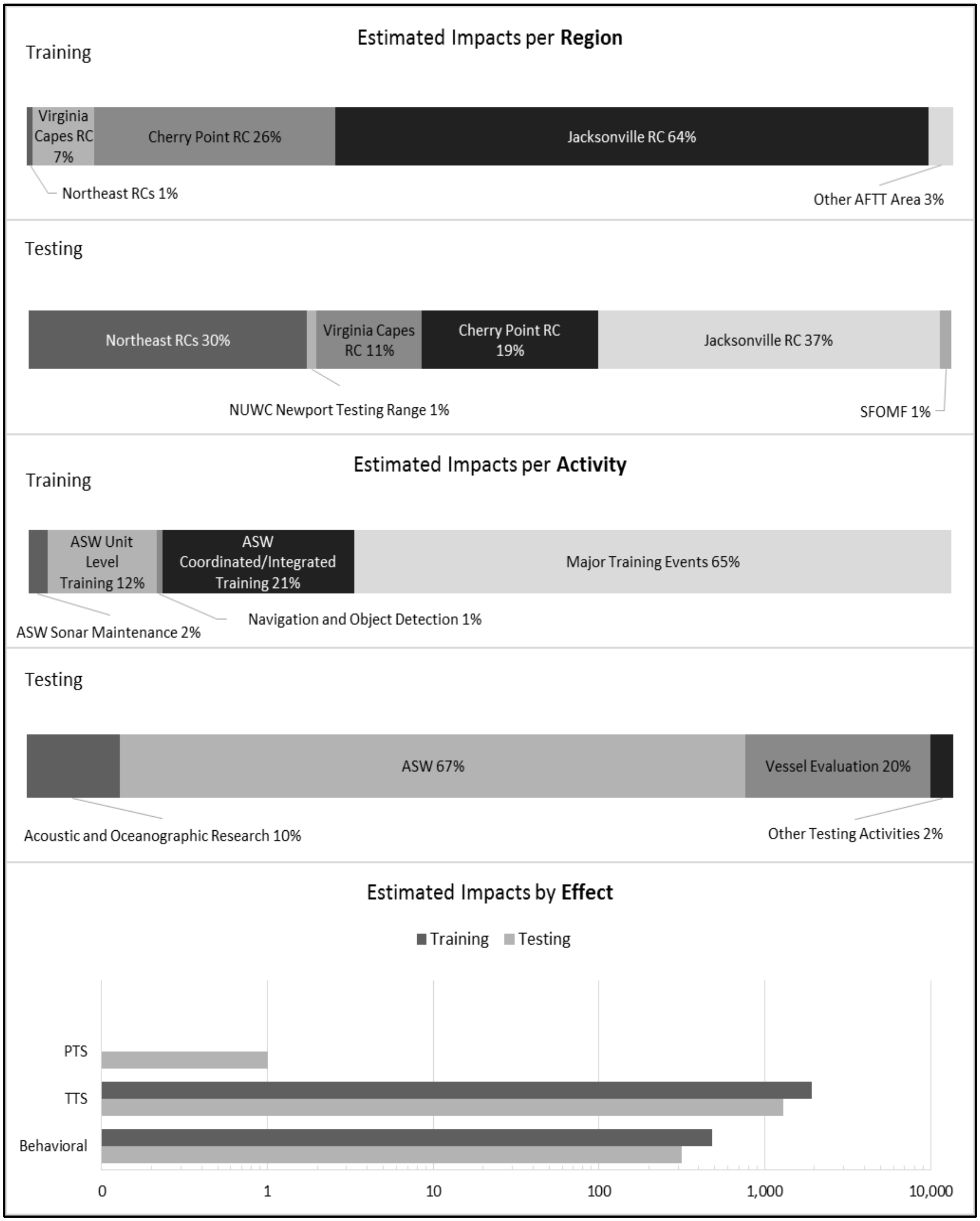
The feeding areas for minke whales identified by LaBrecque et al. (2015a) overlap the Northeast Range Complexes within the Study Area. Navy training activities that use sonar and other transducers could occur year-round within the Northeast Range Complexes. Impacts on minke feeding behavior could occur in the minke whale feeding areas identified by LaBrecque et al. (2015a). As discussed above, minke whale reactions to sonar are most likely short term and moderate; therefore, only few impacts on minke whale feeding behaviors are likely to occur within the feeding areas identified by LaBrecque et al. (2015a) from training with sonar and other transducers. In addition to procedural mitigation that is implemented whenever and wherever active sonar activities occur, the Navy will implement mitigation for active sonar within the Northeast North Atlantic Right Whale Mitigation Area. This will further avoid or reduce potential impacts on minke whale feeding behavior within the feeding areas identified by LaBrecque et al. (2015a) (see Section 5.4.2, Mitigation Areas off the Northeastern United States).

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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Minke Whales 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 under Alternative 1. See Figure 3.7-23 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the Canadian East Coast stock.

As described for other 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. PTS could reduce an animal's ability to detect biologically important sounds. 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent Canadian East Coast stock. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-23: Minke Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

The feeding areas for minke whales identified by LaBrecque et al. (2015a) overlap the Northeast Range Complexes within the Study Area. Navy testing activities that use sonar and other transducers could occur year-round within the Northeast Range Complexes. Impacts on minke feeding behavior could occur in the minke whale feeding areas identified by LaBrecque et al. (2015a). As discussed above, minke whale reactions to sonar are most likely short term and moderate; therefore, only few impacts on minke whale feeding behaviors are likely to occur within the feeding areas identified by LaBrecque et al. (2015a) from testing with sonar and other transducers. In addition to procedural mitigation that is implemented whenever and wherever active sonar activities occur, the Navy will implement mitigation for active sonar within the Northeast North Atlantic Right Whale Mitigation Area. This will further avoid or reduce potential impacts on minke whale feeding behavior within the feeding areas identified by LaBrecque et al. (2015a) (see Section 5.4.2, Mitigation Areas off the Northeastern United States).

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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Minke whales 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 under Alternative 2. See Figure 3.7-24 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the Canadian East Coast stock.

Potential PTS is estimated under Alternative 2, unlike under Alternative 1. Otherwise, potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1. PTS could reduce an animal's ability to detect biologically important sounds. 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.

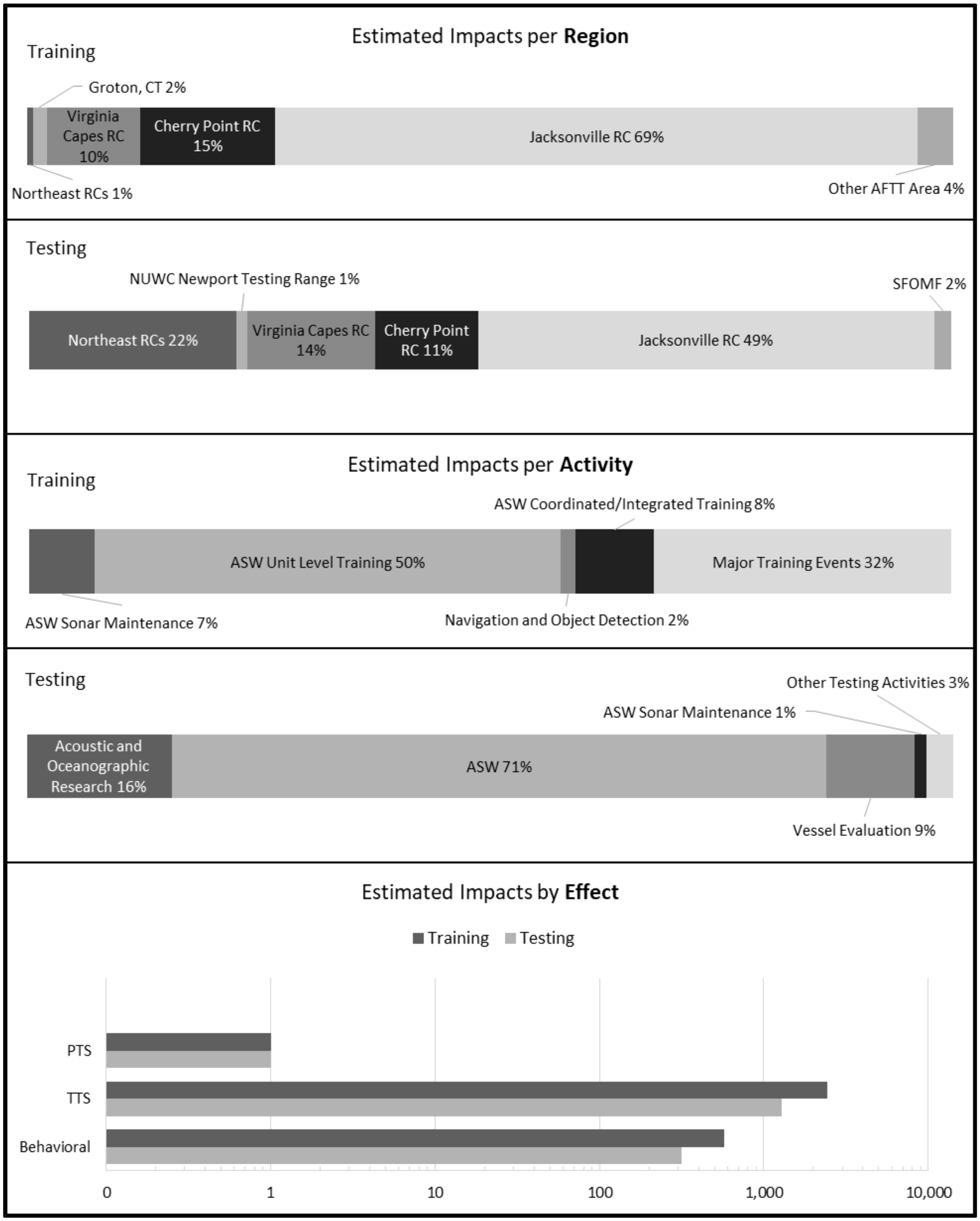
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of minke whales incidental to those activities.

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

Minke Whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions, TTS, and PTS under Alternative 2. See Figure 3.7-24 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the Canadian East Coast stock.

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent Canadian East Coast stock. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-24: Minke Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing 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 sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-25 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the Nova Scotia stock.

As described for other 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

The feeding area for sei whales identified by LaBrecque et al. (2015a) overlaps the Northeast Range Complexes within the Study Area. Navy training activities that use sonar and other transducers could occur year-round within the Northeast Range Complexes. Impacts on sei feeding behavior could occur in the sei whale feeding area identified by LaBrecque et al. (2015a). As discussed above, sei whale reactions to sonar are most likely short term and mild to moderate; therefore, significant impacts on sei whale feeding behaviors are unlikely to occur within the feeding area identified by LaBrecque et al. (2015a) from training with sonar and other transducers. In addition to procedural mitigation that is implemented whenever and wherever active sonar activities occur, the Navy will implement mitigation for active sonar within the Northeast North Atlantic Right Whale Mitigation Area. This will further avoid or reduce potential impacts on sei whale feeding behavior within the feeding area identified by LaBrecque et al. (2015a) (see Section 5.4.2, Mitigation Areas off the Northeastern United States).

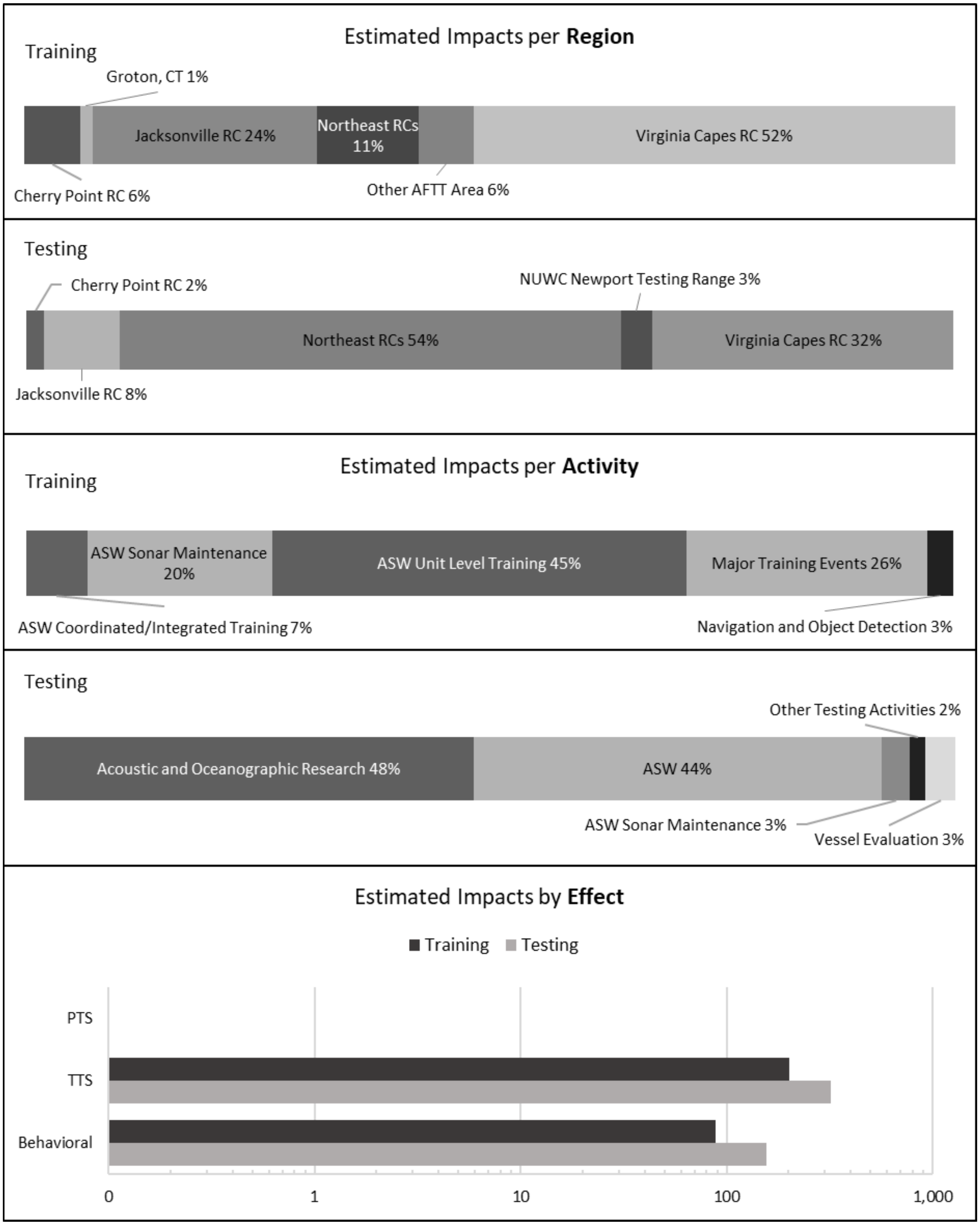
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of sei whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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 has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.

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

Sei whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-25 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the Nova Scotia stock.

As described for other 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent Nova Scotia stock. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-25: Sei Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

The feeding area for sei whales identified by LaBrecque et al. (2015a) overlaps the Northeast Range Complexes within the Study Area. Navy testing activities that use sonar and other transducers could occur year-round within the Northeast Range Complexes. Impacts on sei feeding behavior could occur in the sei whale feeding area identified by LaBrecque et al. (2015a). As discussed above, sei whale reactions to sonar are most likely short term and mild to moderate; therefore, significant impacts on sei whale feeding behaviors are unlikely to occur within the feeding area identified by LaBrecque et al. (2015a) from testing with sonar and other transducers. In addition to procedural mitigation that is implemented whenever and wherever active sonar activities occur, the Navy will implement mitigation for active sonar within the Northeast North Atlantic Right Whale Mitigation Area. This will further avoid or reduce potential impacts on sei whale feeding behavior within the feeding area identified by LaBrecque et al. (2015a) (see Section 5.4.2, Mitigation Areas off the Northeastern United States).

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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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 has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.

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

Sei whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-26 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the Nova Scotia stock.

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

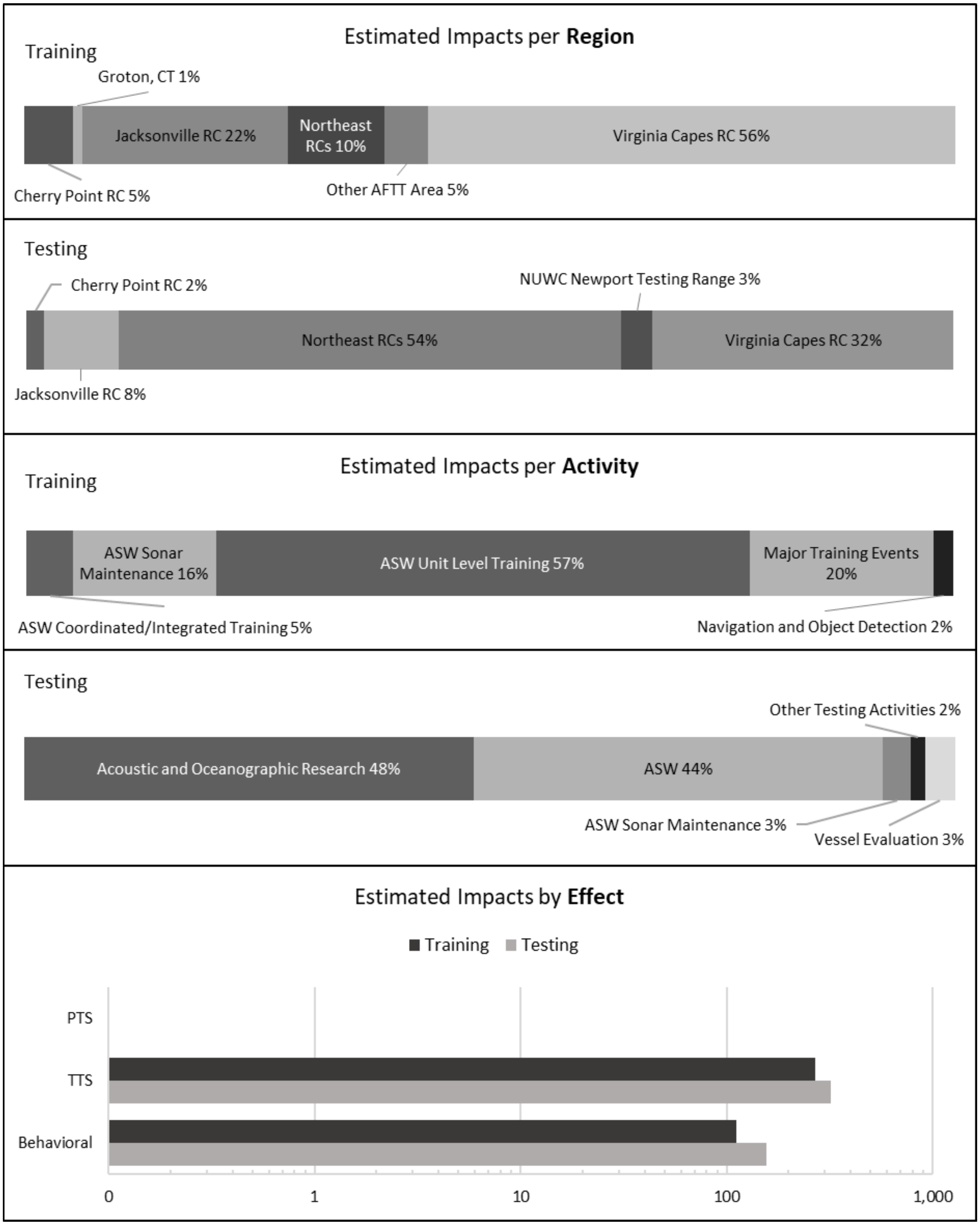
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of sei whales incidental to those activities.

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 sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-26 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the Nova Scotia stock.

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent Nova Scotia stock. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-26: Sei Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing 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.

Odontocetes

Odontocetes may be exposed to sound from sonar and other transducers associated with training activities throughout the year. Low- (less than 1 kHz), mid- (1 to 10 kHz), high-frequency (10 to 100 kHz), and very-high-frequency (100 to 200 kHz) sonars produce sounds that are likely to be within the audible range of odontocetes (see Section 3.7.2.1.4, 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 3.7.3.1.2.2 (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. On the other hand, harbor porpoises and beaked whales have generally demonstrated a high level of sensitivity to human made sound and disturbance. 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 3.7.3.1.1.5, 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 activities 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 activities 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 vessel). 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 3.7.3.1.1.5, 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 training and testing activities 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. 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.

Some odontocetes may avoid larger activities such as a major training exercise as it moves through an area, although these activities typically do not use the same training locations day-after-day during multi-day activities. Sensitive species of odontocetes, such as beaked whales, may avoid the area for the duration of the event. Section 3.7.3.1.1.5 (Behavioral Reactions) discusses these species' observed reactions to sonar and other active acoustic sources. Displaced animals would likely return after the sonar activity subsides within an area, as seen in Blainville's beaked whales in the Bahamas (Tyack et al., 2011) and Hawaii (Henderson et al., 2015; Henderson et al., 2016; Manzano-Roth et al., 2016). This would allow the animal to recover from any energy expenditure or missed resources, reducing the likelihood of long-term consequences for the individual. It is unlikely that most animals would encounter a major training exercise more than once per year due to where major training exercises are typically conducted. Outside of Navy instrumented ranges and homeports, the use of sonar and other active acoustic sources is transient and is unlikely to expose the same population of animals repeatedly over a short period. However, a few behavioral reactions per year from a single individual are unlikely to produce long-term consequences for that individual.

Behavioral research indicates that most odontocetes avoid sound sources at levels that would cause any temporary hearing loss (i.e., TTS) (see Section 3.7.3.1.1.5, 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 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 harbor porpoise 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 3.7.3.1.1.4 (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.

Sperm Whales (Endangered Species Act-Listed)

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

Sperm whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-27 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-17).

As described for other 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 will 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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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 has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.

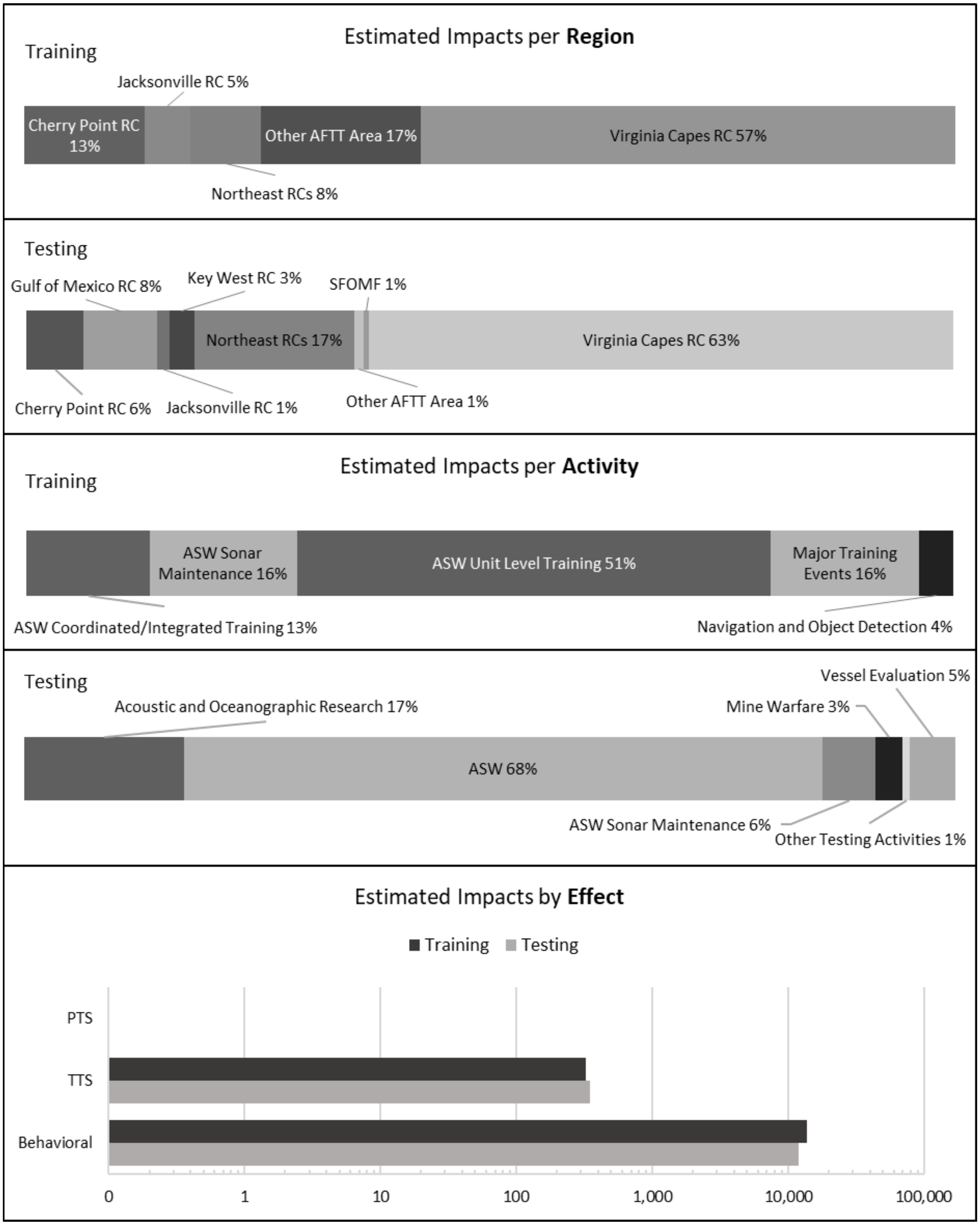
Impacts from Sonar and Other Transducers Under Alternative 1 for Testing Activities

Sperm whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-27 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-17)

As described for other 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 will 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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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 has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-27: Sperm Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.7-17: 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 per **Species' Stock**		
Stock	***Training***	***Testing***
Gulf of Mexico Oceanic	0%	9%
North Atlantic	100%	91%

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

Sperm whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-28 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-18).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

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.

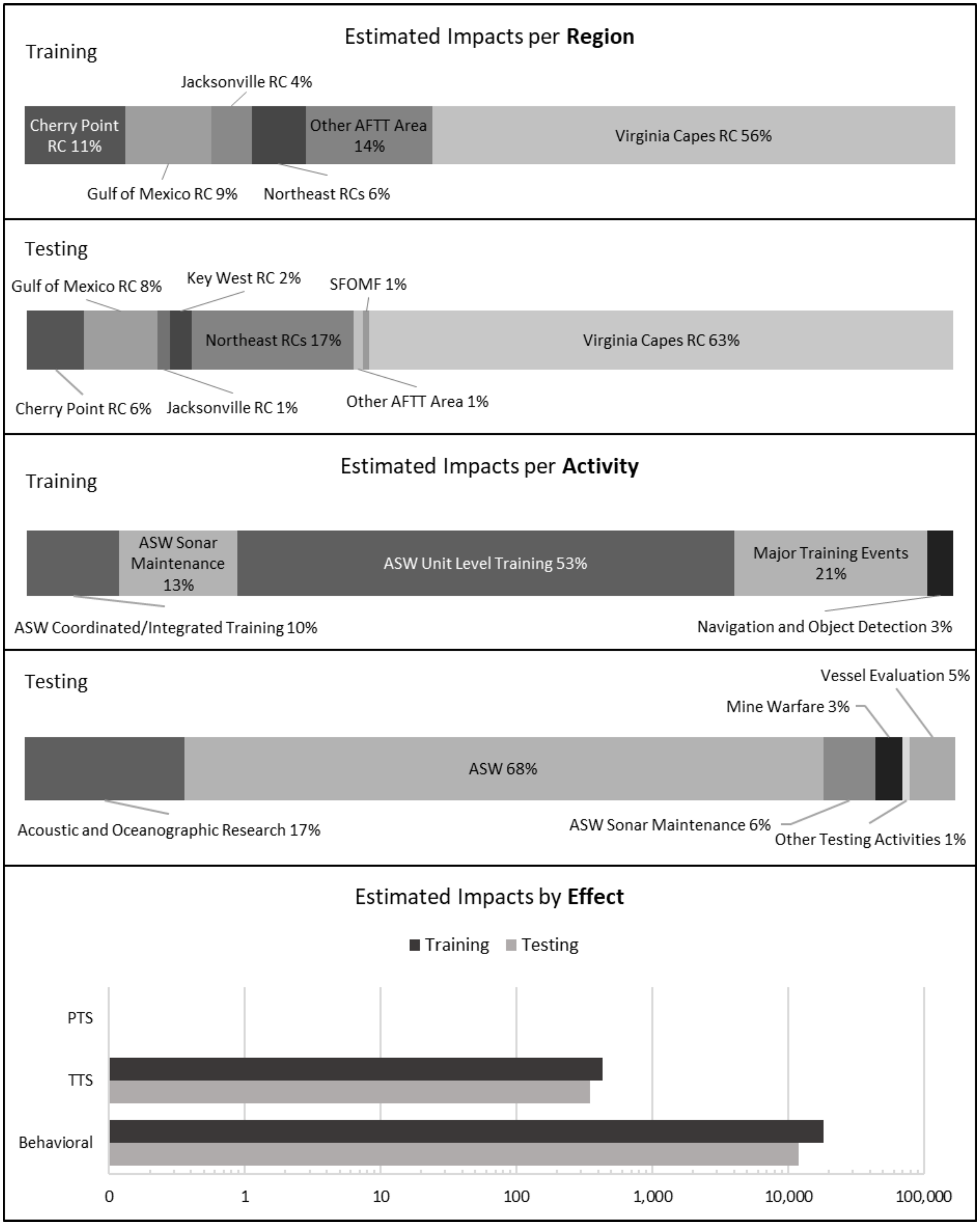
Impacts from Sonar and Other Transducers Under Alternative 2 for Testing Activities

Sperm whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-28 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-18).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-28: Sperm Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Testing Under Alternative 2

Table 3.7-18: 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 per **Species' Stock**		
Stock	***Training***	***Testing***
Gulf of Mexico Oceanic	9%	9%
North Atlantic	91%	91%

Kogia Whales

Kogia whales include two species that are often difficult to distinguish from one another: dwarf sperm whales and pygmy sperm whales.

The quantitative analysis predicts a few PTS per year; however, as discussed above for odontocetes overall, Kogia whales would likely avoid sound levels that could cause higher levels of TTS (greater than 20 dB) or PTS. TTS and PTS thresholds for high-frequency cetaceans, including Kogia whales, 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). Kogia whales that do experience hearing loss (i.e., TTS or PTS) from sonar sounds may have reduced ability to detect biologically important sounds until their hearing recovers. TTS would be recoverable and PTS would leave some residual hearing loss. During the period that a Kogia whale had hearing loss, biologically important sounds could be more difficult to detect or interpret. Odontocetes, including Kogia whales, use echolocation clicks to find and capture prey. These echolocation clicks are at frequencies above a few tens of kHz in Kogia whales; therefore, a threshold shift at lower frequencies is unlikely to affect echolocation and should not affect a Kogia whale's ability to locate prey or rate of feeding.

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

Kogia whales 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 3.7-29 and Figure 3.7-30 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-19 and Table 3.7-20).

A few minor to moderate TTS or short-term 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, 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 stocks. Considering these factors and the mitigation measures that will 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 (dwarf sperm whales and pygmy sperm whales) incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Kogia whales 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 3.7-29 and Figure 3.7-30 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-19 and Table 3.7-20).

A few minor to moderate TTS or short-term 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, 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 stocks. Considering these factors and the mitigation measures that will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

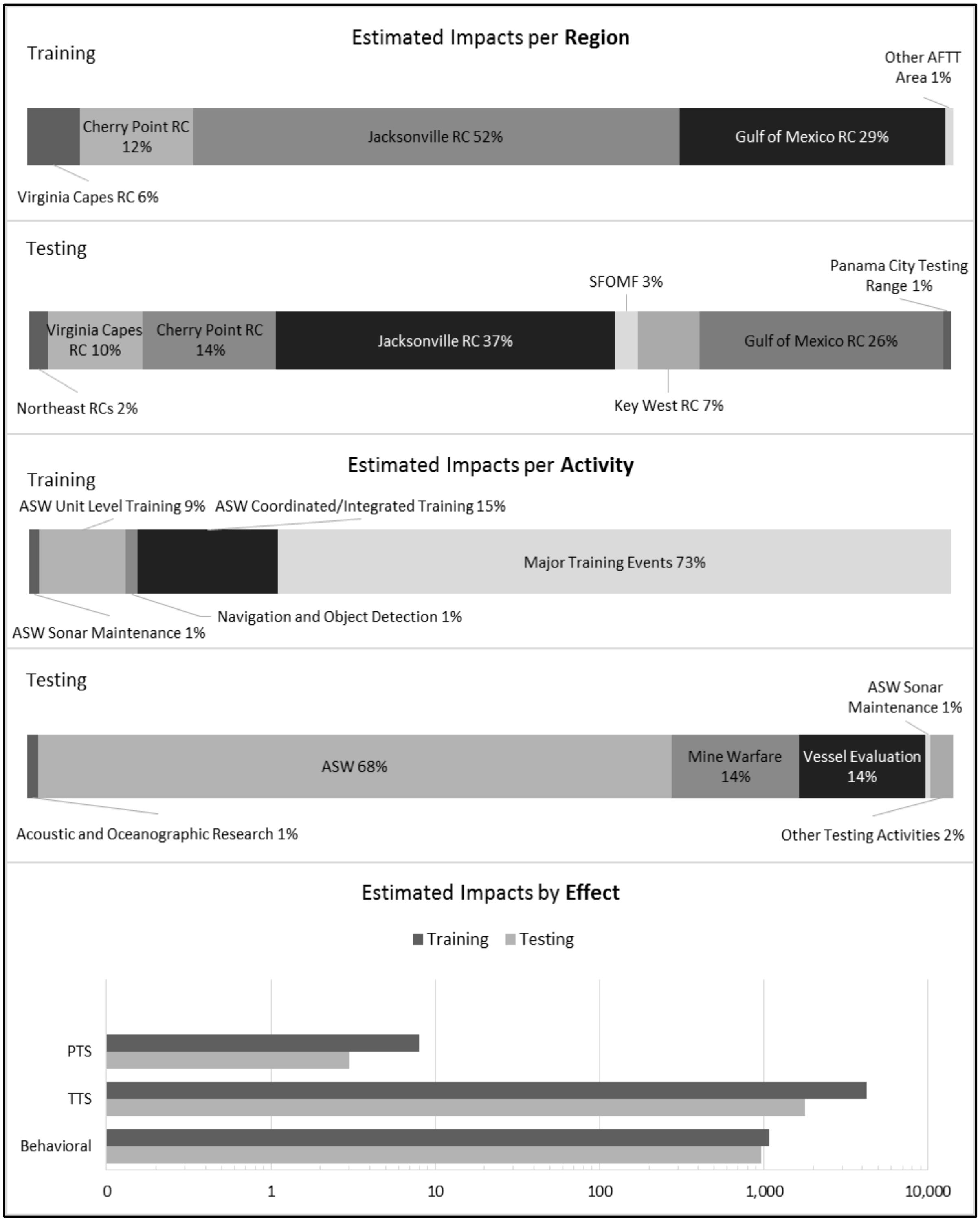
Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will result in the unintentional taking of Kogia whales (dwarf sperm whales and pygmy sperm whales) incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Table 3.7-19: Estimated Impacts on Individual Dwarf Sperm Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Gulf of Mexico Oceanic	29%	29%
Western North Atlantic	71%	71%

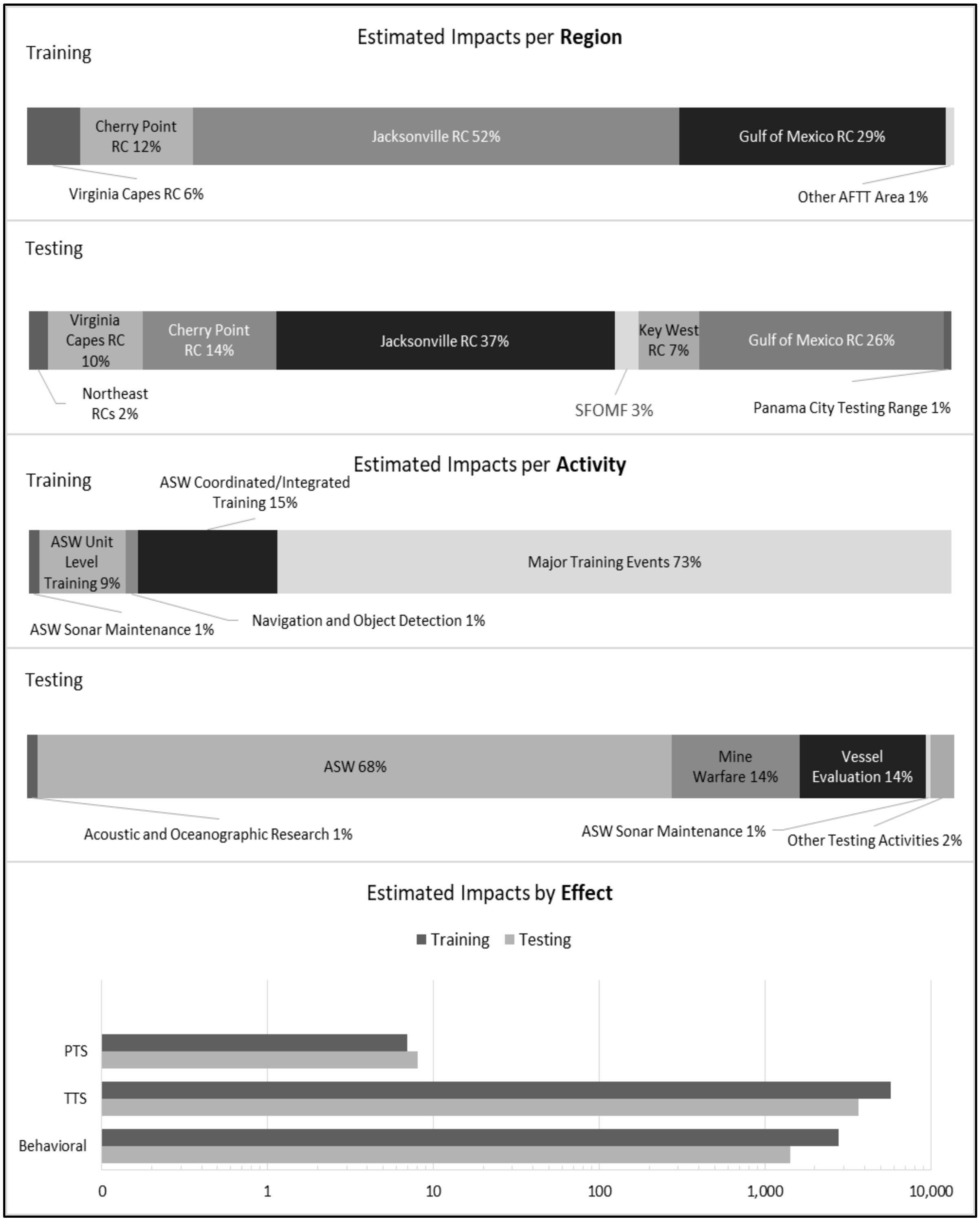
Table 3.7-20: Estimated Impacts on Individual Pygmy Sperm Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	29%	29%
Western North Atlantic	71%	71%



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-29: Dwarf Sperm Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-30: Pygmy Sperm Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

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

Kogia whales 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 3.7-31 and Figure 3.7-32 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-21 and Table 3.7-22).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

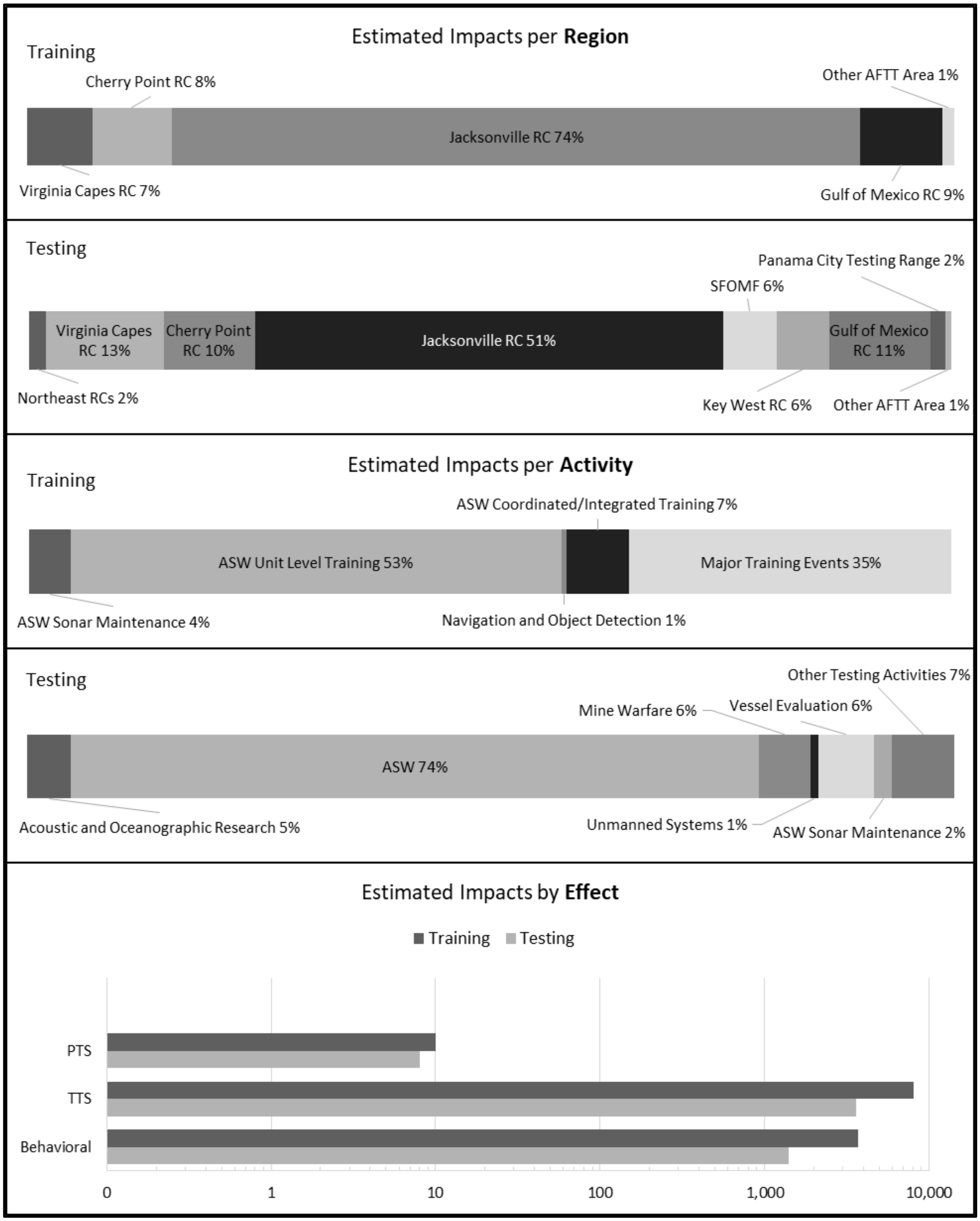
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of Kogia whales (dwarf sperm whales and pygmy sperm whales) incidental to those activities.

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

Kogia whales may be exposed to 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 3.7-31 and Figure 3.7-32 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-21 and Table 3.7-22).

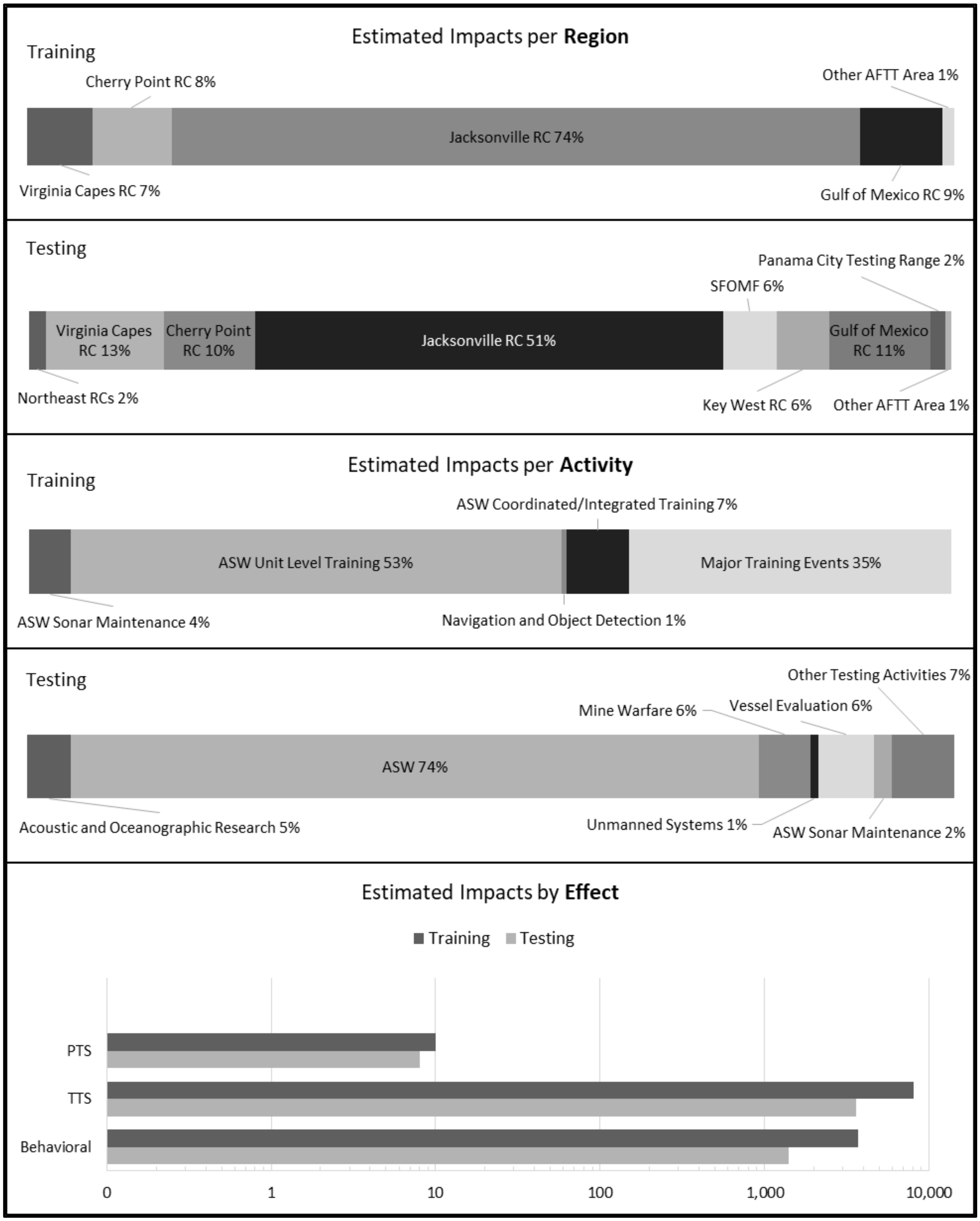
Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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 (dwarf sperm whales and pygmy sperm whales) incidental to those activities.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-31: Dwarf Sperm Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-32: Pygmy Sperm Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.7-21: Estimated Impacts on Individual Dwarf Sperm Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Gulf of Mexico Oceanic	9%	14%
Western North Atlantic	91%	86%

Table 3.7-22: Estimated Impacts on Individual Pygmy Sperm Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	9%	14%
Western North Atlantic	91%	86%

Beaked Whales

Beaked whales are a group of species which within the AFTT Study Area includes: Cuvier's beaked whales, True's beaked whales, Gervais' beaked whales, Sowerby's beaked whales, Blainville's beaked whales, and Northern bottlenose whales.

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 to 20 dB). Specifically for beaked whales, behavioral response research discussed below and in Section 3.7.3.1.1.5 (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 (3.7.3.1.1.5, Behavioral Reactions) show that if beaked whales are exposed to sonar or other active acoustic sources 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., 2015; 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. 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 active acoustic 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 sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-33 through Figure 3.7-38 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks for Blainville's beaked whales, Cuvier's beaked whales, and Gervais' beaked whales (Table 3.7-23 through Table 3.7-25) and for the western North Atlantic stock of the northern bottlenose whale, as well as Sowerby's and True's beaked whales.

As described for other 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

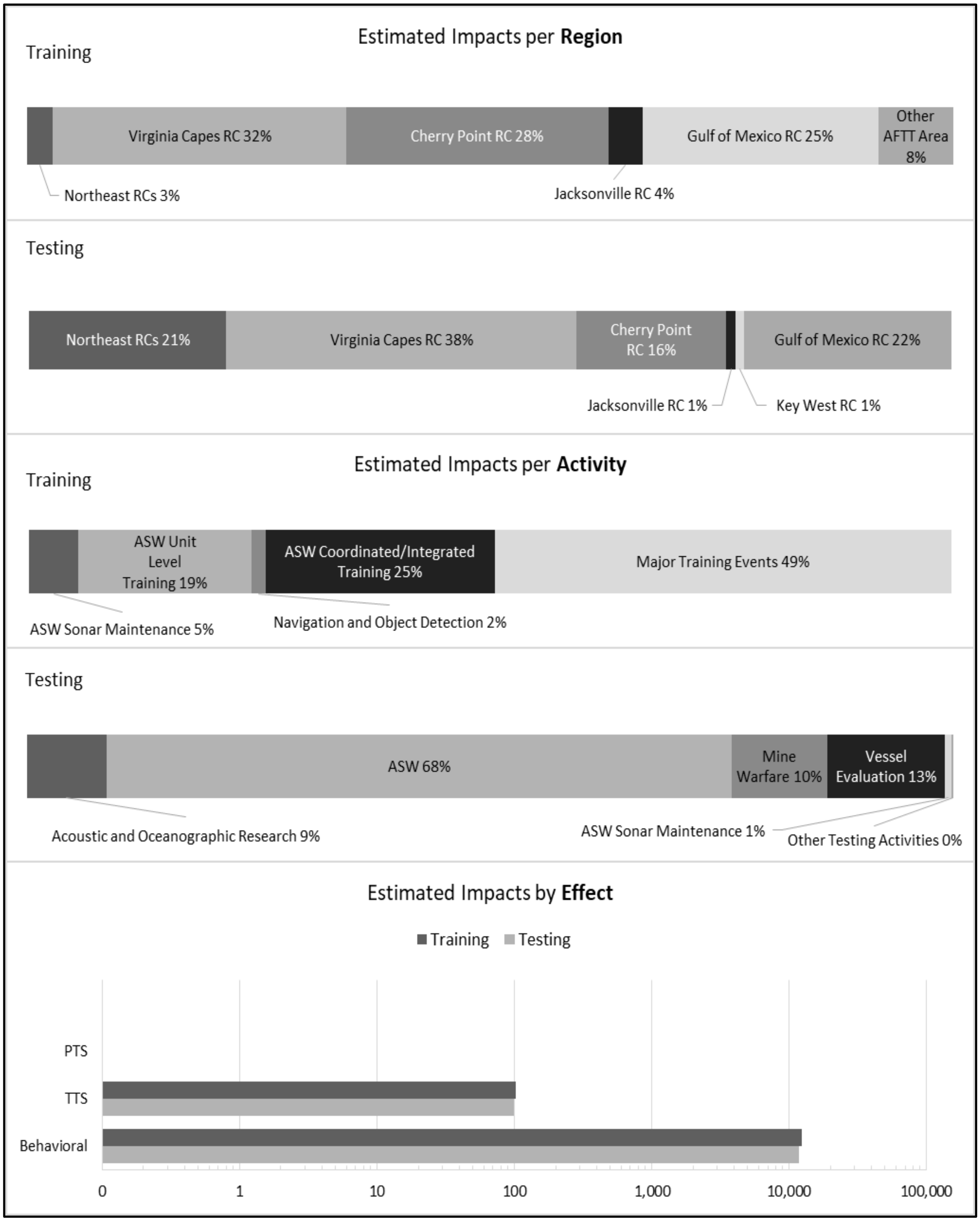
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of beaked whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Beaked whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-33 through Figure 3.7-38 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks for Blainville's beaked whales, Cuvier's beaked whales, and Gervais' beaked whales (Table 3.7-23 through Table 3.7-25) and for the western North Atlantic stock of the northern bottlenose whale, as well as Sowerby's and True's beaked whales.

As described for other 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 will 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 beaked whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species.
AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

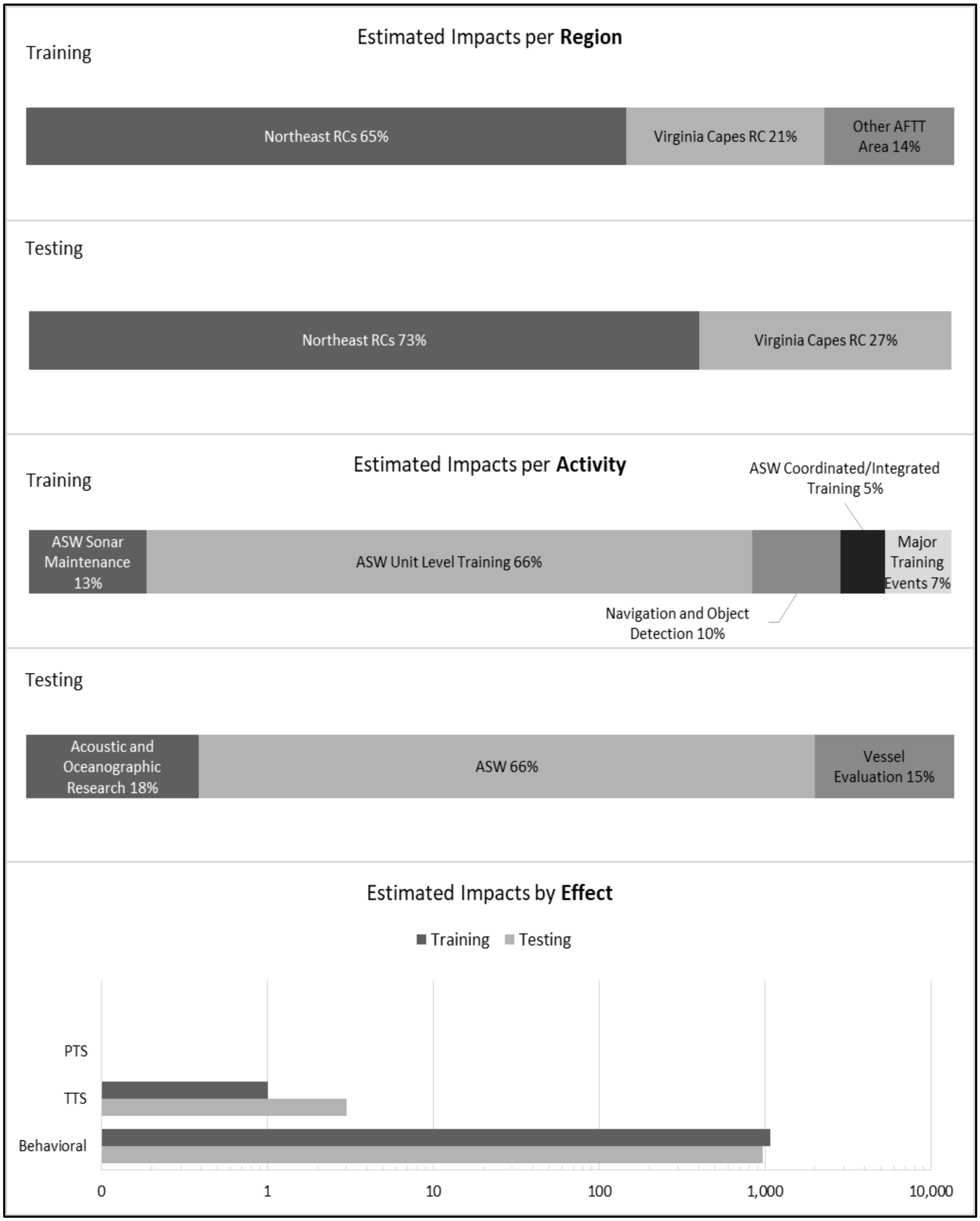
Figure 3.7-33: Blainville's Beaked Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-34: Cuvier's Beaked Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

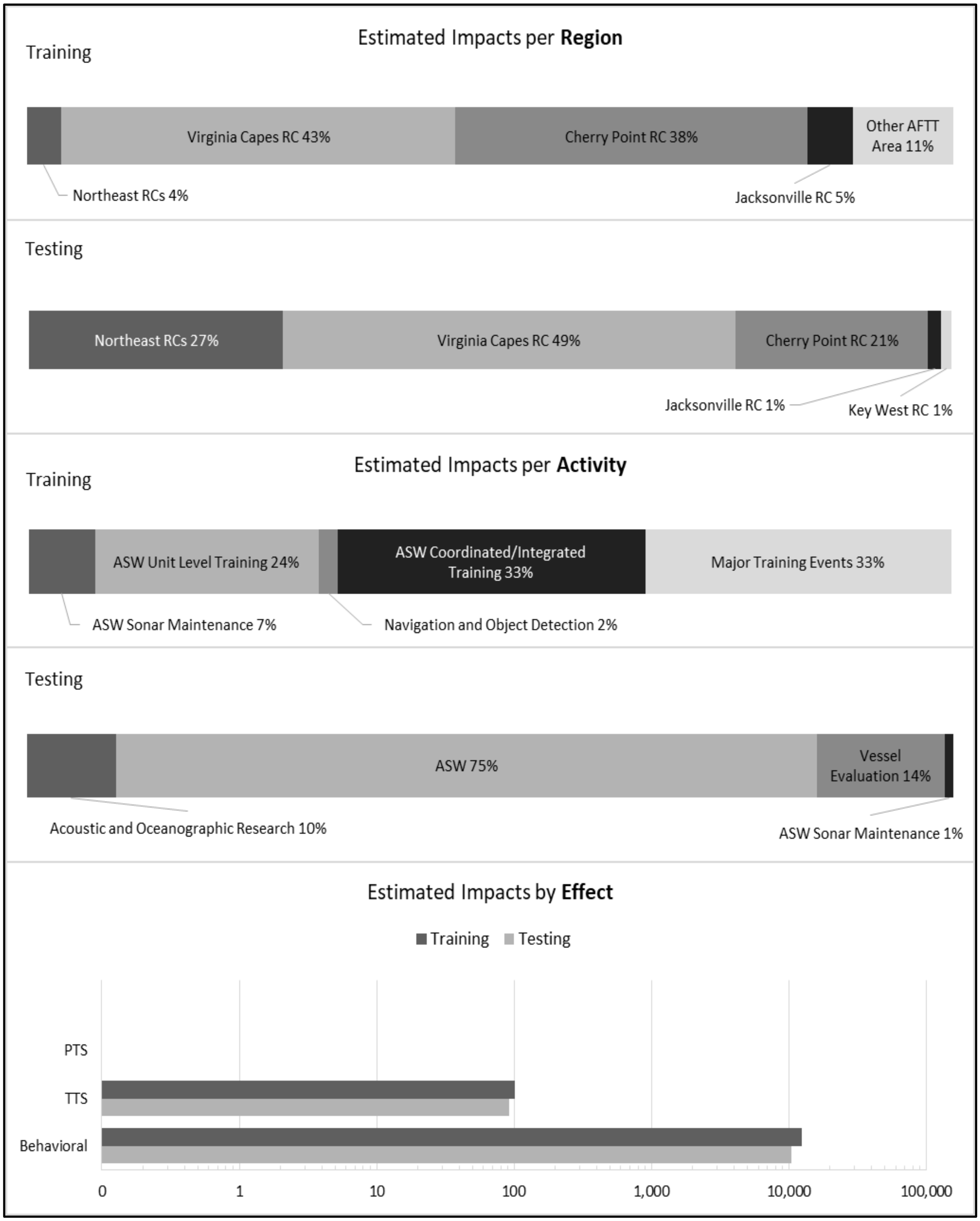
Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species.
AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-35: Gervais' Beaked Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1



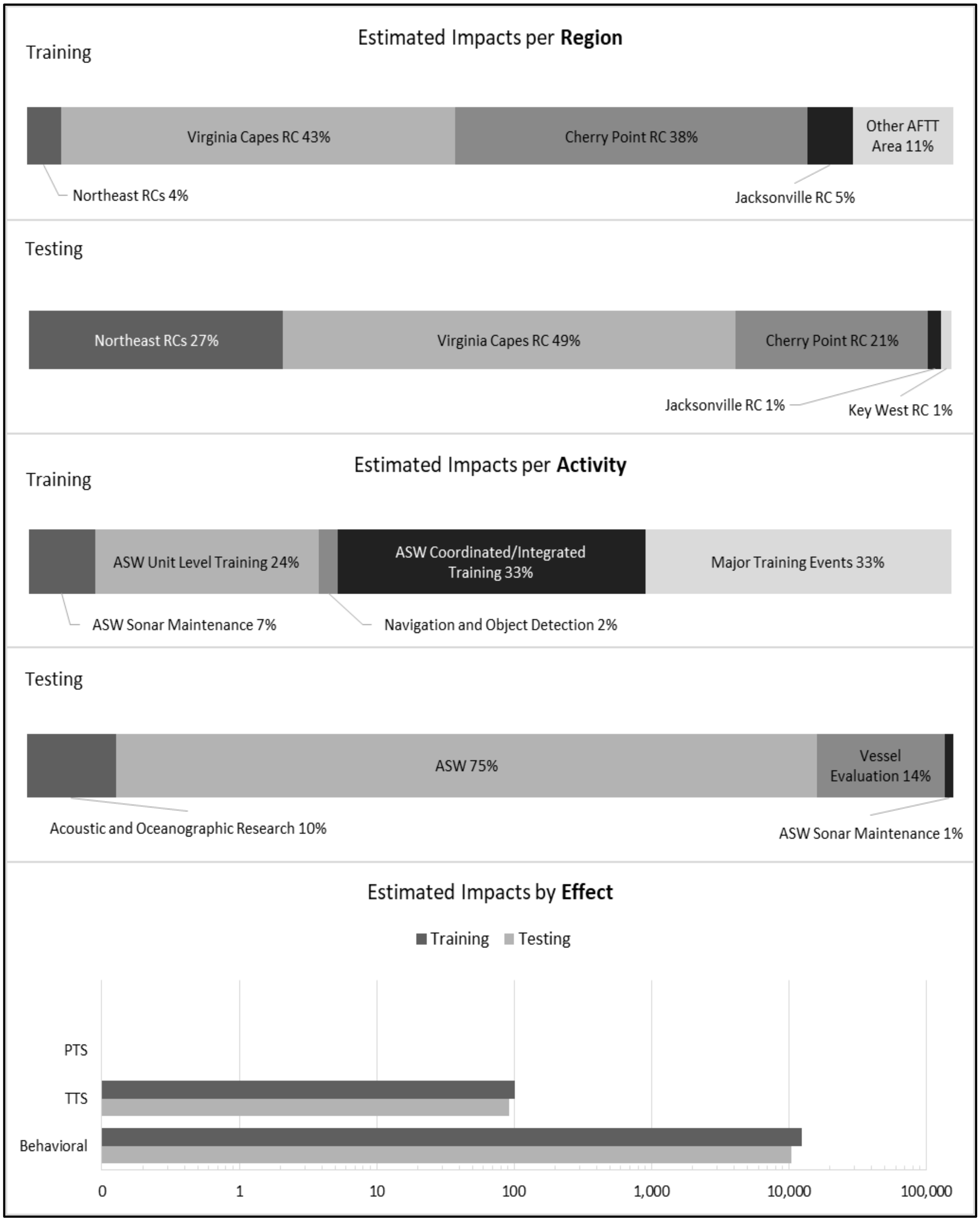
Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent western North Atlantic stock. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-36: Northern Bottlenose Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent western North Atlantic stock. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-37: Sowerby's Beaked Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent western North Atlantic stock. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-38: True's Beaked Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.7-23: Estimated Impacts on Individual Blainesville'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 per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	25%	23%
Western North Atlantic	75%	77%

Table 3.7-24: 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 per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	8%	8%
Western North Atlantic	92%	92%

Table 3.7-25: Estimated Impacts on Individual Gervais' Beaked Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	25%	23%
Western North Atlantic	75%	77%

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

Beaked whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-39 through Figure 3.7-44 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks for Blainville's beaked whales, Cuvier's beaked whales, and Gervais' beaked whales (Table 3.7-26 through Table 3.7-28) and for the western North Atlantic stock of the northern bottlenose whale, as well as Sowerby's and True's beaked whales.

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

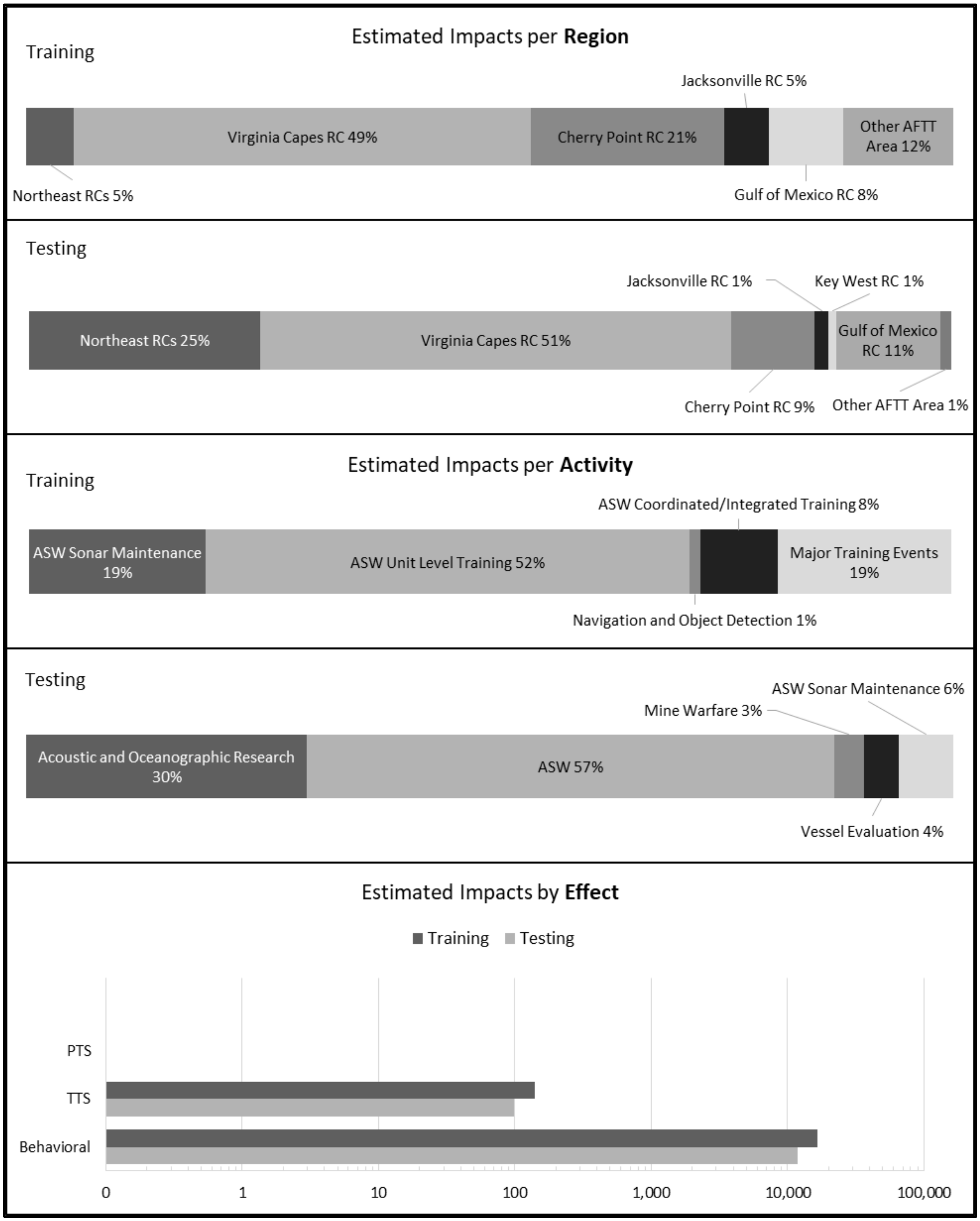
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of beaked whales incidental to those activities.

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

Beaked whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-39 through Figure 3.7-44 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks for Blainville's beaked whales, Cuvier's beaked whales, and Gervais' beaked whales (Table 3.7-26 through Table 3.7-28) and for the western North Atlantic stock of the northern bottlenose whale, as well as Sowerby's and True's beaked whales.

Potential impacts under Alternative 2 from Sonar and other Transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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 beaked whales incidental to those activities.

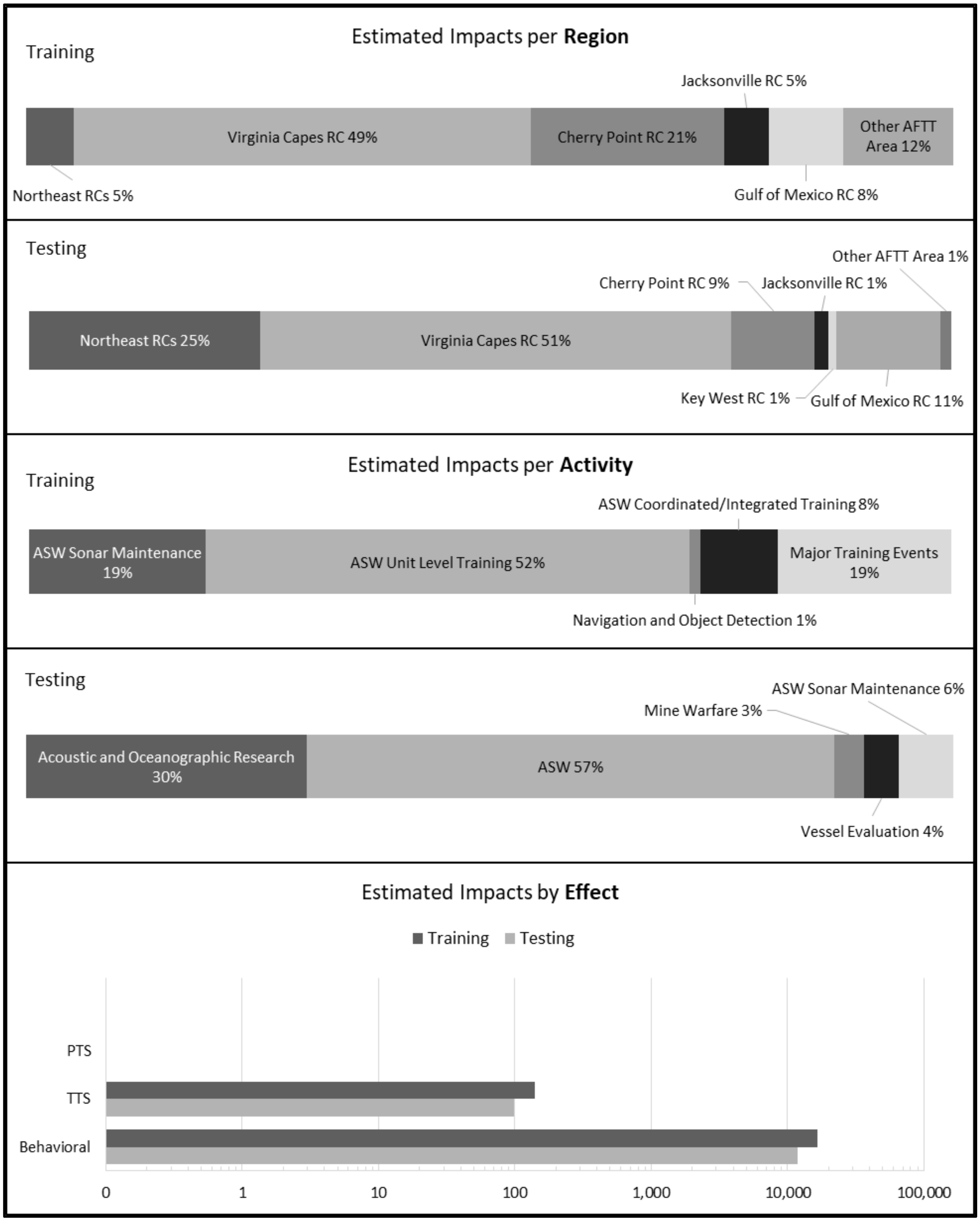


Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species.
AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-39: Blainville's Beaked Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-40: Cuvier's Beaked Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-41: Gervais' Beaked Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.7-26: Estimated Impacts on Individual Blainesville's Beaked Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

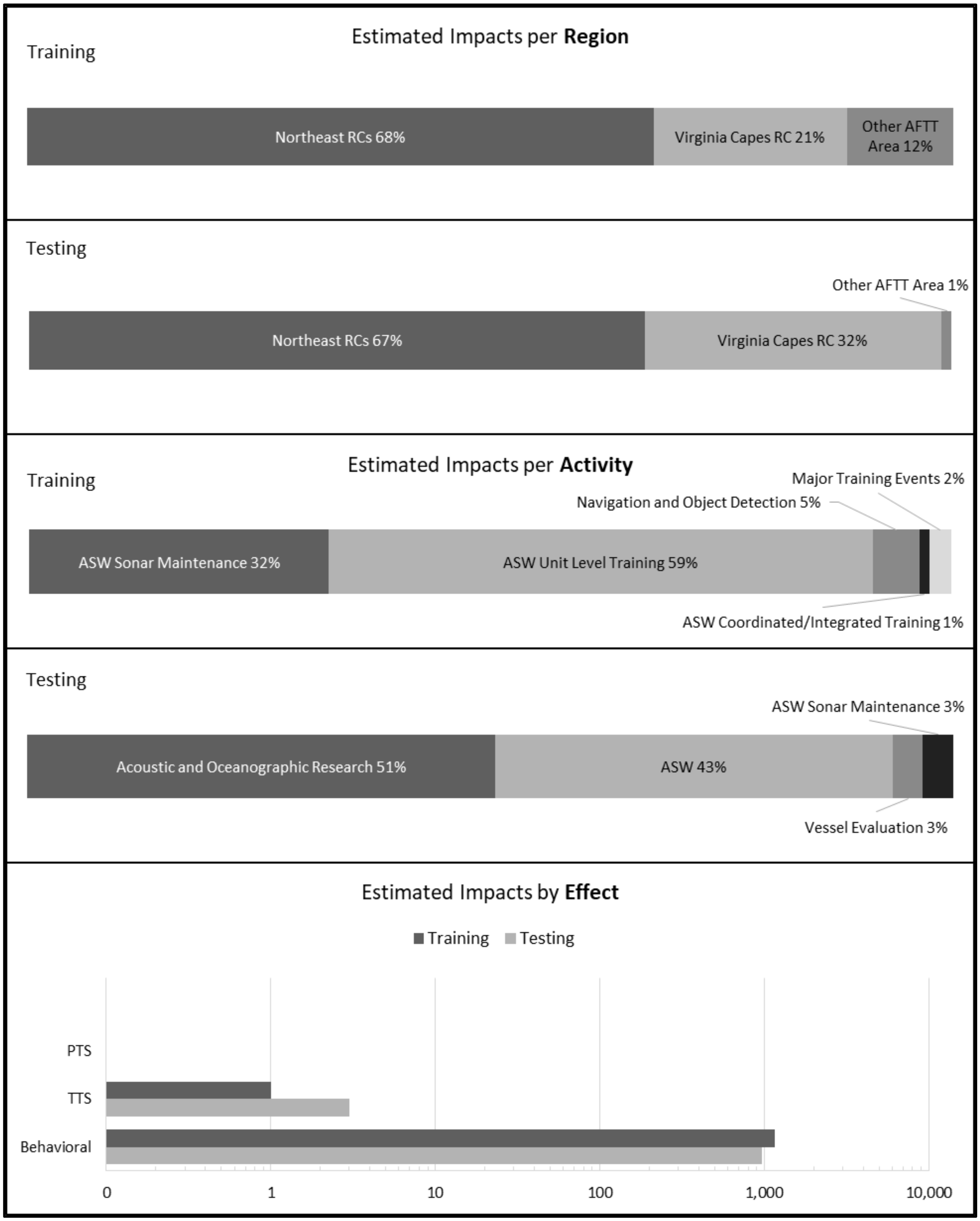
Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	8%	12%
Western North Atlantic	92%	88%

Table 3.7-27: 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 per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	2%	4%
Western North Atlantic	98%	96%

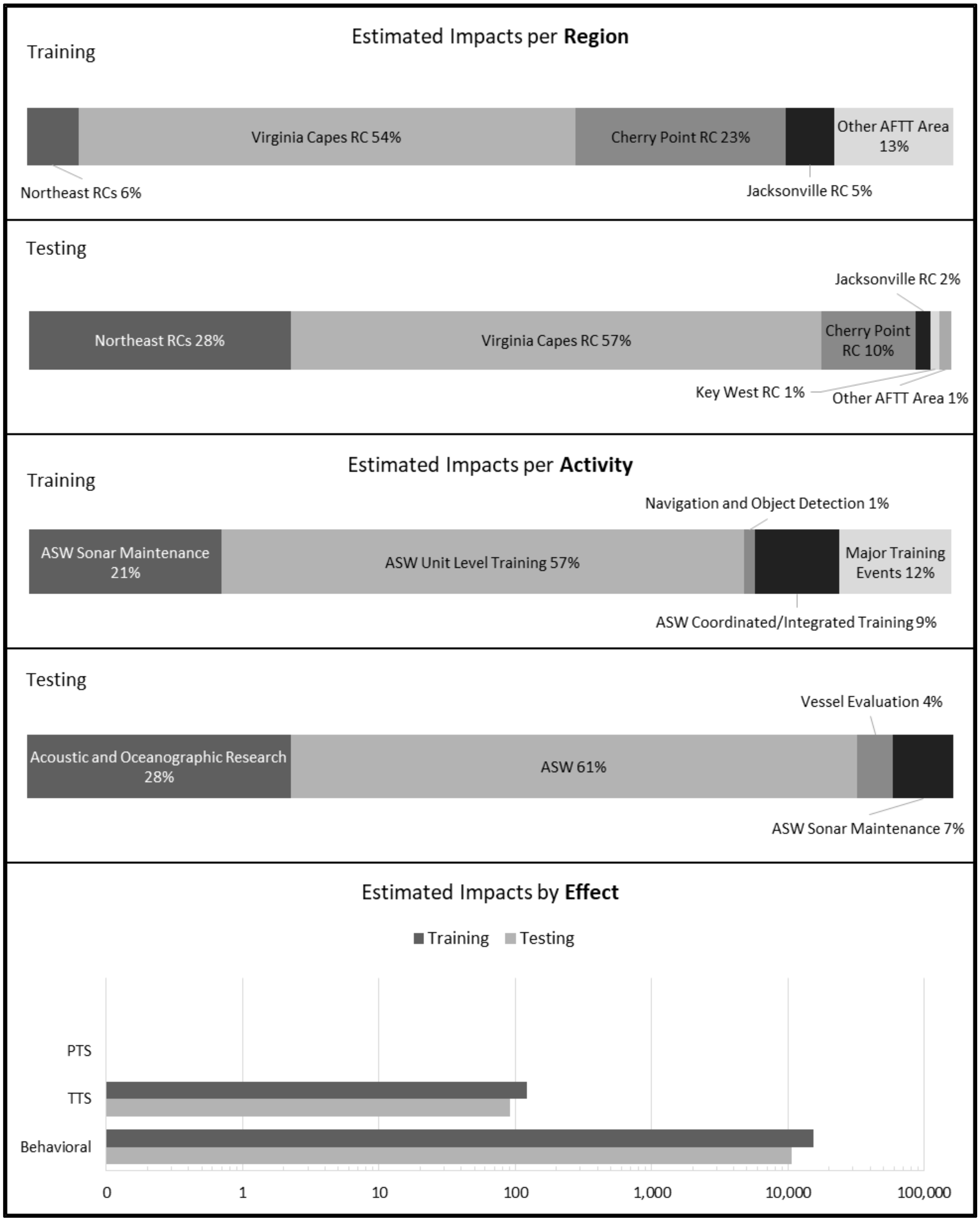
Table 3.7-28: Estimated Impacts on Individual Gervais' Beaked Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	8%	12%
Western North Atlantic	92%	88%



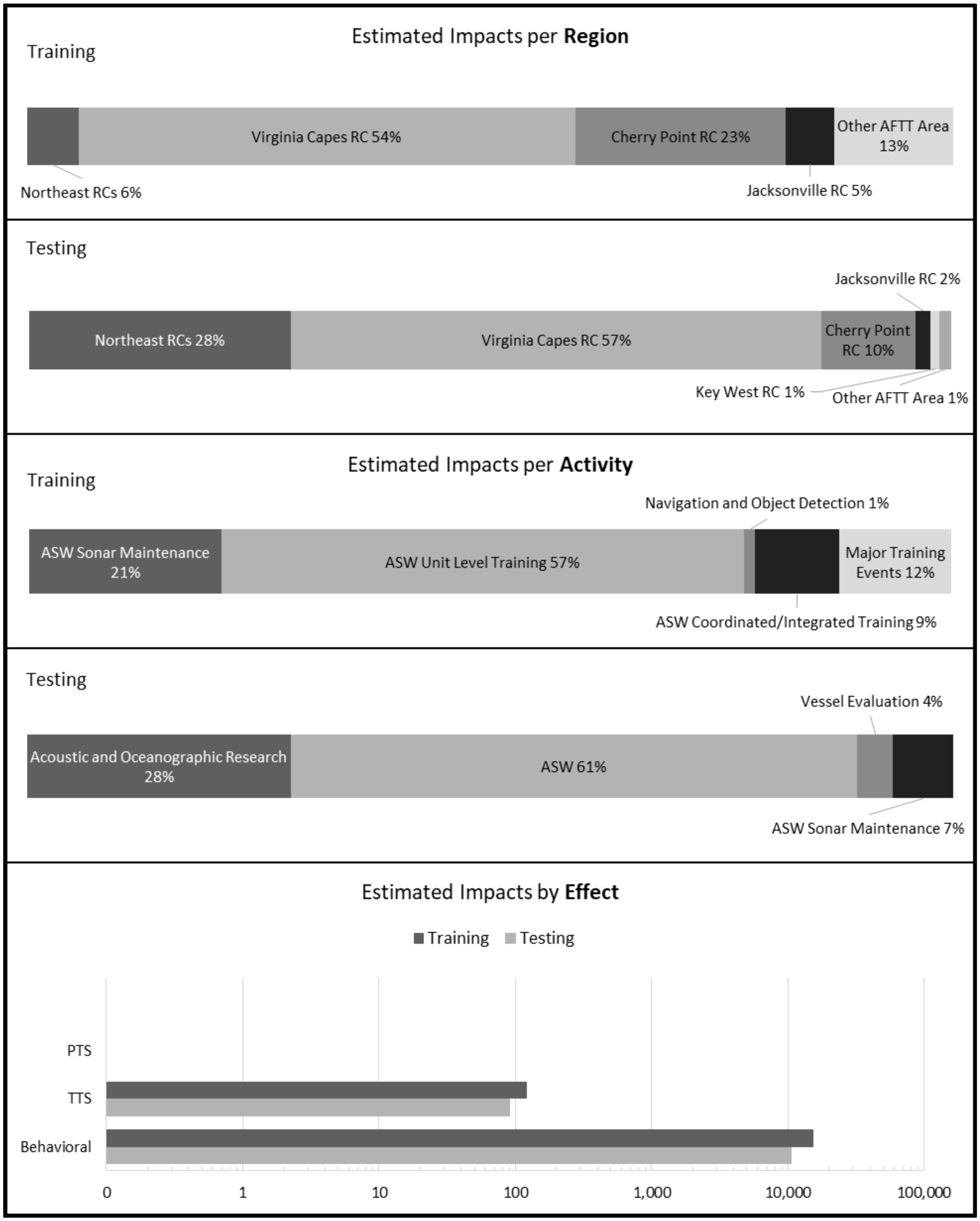
Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent western North Atlantic stock. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-42: Northern Bottlenose Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent western North Atlantic stock. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-43: Sowerby's Beaked Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent western North Atlantic stock. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-44: True's Beaked Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Atlantic Spotted Dolphins

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

Atlantic spotted dolphins may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-45 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-29).

As described for other 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 will 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 Atlantic spotted dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Atlantic spotted dolphins may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-45 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-29).

As described for other 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 will 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 Atlantic spotted dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-45: Atlantic Spotted Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.7-29: Estimated Impacts on Individual Atlantic Spotted Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	10%	24%
Western North Atlantic	90%	76%

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

Atlantic spotted dolphins may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-46 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-30).

Potential impacts under Alternative 2 from Sonar and other Transducers would be similar in type as for Alternative 2, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

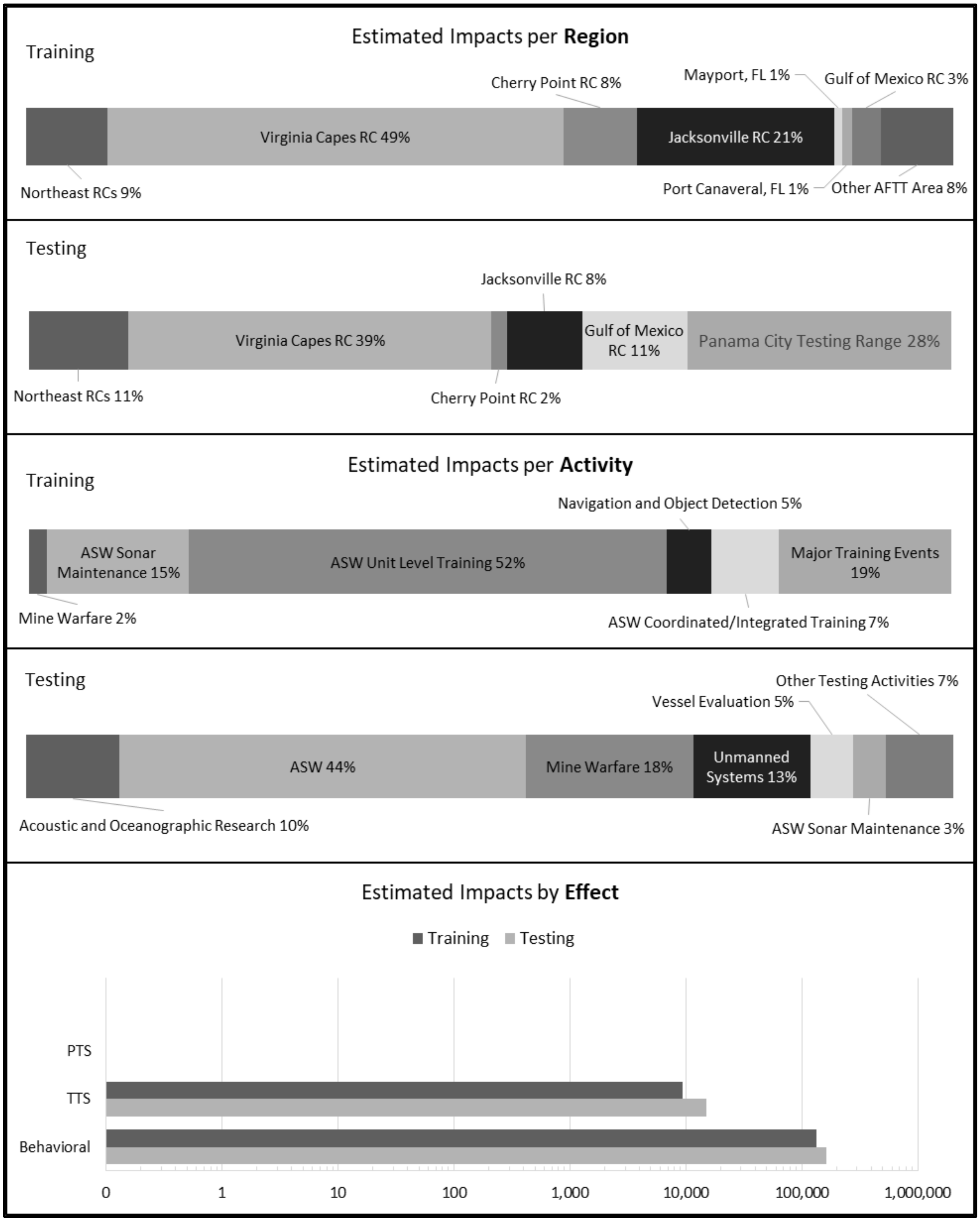
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of Atlantic spotted dolphins incidental to those activities.

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

Atlantic spotted dolphins may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-46 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-30).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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 Atlantic spotted dolphins incidental to those activities.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-46: Atlantic Spotted Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.7-30: Estimated Impacts on Individual Atlantic Spotted Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	3%	40%
Western North Atlantic	97%	60%

Atlantic White-Sided Dolphins

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

Atlantic white-sided dolphins may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-47 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

As described for other 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

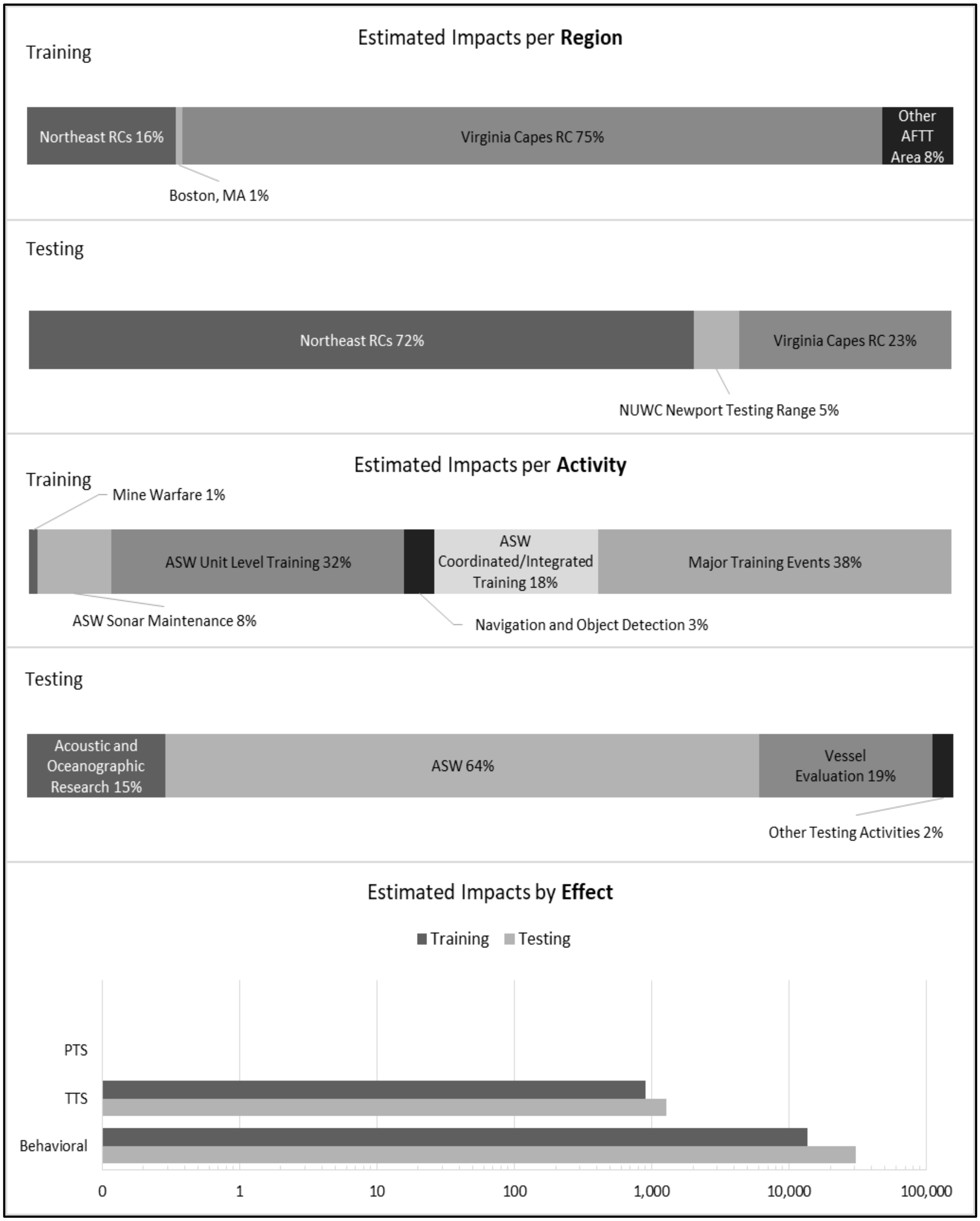
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of Atlantic white-sided dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Atlantic white-sided dolphins may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-47 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

As described for other 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 will 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 Atlantic white-sided dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent western North Atlantic stock. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-47: Atlantic White-Sided Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

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

Atlantic white-sided dolphins may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-48 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

Potential impacts under Alternative 2 from Sonar and other Transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

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 Atlantic white-sided dolphins incidental to those activities.

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

Atlantic white-sided dolphins may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-48 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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 Atlantic white-sided dolphins incidental to those activities.

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent western North Atlantic stock. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-48: Atlantic White-Sided Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Bottlenose Dolphins

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

Bottlenose dolphins 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 under Alternative 1. See Figure 3.7-49 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-31).

As described for other 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

There are 21 small and resident population areas for bottlenose dolphins identified by LaBrecque et al. (2015a, 2015b) that overlap or are directly adjacent to the AFTT Study Area. These identified areas are within bays and estuaries where the Navy does not typically train with sonar and other transducers. Bottlenose dolphins in the identified small and resident population areas identified by LaBrecque et al. (2015a, 2015b) would not typically be exposed to sound from sonar and other transducers; therefore, impacts on natural behaviors or abandonment of the area would not be anticipated within the identified bottlenose dolphin small and resident population areas from training with explosives.

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 bottlenose dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Bottlenose dolphins 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 under Alternative 1. See Figure 3.7-49 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-31).

As described for other 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-49: Bottlenose Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.7-31: Estimated Impacts on Individual Bottlenose Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Gulf of Mexico Northern Coastal	1%	4%
Gulf of Mexico Western Coastal	3%	4%
Northern Gulf of Mexico Continental Shelf	9%	35%
Northern Gulf of Mexico Oceanic	1%	4%
Northern North Carolina Estuarine System	2%	0%
Western North Atlantic Central Florida Coastal	1%	1%
Western North Atlantic Northern Migratory Coastal	3%	5%
Western North Atlantic Offshore	76%	46%
Western North Atlantic South Carolina/ Georgia Coastal	1%	1%
Western North Atlantic Southern Migratory Coastal	3%	2%

There are 21 small and resident population areas for bottlenose dolphins identified by LaBrecque et al. (2015a, 2015b) that overlap or are directly adjacent to the AFTT Study Area. These identified areas are within bays and estuaries where the Navy does not typically test with sonar and other transducers. Bottlenose dolphins in the identified small and resident population areas identified by LaBrecque et al. (2015a, 2015b) would not typically be exposed to sound from sonar and other transducers; therefore, impacts on natural behaviors or abandonment of the area would not be anticipated within the identified bottlenose dolphin small and resident population areas.

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 bottlenose dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Bottlenose dolphins 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 under Alternative 2. See Figure 3.7-50 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-32).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

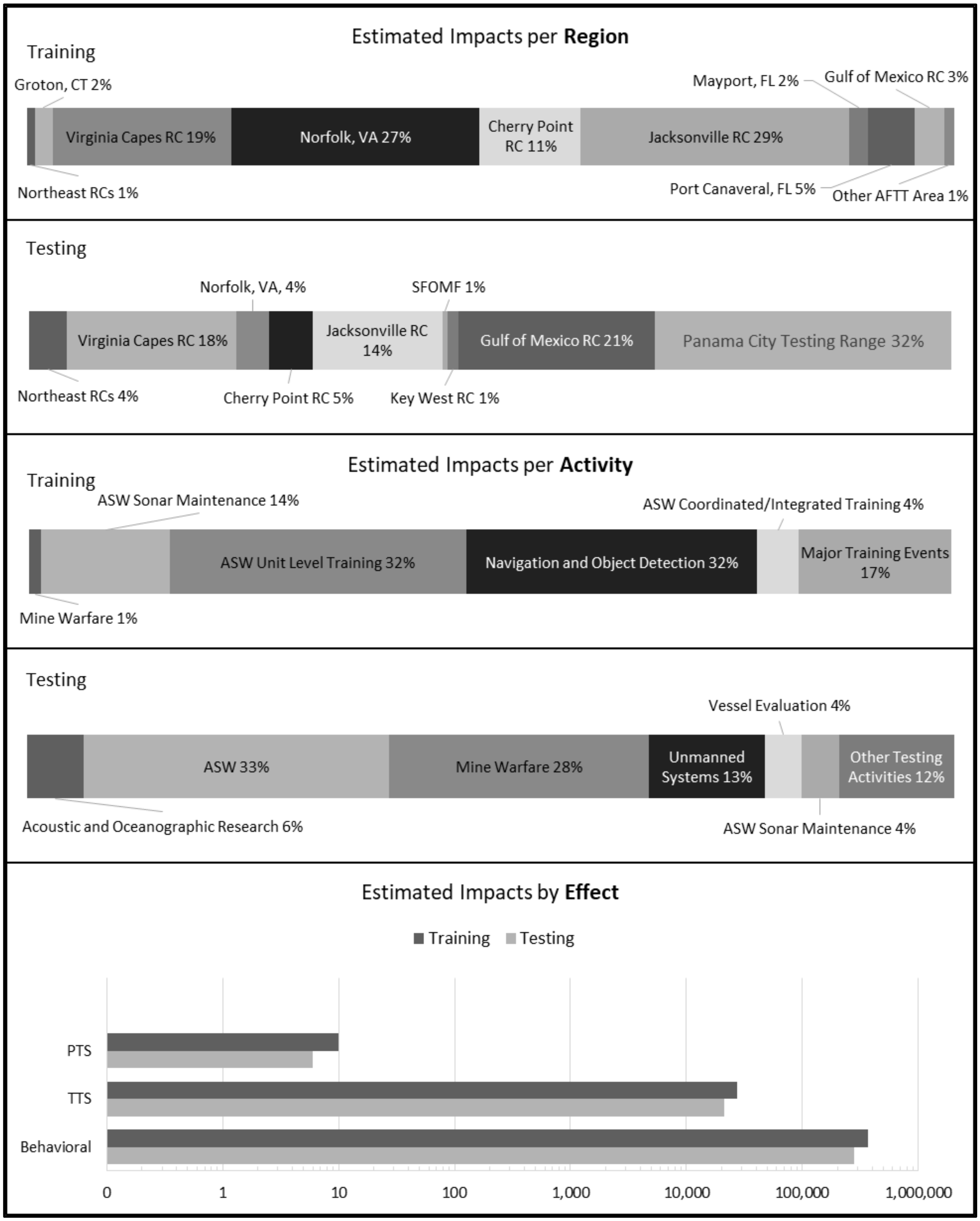
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of bottlenose dolphins incidental to those activities.

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

Bottlenose dolphins 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 under Alternative 2. See Figure 3.7-50 or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-32).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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 bottlenose dolphins incidental to those activities.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-50: Bottlenose Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.7-32: Estimated Impacts on Individual Bottlenose Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Gulf of Mexico Northern Coastal	0%	5%
Gulf of Mexico Western Coastal	0%	1%
Northern Gulf of Mexico Continental Shelf	3%	42%
Northern Gulf of Mexico Oceanic	0%	5%
Western North Atlantic Central Florida Coastal	2%	1%
Western North Atlantic Northern Migratory Coastal	7%	4%
Western North Atlantic Offshore	83%	40%
Western North Atlantic South Carolina/ Georgia Coastal	1%	1%
Western North Atlantic Southern Migratory Coastal	3%	1%

Clymene Dolphins

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

Clymene dolphins may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-51 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-33).

As described for other 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 will 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 clymene dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Clymene dolphins may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-51 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-33).

As described for other 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 will 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 clymene dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species.
AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-51: Clymene Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.7-33: Estimated Impacts on Individual Clymene Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	21%	21%
Western North Atlantic	79%	79%

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

Clymene dolphins may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-52 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-34).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

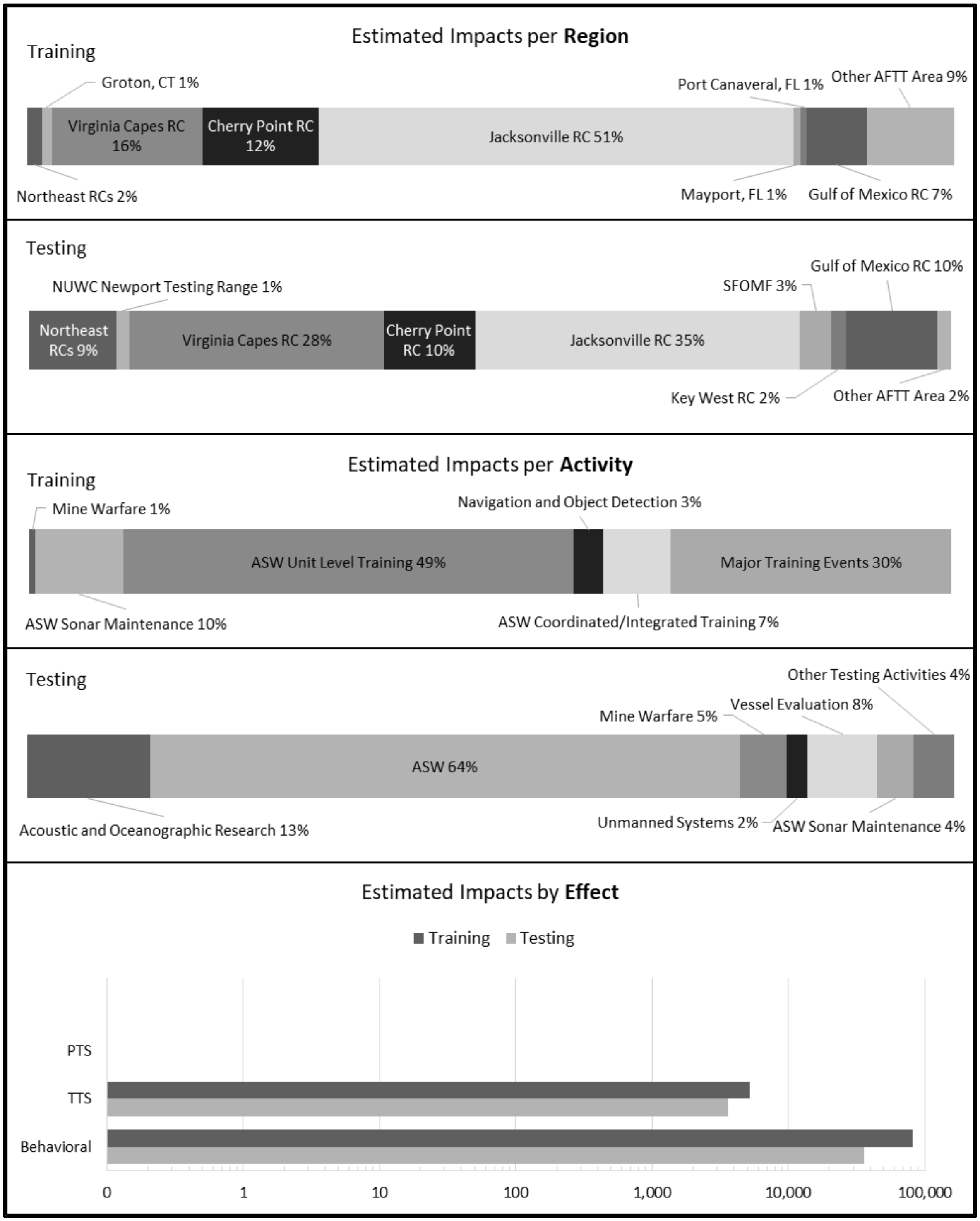
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of clymene dolphins incidental to those activities.

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

Clymene dolphins may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-52 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-34).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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 clymene dolphins incidental to those activities.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-52: Clymene Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.7-34: Estimated Impacts on Individual Clymene Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	7%	10%
Western North Atlantic	93%	90%

False Killer Whales

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

False killer whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-53 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-35).

As described for other 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

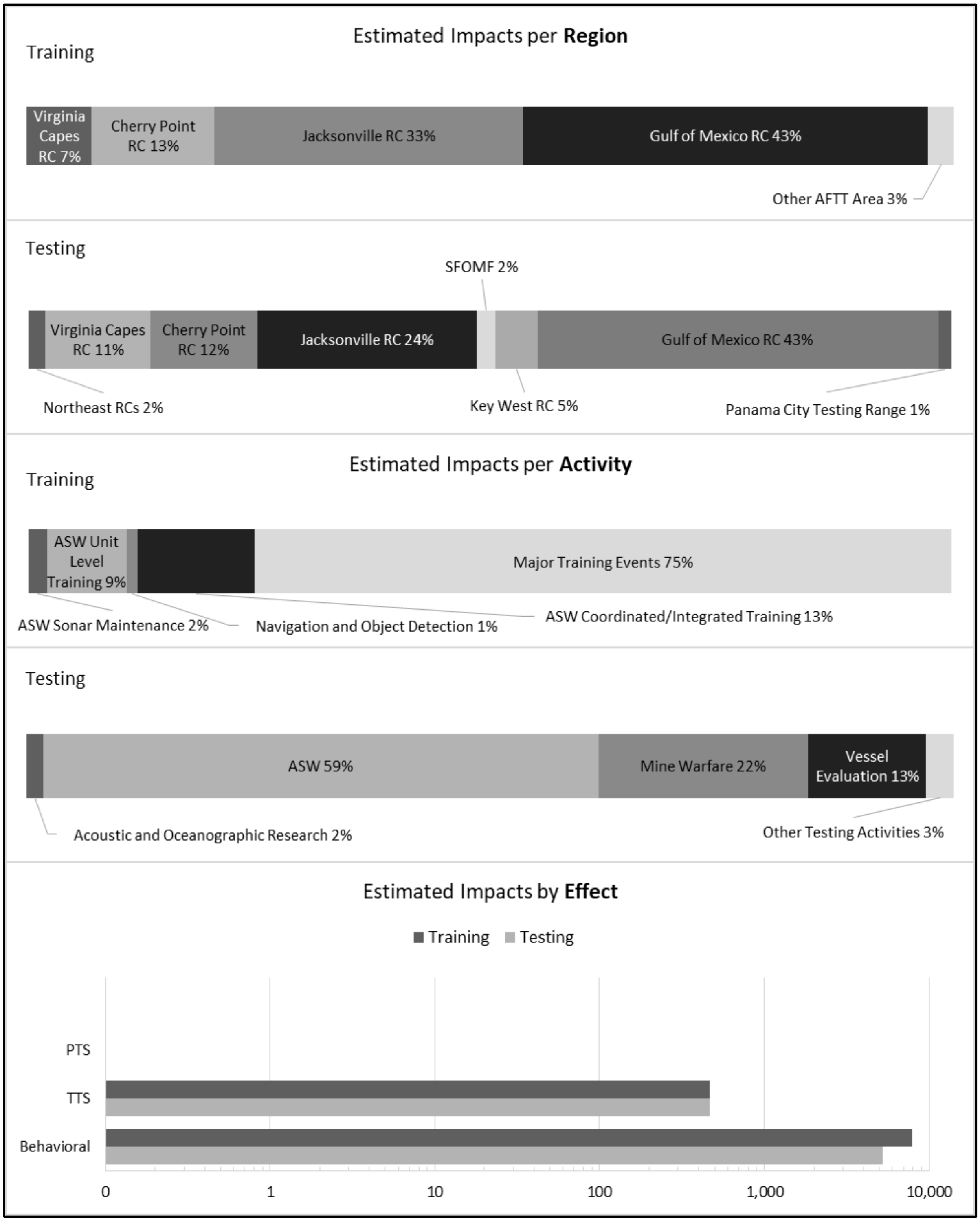
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of false killer whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

False killer whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-53 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-35).

As described for other 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 will 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 false killer whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-53: False Killer Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.7-35: Estimated Impacts on Individual False Killer Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	43%	46%
Western North Atlantic	57%	54%

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

False killer whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-54 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-36).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

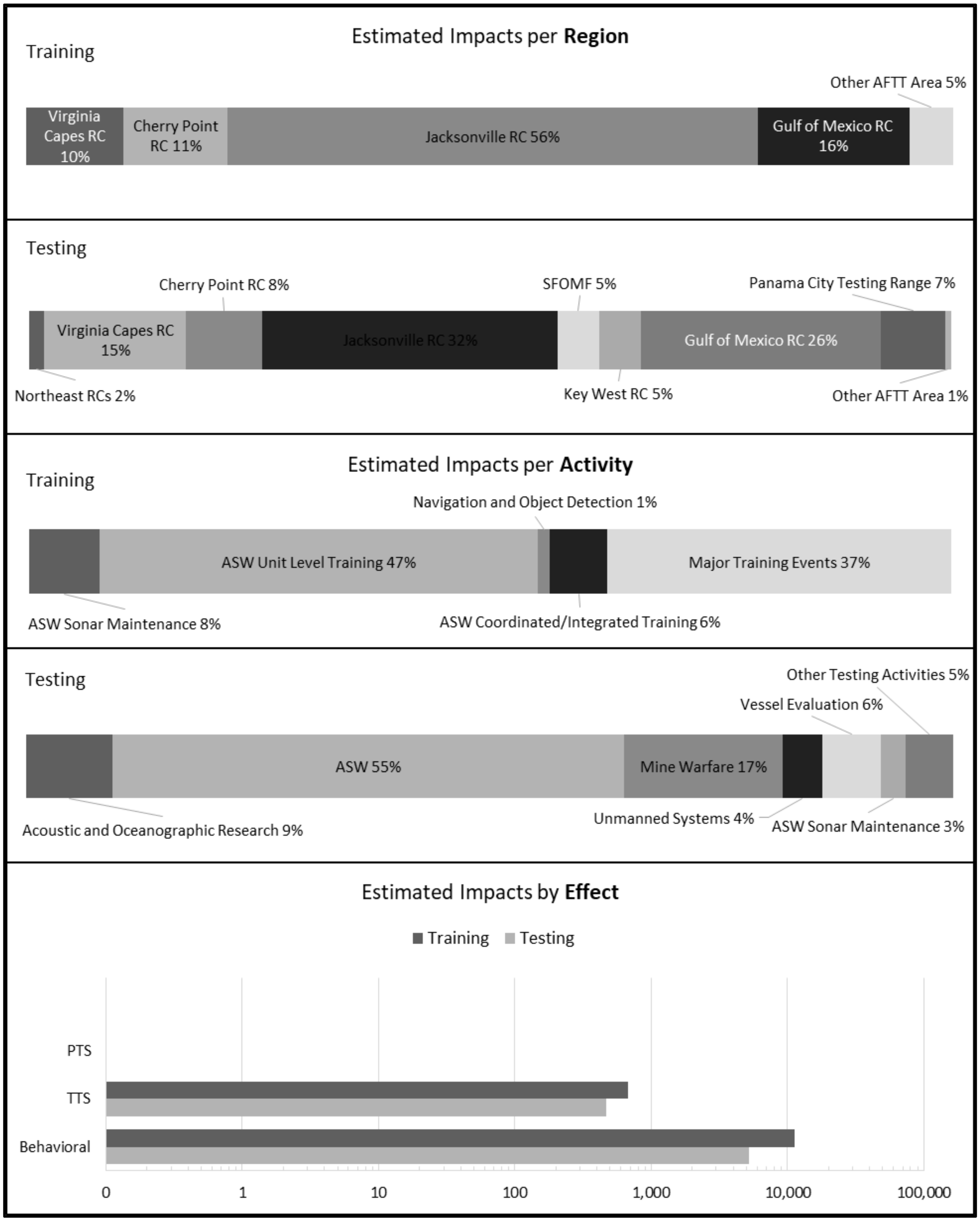
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of false killer whales incidental to those activities.

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

False killer whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-54 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-36).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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 false killer whales incidental to those activities.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-54: False Killer Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.7-36: Estimated Impacts on Individual False Killer Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	16%	34%
Western North Atlantic	84%	66%

Fraser's Dolphins

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

Fraser's dolphins may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-55 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-37).

As described for other 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

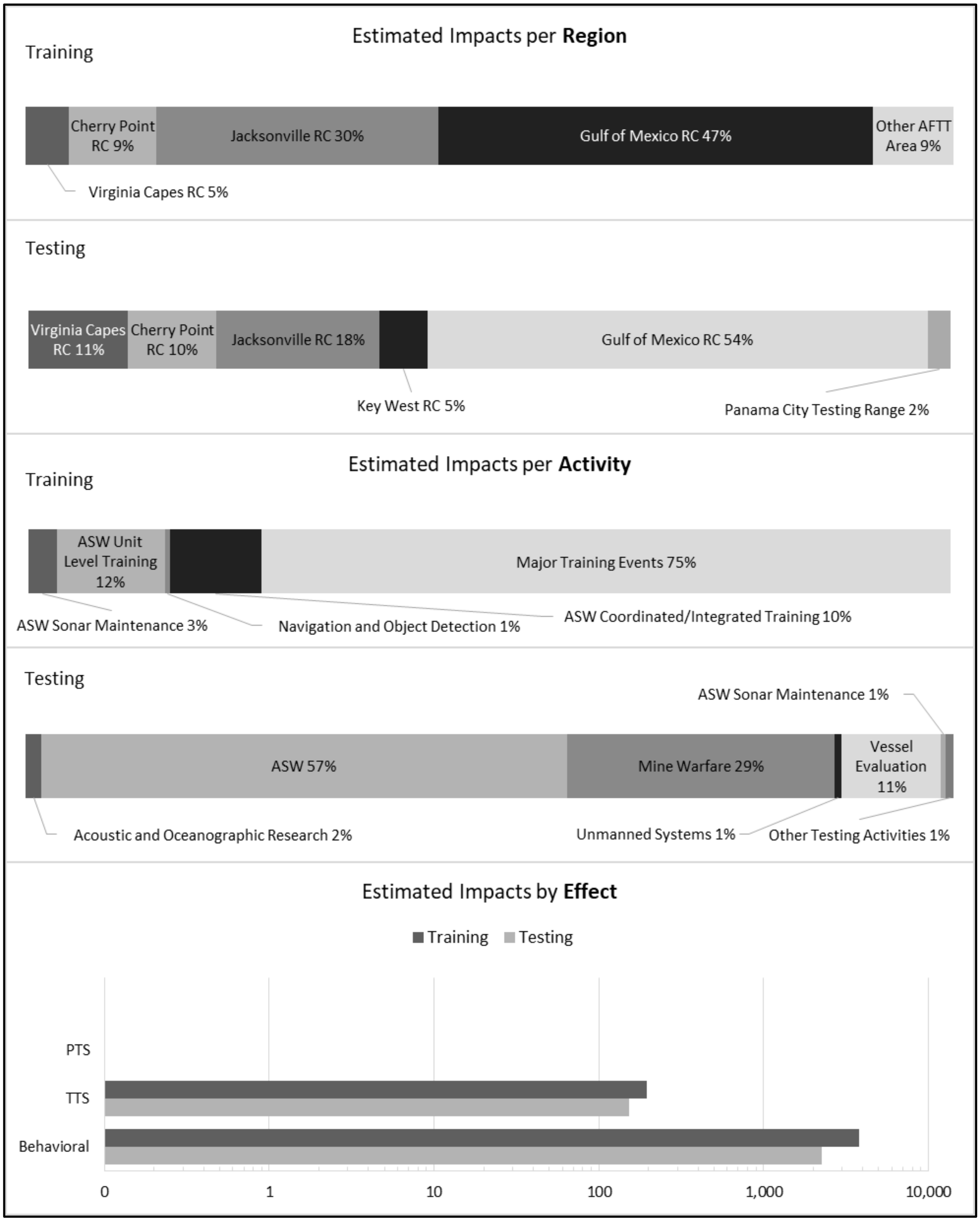
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of Fraser's dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Fraser's dolphins may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-55 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-37).

As described for other 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 will 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 Fraser's dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species.
AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-55: Fraser's Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.7-37: Estimated Impacts on Individual Fraser's Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	47%	58%
Western North Atlantic	53%	42%

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

Fraser's dolphins may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-56 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-38).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

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 Fraser's dolphins incidental to those activities.

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

Fraser's dolphins may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-56 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-38).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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 Fraser's dolphins incidental to those activities.

Region and Activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-56: Fraser's Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.7-38: Estimated Impacts on Individual Fraser's Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	18%	46%
Western North Atlantic	82%	54%

Killer Whales

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

Killer whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-57 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-39).

As described for other 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

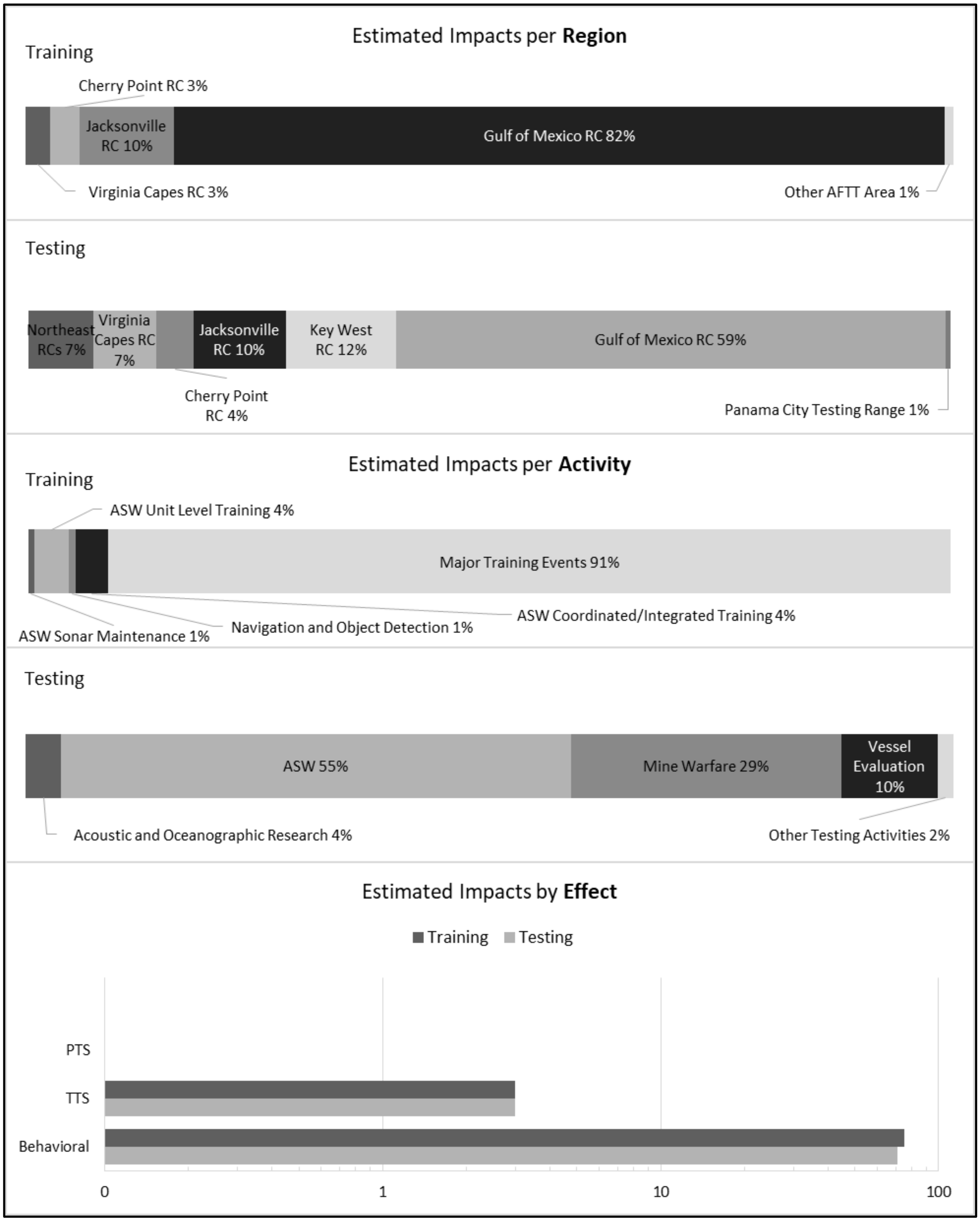
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of killer whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Killer whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-57 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-39).

As described for other 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 will 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 killer whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-57: Killer Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.7-39: 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 per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	82%	63%
Western North Atlantic	18%	37%

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

Killer whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-58 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-40).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

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.

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

Killer whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-58 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-40).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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.

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-58: Killer Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.7-40: 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 per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	48%	44%
Western North Atlantic	52%	56%

Melon-Headed Whales

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

Melon-headed whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-59 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-41).

As described for other 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

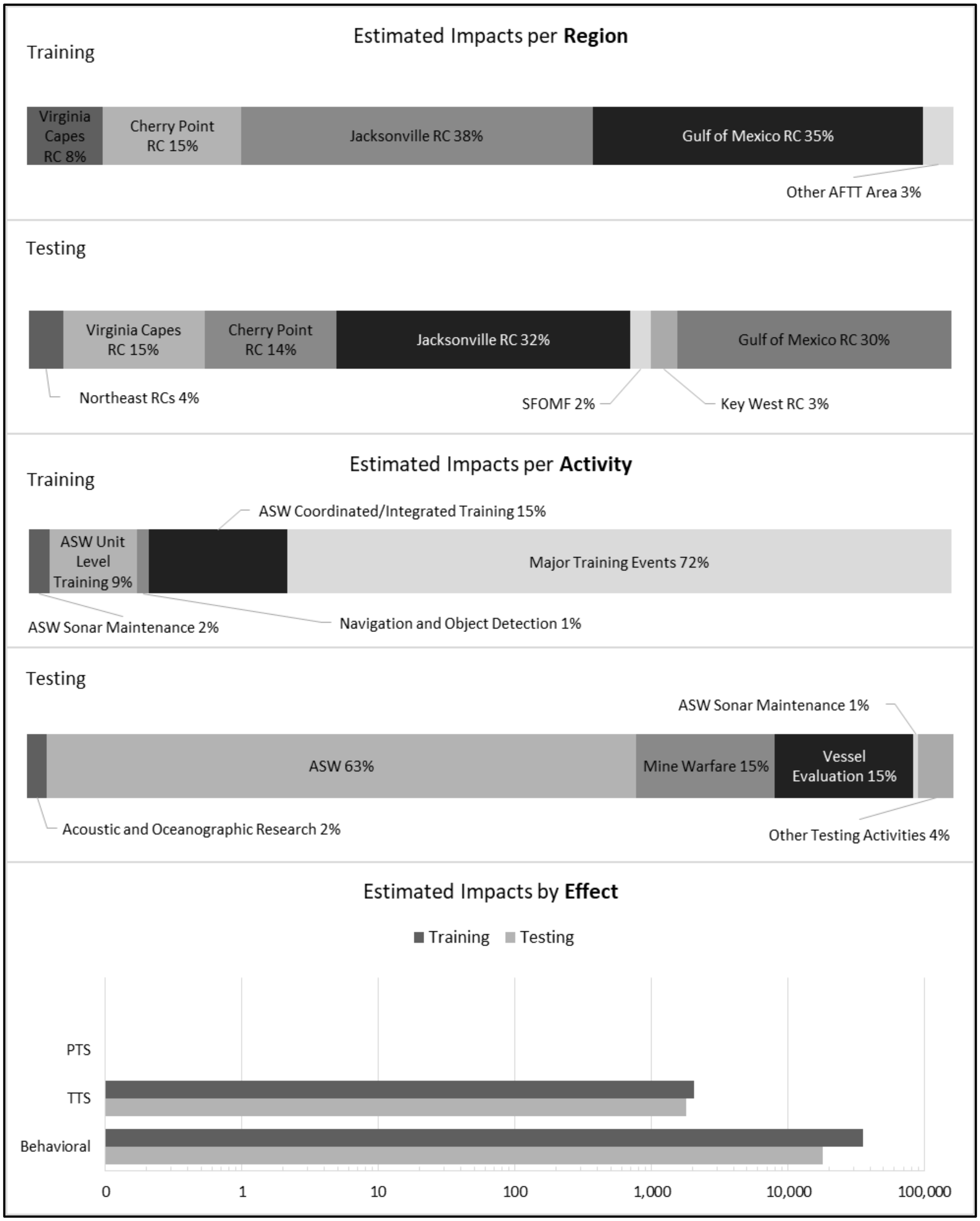
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of melon-headed whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Melon-headed whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-59 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-41).

As described for other 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 will 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 melon-headed whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-59: Melon-Headed Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.7-41: Estimated Impacts on Individual Melon-Headed Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	35%	31%
Western North Atlantic	65%	69%

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

Melon-headed whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-60 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-42).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

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 melon-headed whales incidental to those activities.

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

Melon-headed whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-60 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-42).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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 melon-headed whales incidental to those activities.

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-60: Melon-Headed Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.7-42: Estimated Impacts on Individual Melon-Headed Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	12%	16%
Western North Atlantic	88%	84%

Pantropical Spotted Dolphins

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

Pantropical spotted dolphins may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-61 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-43).

As described for other 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

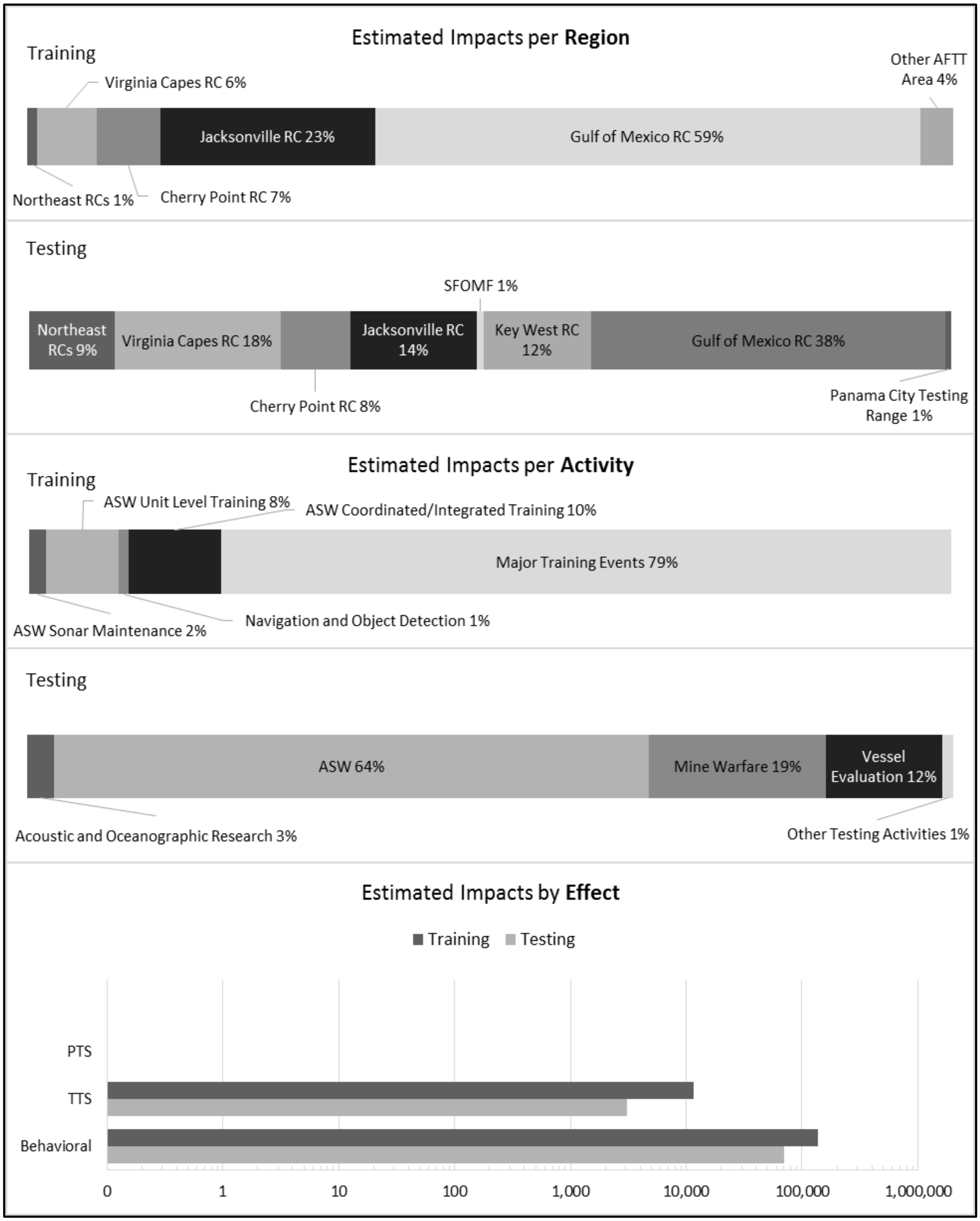
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of pantropical spotted dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Pantropical spotted dolphins may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-61 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-43).

As described for other 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 will 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 pantropical spotted dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-61: Pantropical Spotted Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.7-43: Estimated Impacts on Individual Pantropical Spotted Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	59%	42%
Western North Atlantic	41%	58%

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

Pantropical spotted dolphins may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-62 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-44).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

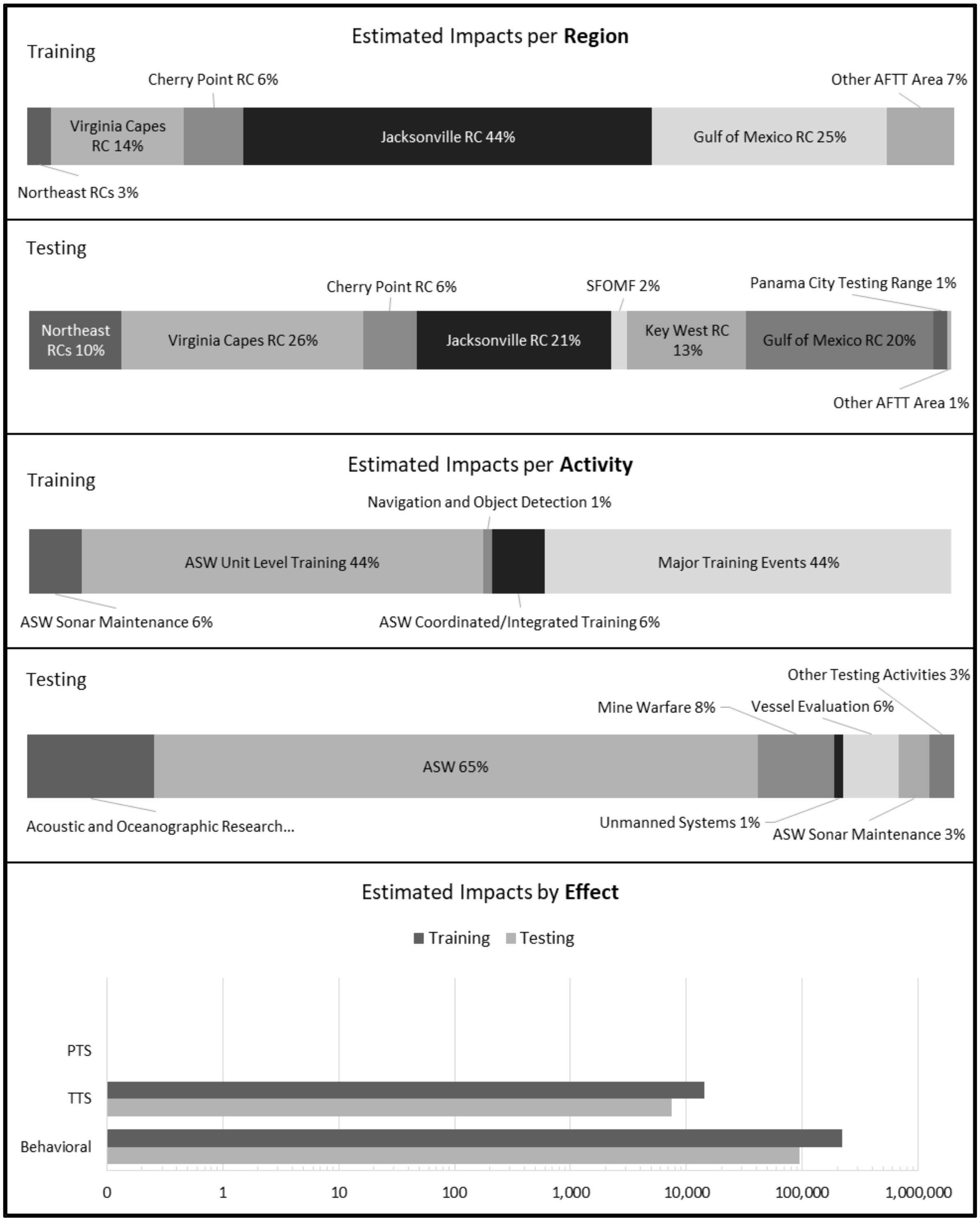
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of pantropical spotted dolphins incidental to those activities.

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

Pantropical spotted dolphins may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-62 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-44).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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 pantropical spotted dolphins incidental to those activities.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-62: Pantropical Spotted Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.7-44: Estimated Impacts on Individual Pantropical Spotted Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	25%	25%
Western North Atlantic	75%	75%

Pilot Whales

Pilot whales include two species that are often difficult to distinguish from one another: long-finned pilot whales and short-finned pilot whales.

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

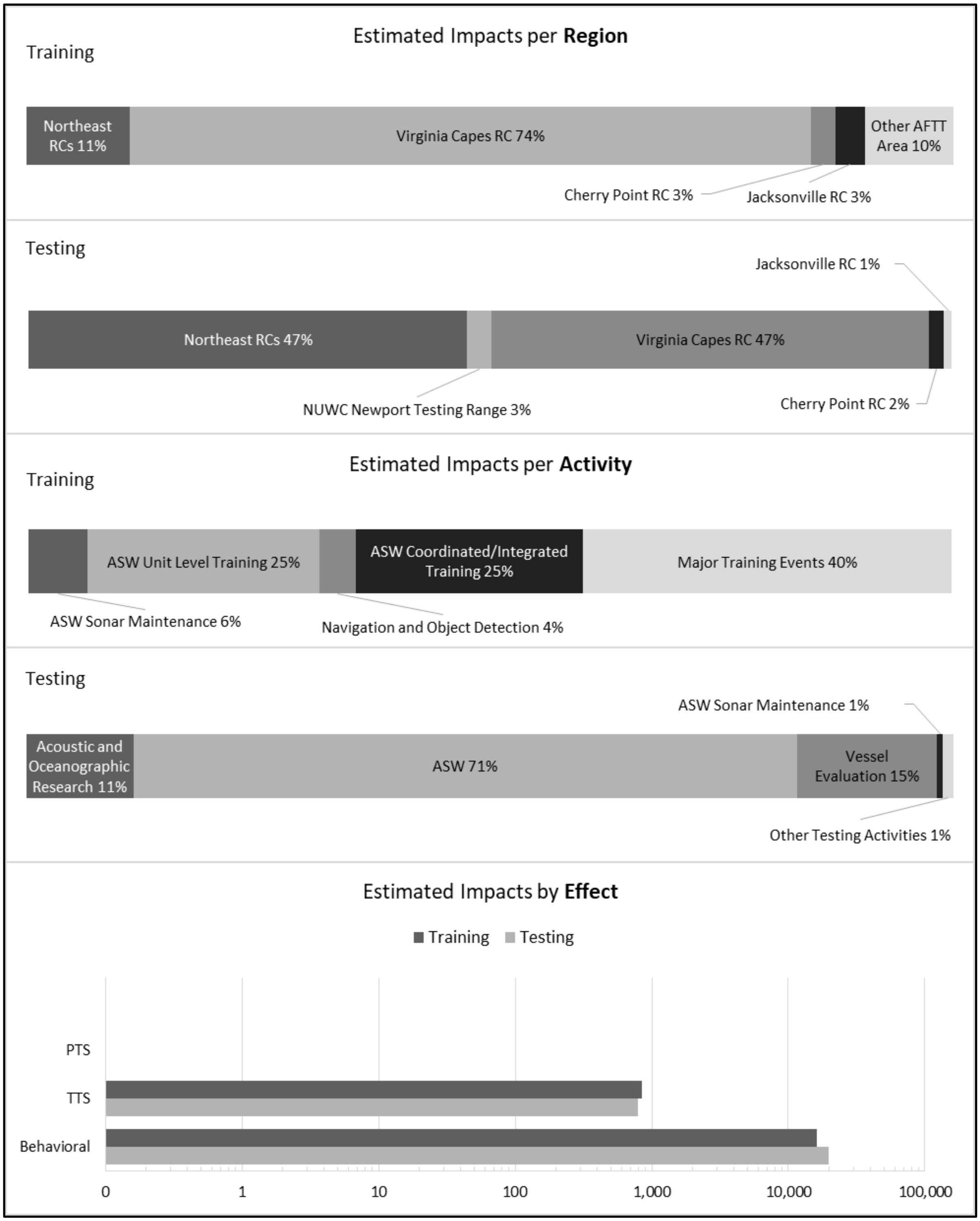
Pilot whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 for both long-finned and short-finned pilot whales. See Figure 3.7-63 and Figure 3.7-64 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock of long-finned pilot whales and multiple stocks of short-finned pilot whales (see Table 3.7-45).

As described for other 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 will 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 pilot whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Pilot whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1 for both long-finned and short-finned pilot whales. See Figure 3.7-63 and Figure 3.7-64 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock of long-finned pilot whales and multiple stocks of short-finned pilot whales (see Table 3.7-45).



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent western North Atlantic stock. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-63: Long-Finned Pilot Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

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

Figure 3.7-64: Short-finned Pilot Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.7-45: 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 per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	12%	20%
Western North Atlantic	88%	80%

As described for other 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 will 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 pilot whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

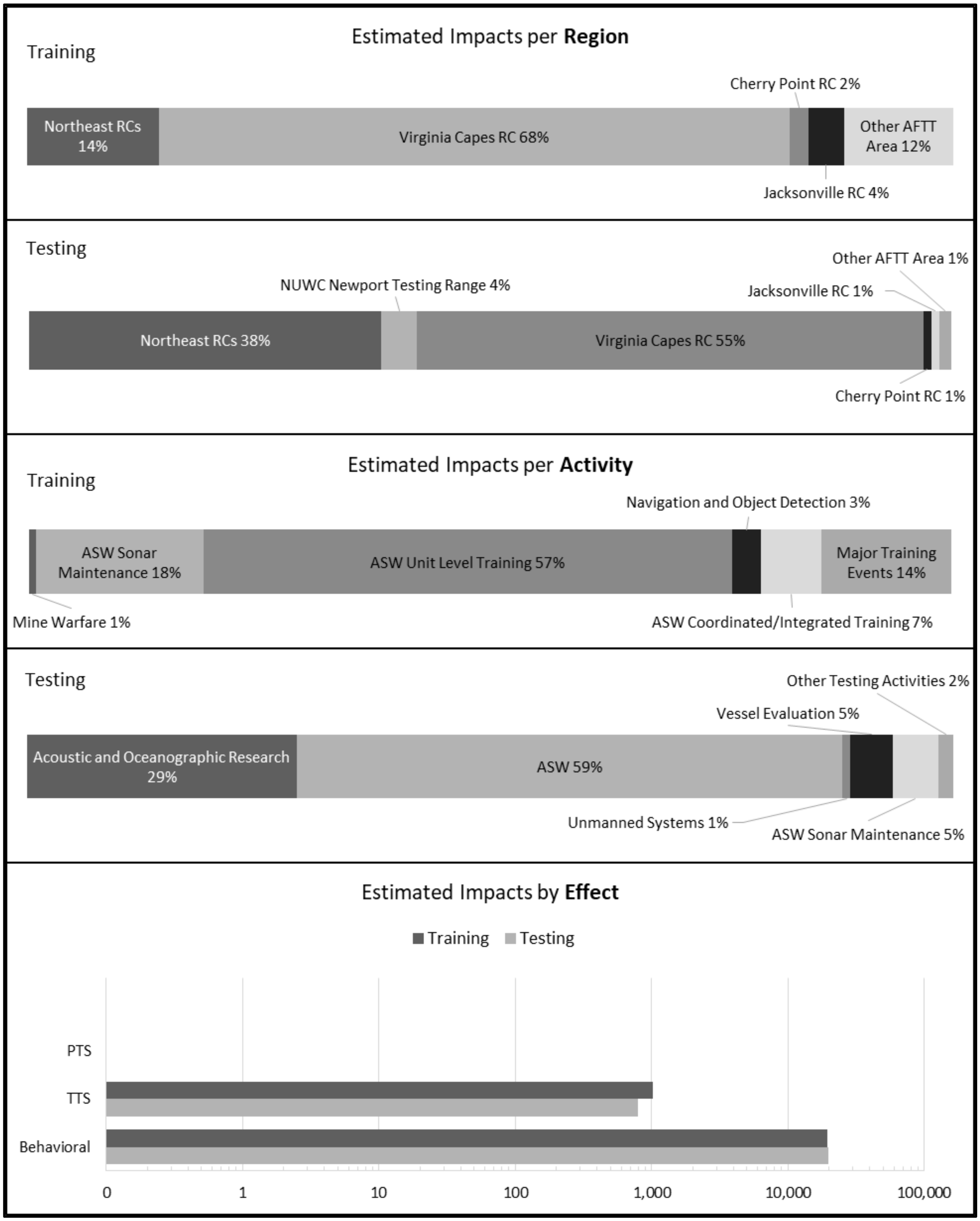
Pilot whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 for both long-finned and short-finned pilot whales. See Figure 3.7-65 and Figure 3.7-66 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock of long-finned pilot whales and multiple stocks of short-finned pilot whales (see Table 3.7-45).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

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 pilot whales incidental to those activities.

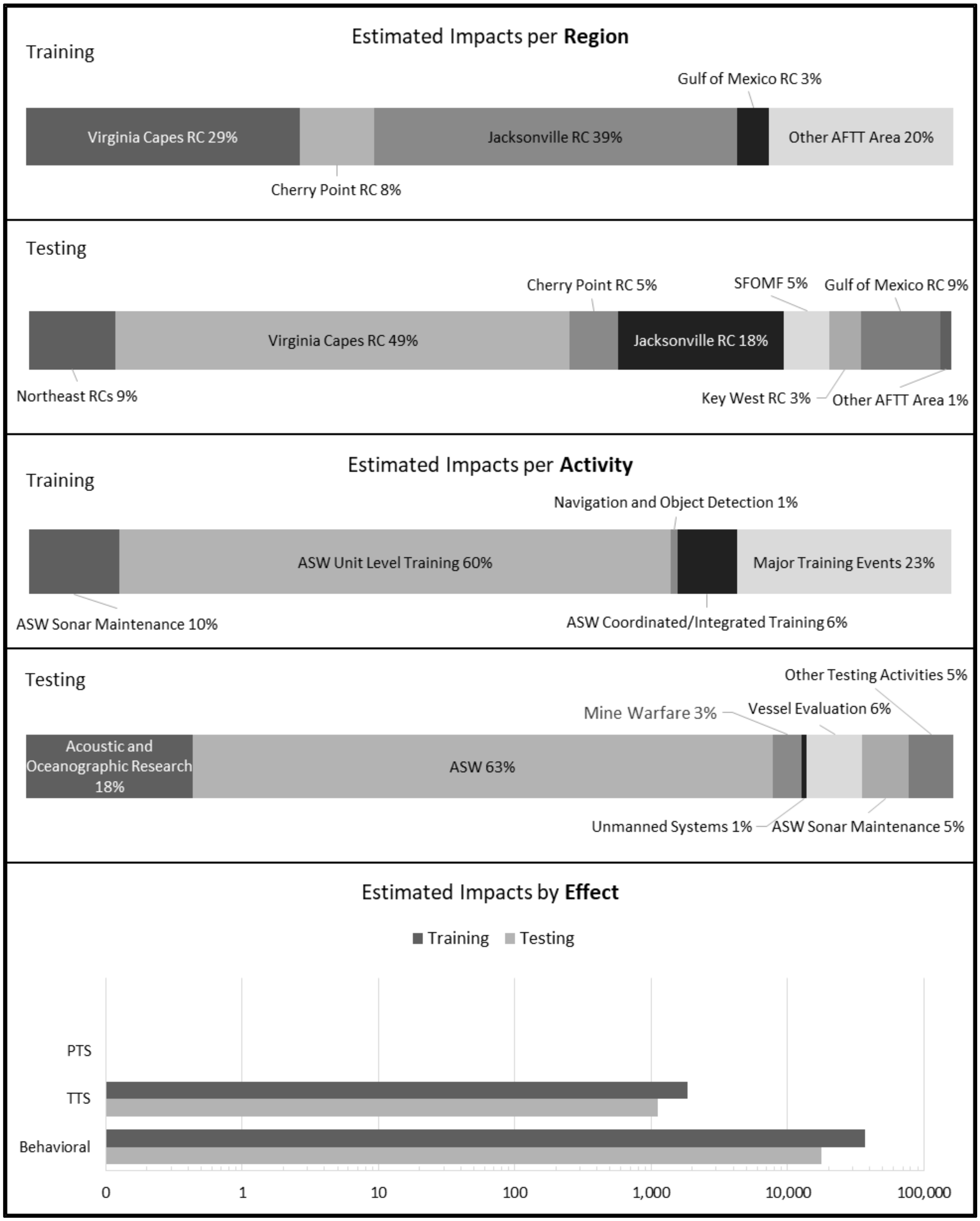
Impacts from Sonar and Other Transducers Under Alternative 2 for Testing Activities

Pilot whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2 for both long-finned and short-finned pilot whales. See Figure 3.7-65 and Figure 3.7-66 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock of long-finned pilot whales and multiple stocks of short-finned pilot whales (see Table 3.7-45).



Region and Activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-65: Long-Finned Pilot Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2



Region and Activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-66: Short-Finned Pilot Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.7-46: 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 per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	3%	10%
Western North Atlantic	97%	90%

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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 pilot whales incidental to those activities.

Pygmy Killer Whales

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

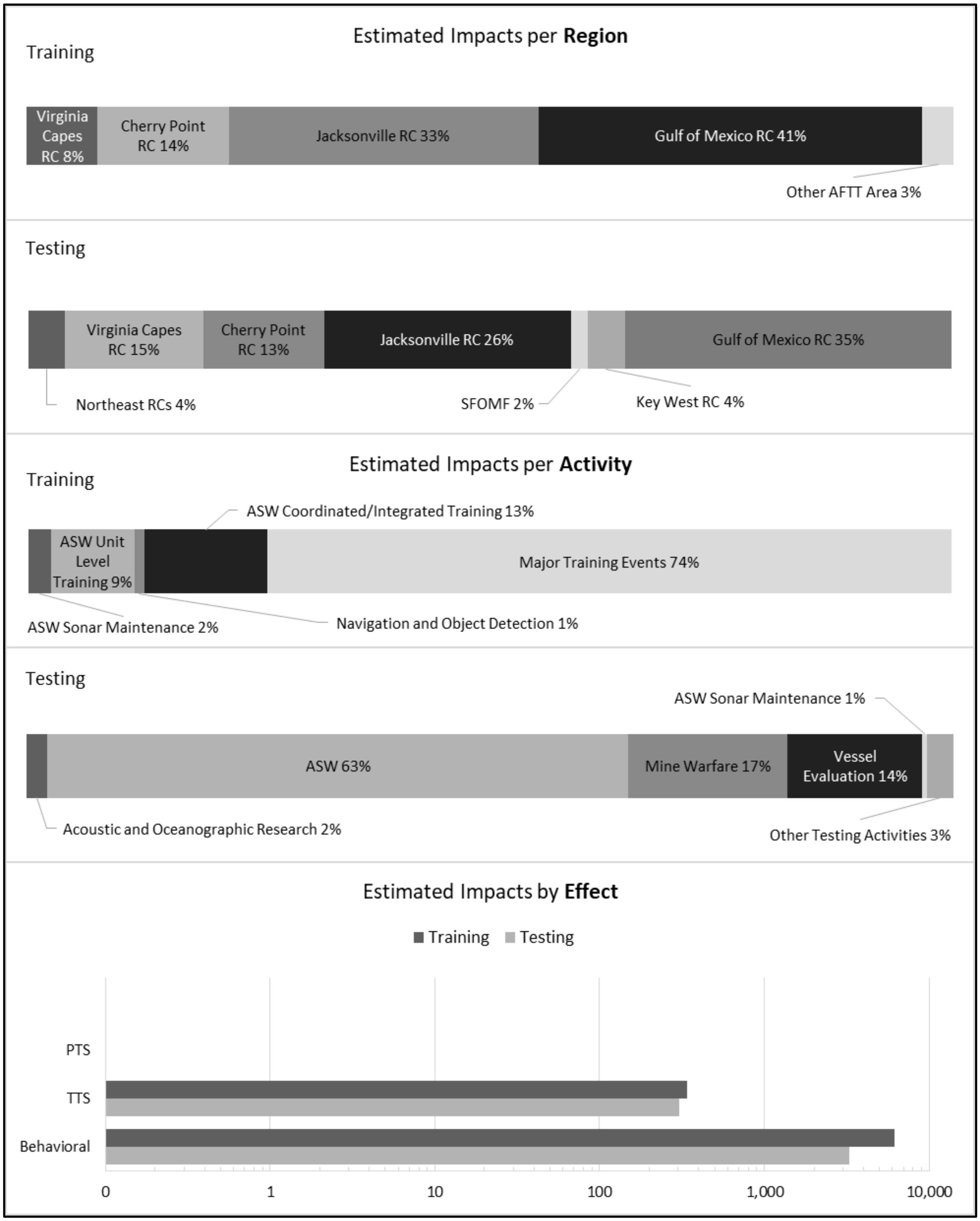
Pygmy killer whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-67 below or Appendix E (Estimated Marine Mammals and Sea Turtle Impacts 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-47).

As described for other 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 will 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 pygmy killer whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Pygmy killer whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-67 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-47).



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-67: Pygmy Killer Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.7-47: Estimated Impacts on Individual Pygmy Killer Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	41%	36%
Western North Atlantic	59%	64%

As described for other 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 will 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 pygmy killer whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

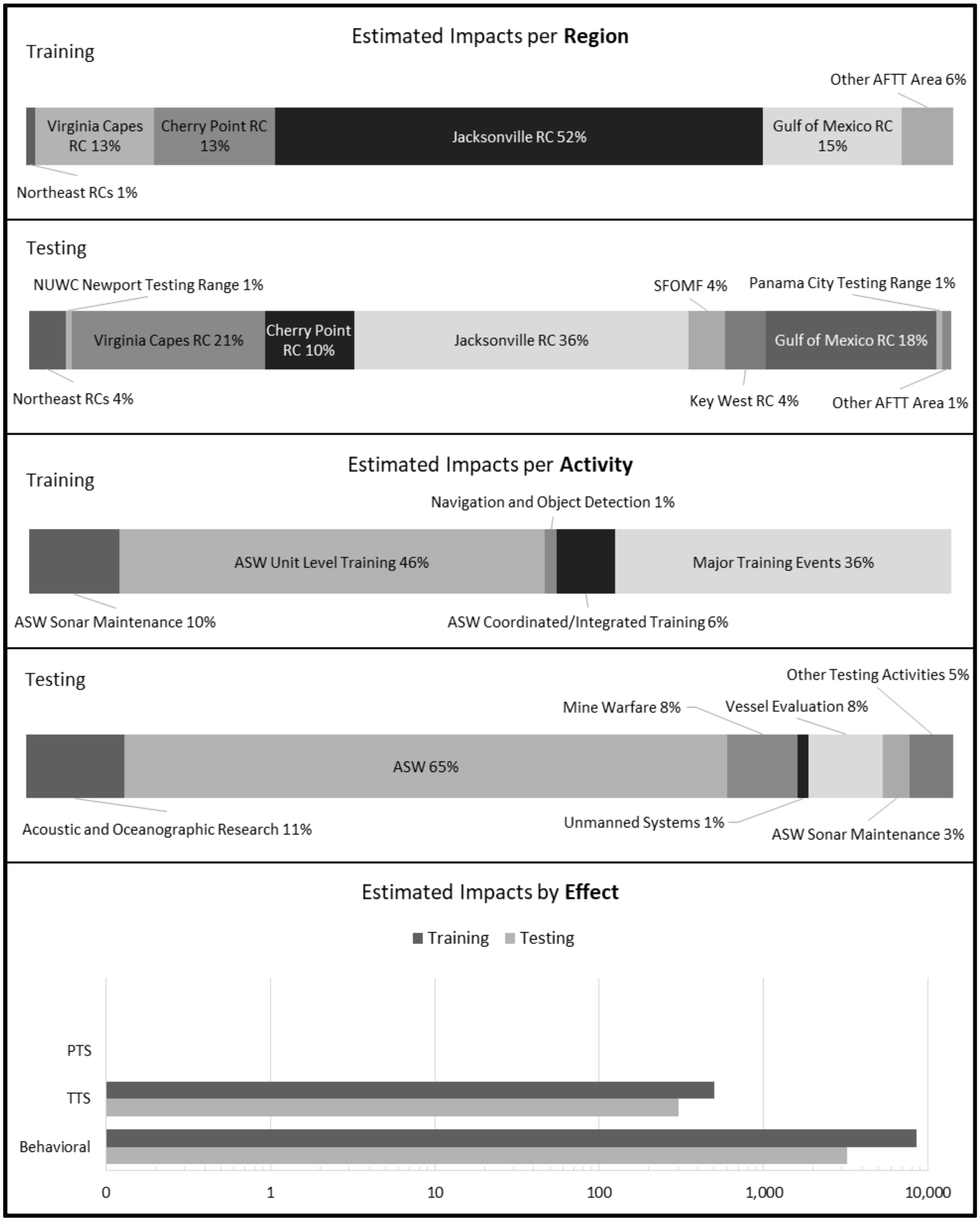
Pygmy killer whales may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-68 below or Appendix E (Estimated Marine Mammals and Sea Turtle Impacts 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-48).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

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 pygmy killer whales incidental to those activities.

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

Pygmy killer whales may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-68 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-48).



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-68: Pygmy Killer Whale Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.7-48: Estimated Impacts on Individual Pygmy Killer Whale Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	15%	20%
Western North Atlantic	85%	80%

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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 pygmy killer whales incidental to those activities.

Risso's Dolphins

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

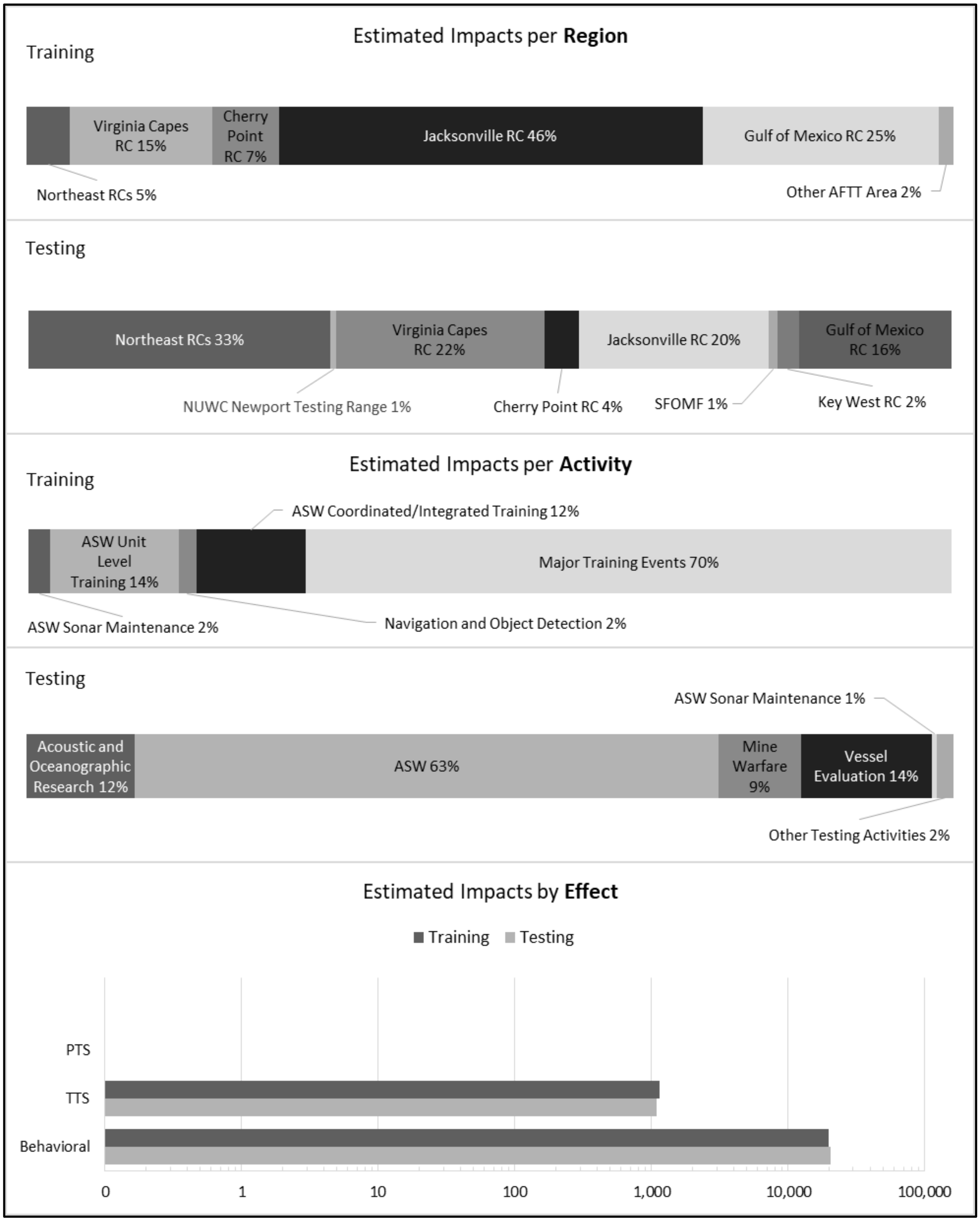
Risso's dolphins may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-69 below or Appendix E (Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities) for tabular results. Impact ranges for this species are discussed in Section 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-49).

As described for other 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 will 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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Risso's dolphins may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-69 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-49).



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-69: Risso's Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.7-49: 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 per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	25%	18%
Western North Atlantic	75%	82%

As described for other 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 will 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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

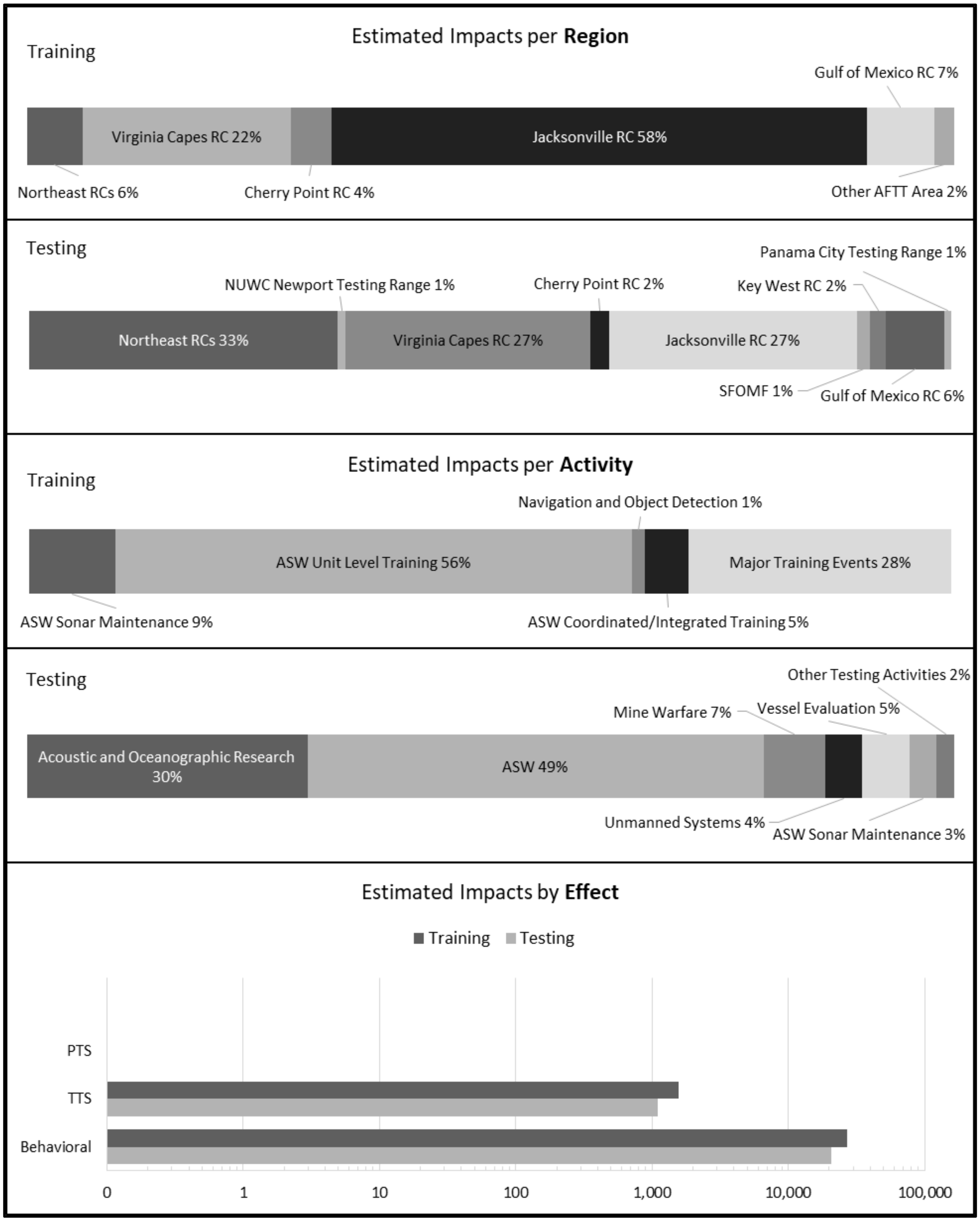
Risso's dolphins may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-70 below or Appendix E (Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities) for tabular results. Impact ranges for this species are discussed in Section 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-50).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

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 sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-70 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-50).



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-70: Risso's Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.7-50: 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 per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	7%	8%
Western North Atlantic	93%	92%

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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.

Rough-Toothed Dolphins

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

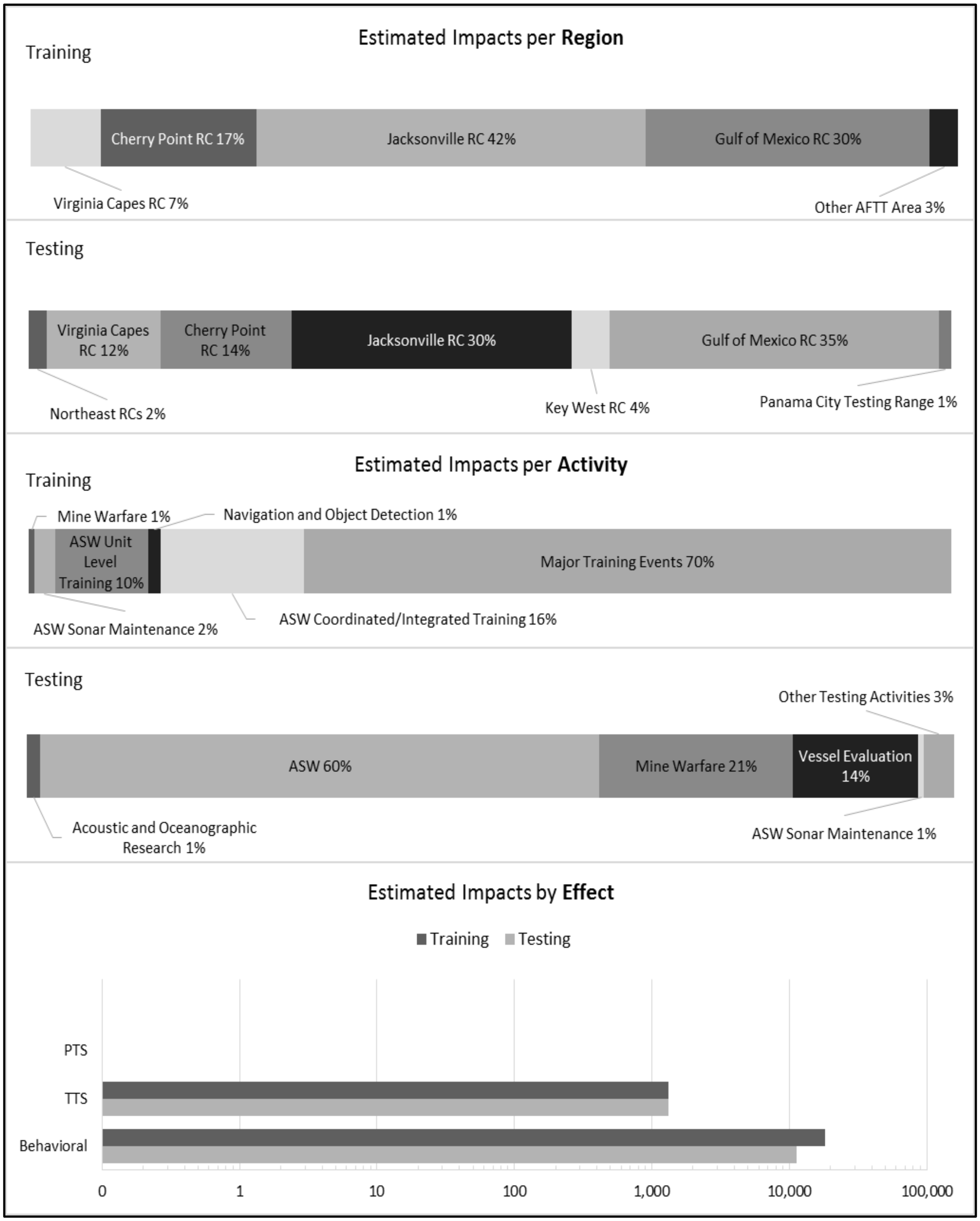
Rough-toothed dolphins may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-71 below or Appendix E (Estimated Marine Mammals and Sea Turtle Impacts 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-51).

As described for other 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 will 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 rough-toothed dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Rough-toothed dolphins may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-71 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-51).



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species.
AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-71: Rough-Toothed Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.7-51: Estimated Impacts on Individual Rough-Toothed Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	30%	37%
Western North Atlantic	70%	63%

As described for other 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 will 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 rough-toothed dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Rough-toothed dolphins may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-72 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-52).

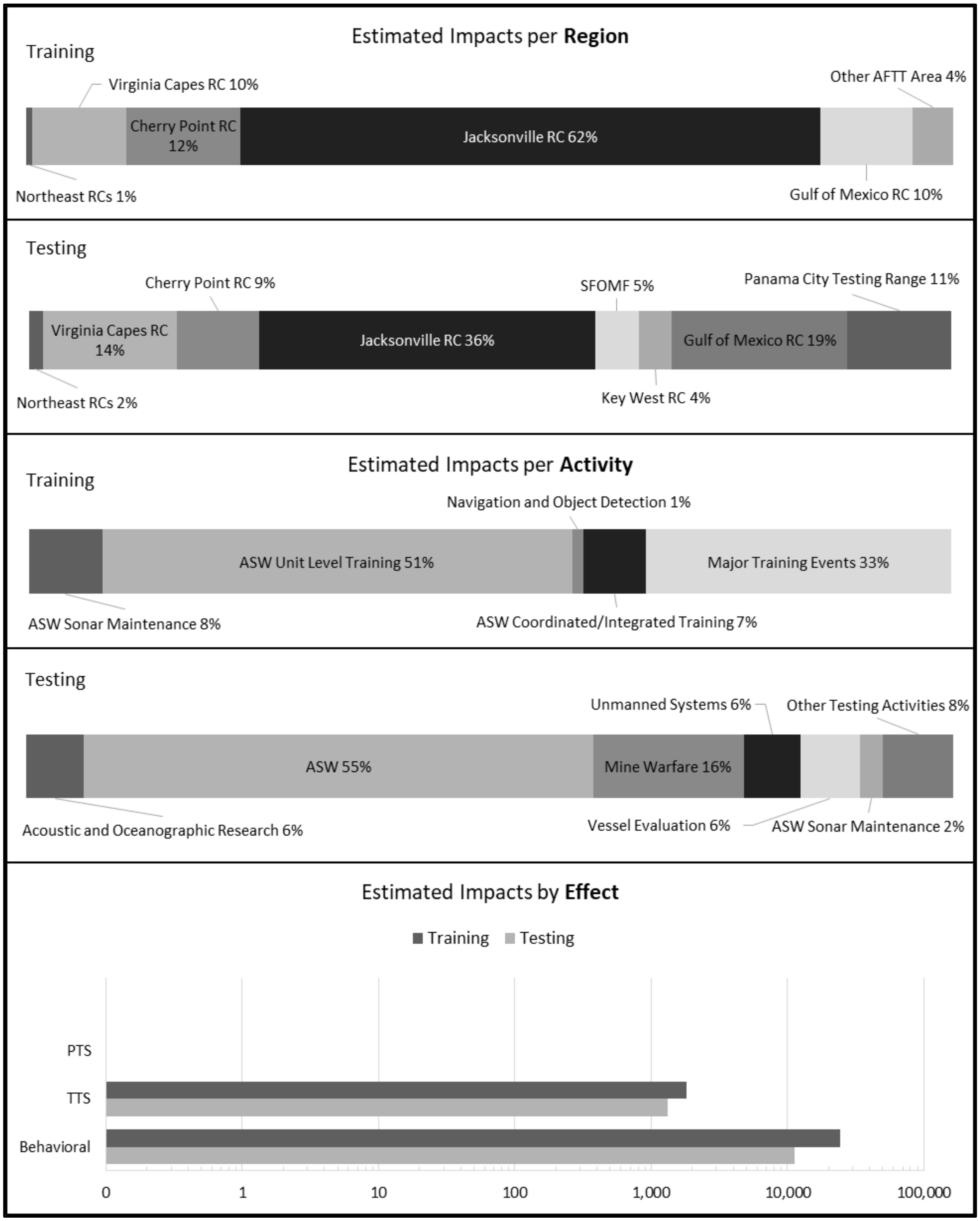
Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

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 rough-toothed dolphins incidental to those activities.

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

Rough-toothed dolphins may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-72 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-52).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-72: Rough-Toothed Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.7-52: Estimated Impacts on Individual Rough-Toothed Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	10%	31%
Western North Atlantic	90%	69%

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 rough-toothed dolphins incidental to those activities.

Short-Beaked Common Dolphins

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

Short-beaked common dolphins may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-73 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

As described for other 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 will 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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Short-beaked common dolphins may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-73 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

As described for other 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-73: Short-Beaked Common Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Short-beaked common dolphins may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-74 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

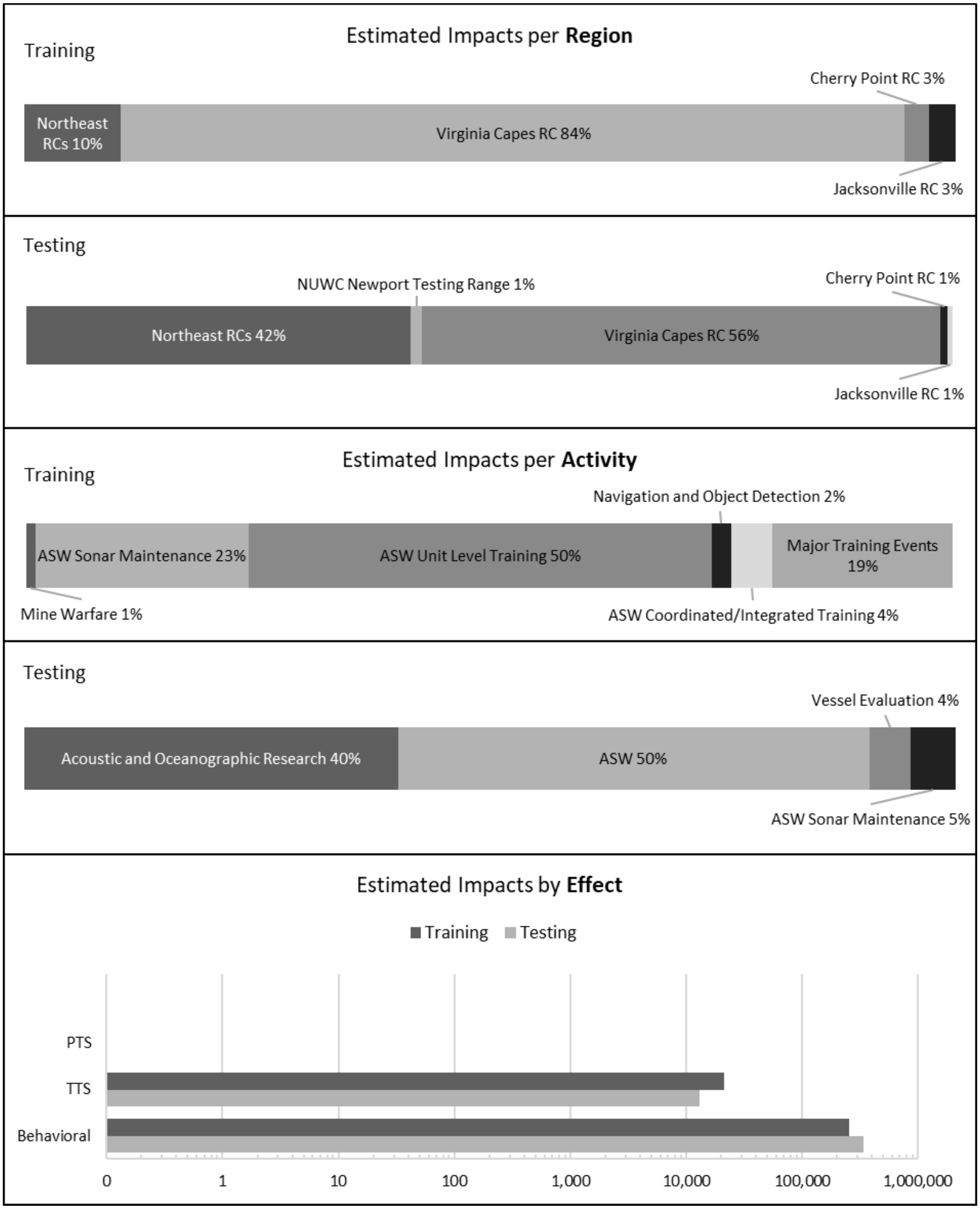
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of short-beaked common dolphins incidental to those activities.

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

Short-beaked common dolphins may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-74 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-74: Short-Beaked Common Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Spinner Dolphins

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

Spinner dolphins may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-75 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-53).

As described for other 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 will 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 spinner dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Spinner dolphins may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-75 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-53).

As described for other 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 will 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 spinner dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-75: Spinner Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.7-53: Estimated Impacts on Individual Spinner Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	56%	38%
Western North Atlantic	44%	62%

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

Spinner dolphins may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-76 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-54).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

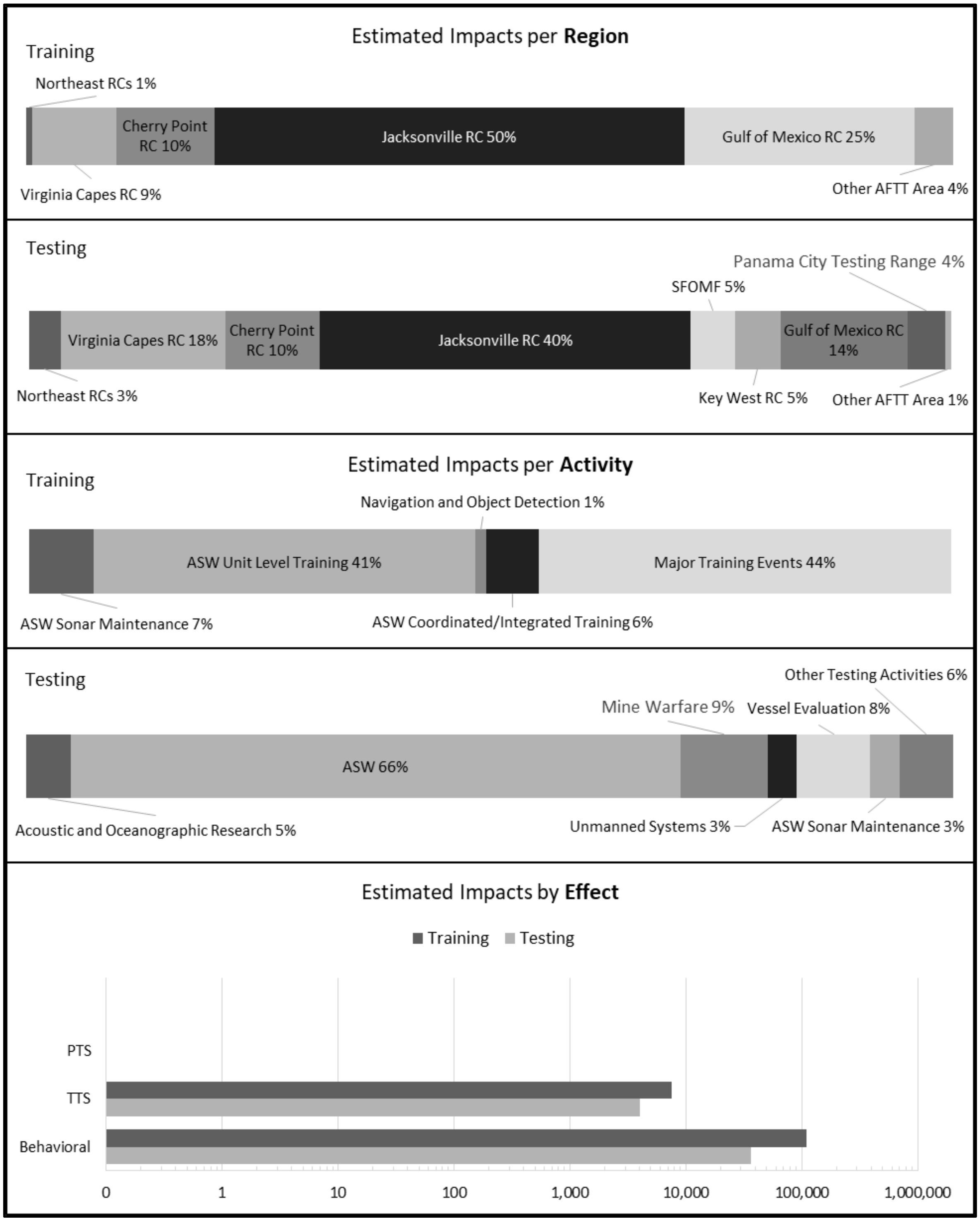
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of spinner dolphins incidental to those activities.

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

Spinner dolphins may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-76 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-54).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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 spinner dolphins incidental to those activities.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-76: Spinner Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.7-54: Estimated Impacts on Individual Spinner Dolphin Stocks Within the Study Area per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	25%	19%
Western North Atlantic	75%	81%

Striped Dolphins

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

Striped dolphins may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-77 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-55).

As described for other 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 will 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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Striped dolphins may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-77 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-55).

As described for other 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 will 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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species.
AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-77: Striped Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

Table 3.7-55: 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 per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	20%	5%
Western North Atlantic	80%	95%

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

Striped dolphins may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-78 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-56).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

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 sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-78 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to multiple stocks (see Table 3.7-56).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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.

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species.
AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-78: Striped Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Table 3.7-56: 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 per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	5%	2%
Western North Atlantic	95%	98%

White-Beaked Dolphin

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

White-beaked dolphins may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-79 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

As described for other 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

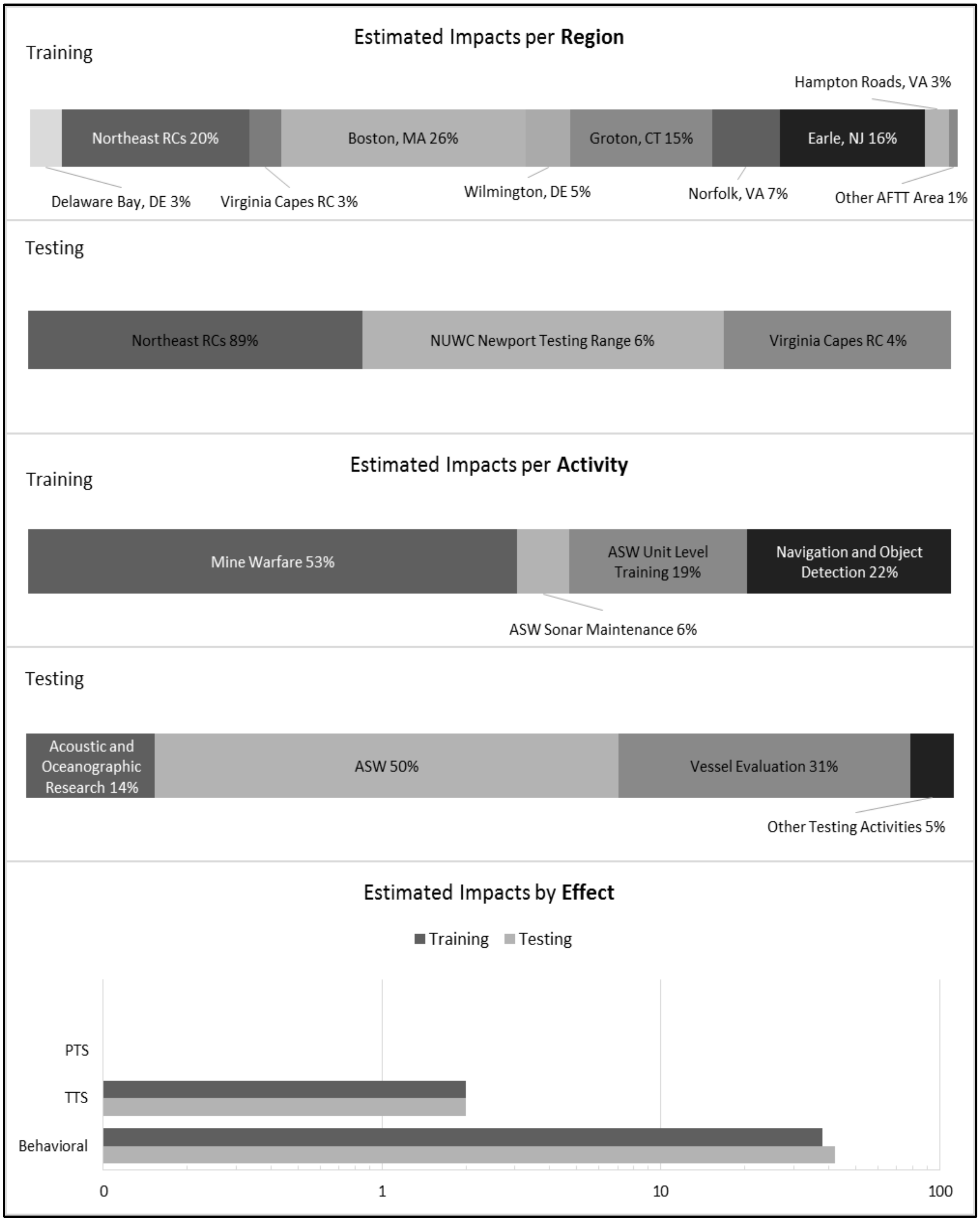
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of white-beaked dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

White-beaked dolphins may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-79 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

As described for other 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 will 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 white-beaked dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent western North Atlantic stock. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-79: White-Beaked Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

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

White-beaked dolphins may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-80 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

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 white-beaked dolphins incidental to those activities.

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

White-beaked dolphins may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. See Figure 3.7-80 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stock.

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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 white-beaked dolphins incidental to those activities.

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-80: White-Beaked Dolphin Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Harbor Porpoises

Harbor porpoise are most likely to respond to exposures to sonar and other transducers with behavioral reactions or minor to moderate TTS that would fully recover quickly (i.e., a few minutes to a few hours). The quantitative analysis predicts a few PTS per year; however, as discussed above, marine mammals would likely avoid sound levels that could cause higher levels of TTS (greater than 20 dB) or PTS. 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. Harbor porpoises that do experience hearing loss (i.e., TTS or PTS) from sonar sounds may have reduced ability to detect biologically important sounds until their hearing recovers. TTS would be recoverable and PTS would leave some residual hearing loss. During the period that a harbor porpoise had hearing loss, biologically important sounds could be more difficult to detect or interpret. Harbor porpoises use echolocation clicks, which are at frequencies above 100 kHz, to find and capture prey. Therefore, echolocation is unlikely to be affected by a threshold shifts at lower frequencies and should not affect a harbor porpoise's ability to locate prey or rate of feeding.

Research and observations (see Section 3.7.3.1.1.5, Behavioral Reactions) of harbor porpoises show that this small species is very wary of human activity and will avoid anthropogenic sound sources in many situations at levels down to 120 dB re 1 µPa. This level was determined by observing harbor porpoise reactions to acoustic deterrent and harassment devices used to drive away animals from around fishing nets and aquaculture facilities. Avoidance distances typically were about 1 km or more to these low-level acoustic sources (i.e., transducers). It is unlikely that animals would react similarly if the sound source were at a distance of tens of kilometers based on observed responses to seismic noise extending at most to 30 km. Harbor porpoises may startle and leave the immediate area of the anti-submarine warfare training exercise but return within a few days after the cessation of the event. Significant behavioral reactions seem more likely than with most other odontocetes. Since these species are typically found in nearshore and inshore habitats, animals that are resident during all or part of the year near Navy ports or fixed ranges could receive multiple exposures over a short period and throughout the year. Animals that do exhibit a significant behavioral reaction would likely recover from any incurred costs, reducing the likelihood of long-term consequences for the individual or population.

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 a few PTS per year under Alternative 1. See Figure 3.7-81 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the Gulf of Maine/Bay of Fundy stock.

A few 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

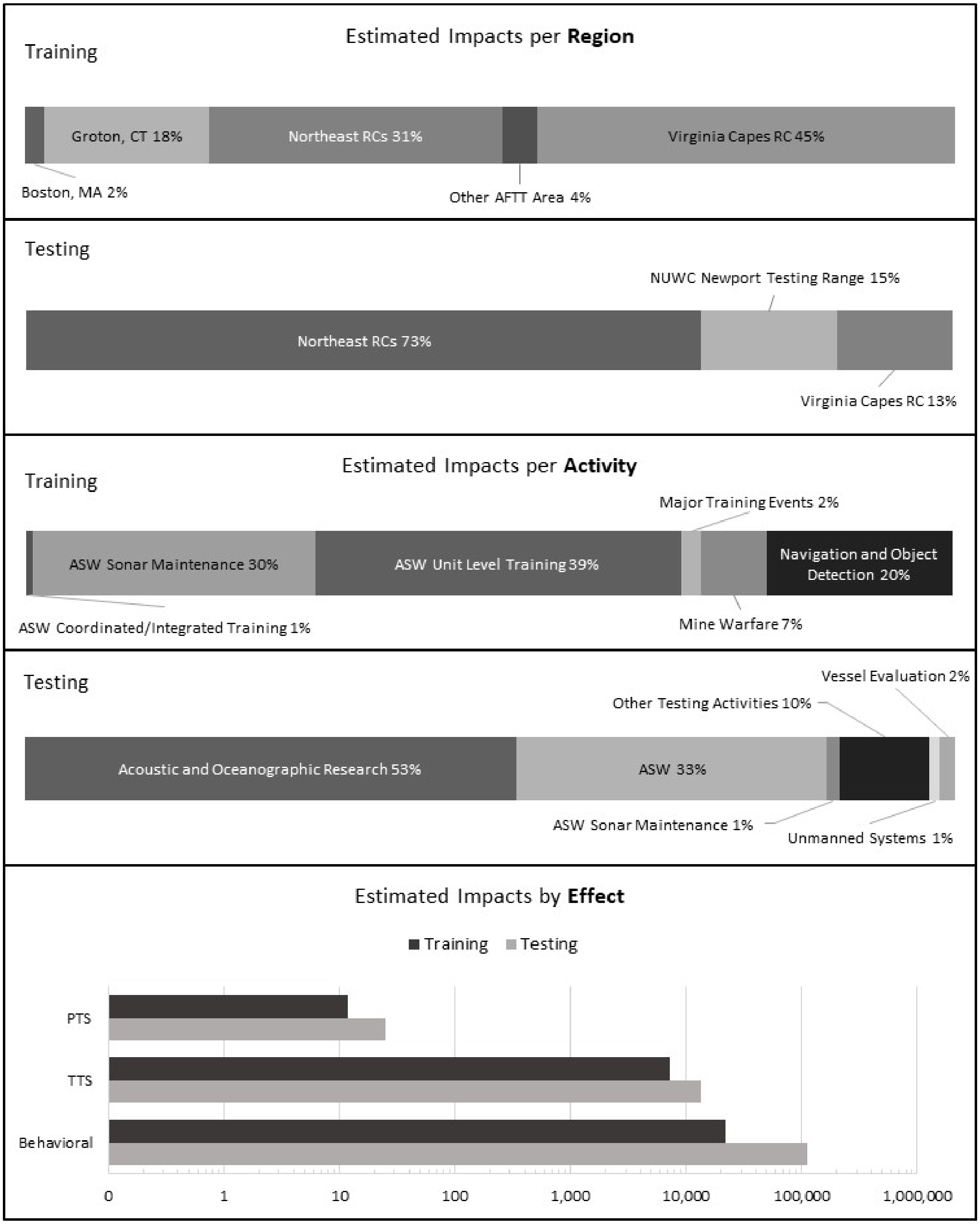
A small and resident population area for harbor porpoises identified by (LaBrecque et al., 2015a) overlaps a portion of the northeast corner of the Northeast Range Complexes. Navy training activities that use sonar and other transducers could occur year-round within the Northeast Range Complexes. Impacts on harbor porpoises could occur within the small and resident population area identified by (LaBrecque et al., 2015a). As discussed above, harbor porpoise reactions to sonar could be significant in some cases. Due to the limited overlap of the identified harbor porpoise area and the Northeast Range Complexes, only a subset of estimated behavioral reactions would occur within the identified harbor porpoise small and resident population area. It is unlikely that these behavioral reactions would have significant impacts on the natural behavior of harbor porpoises or cause abandonment of the harbor porpoise small and resident population area identified by (LaBrecque et al., 2015a). In addition to procedural mitigation that is implemented whenever and wherever active sonar activities occur, the Navy will implement mitigation for active sonar within the Northeast North Atlantic Right Whale Mitigation Area. This will further avoid or reduce potential impacts on the small and resident population of harbor porpoises identified by LaBrecque et al. (2015a) (see Section 5.4.2, Mitigation Areas off the Northeastern United States).

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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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 a few PTS per year under Alternative 1. See Figure 3.7-81 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the Gulf of Maine/Bay of Fundy stock.

A few 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. 100 percent Gulf of Maine/Bay of Fundy stock. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-81: Harbor Porpoise Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

A small and resident population area for harbor porpoises identified by LaBrecque et al. (2015a) overlaps a portion of the northeast corner of the Northeast Range Complexes. Navy testing activities that use sonar and other transducers could occur year-round within the Northeast Range Complexes. Impacts on harbor porpoises could occur within the small and resident population area identified by LaBrecque et al. (2015a). As discussed above, harbor porpoise reactions to sonar could be significant in some cases. Due to the limited overlap of the identified harbor porpoise area and the Northeast Range Complexes, only a subset of estimated behavioral reactions would occur within the identified harbor porpoise small and resident population area. It is unlikely that these behavioral reactions would have significant impacts on the natural behavior of harbor porpoises or cause abandonment of the harbor porpoise small and resident population area identified by LaBrecque et al. (2015a). In addition to procedural mitigation that is implemented whenever and wherever active sonar activities occur, the Navy will implement mitigation for active sonar within the Northeast North Atlantic Right Whale Mitigation Area. This will further avoid or reduce potential impacts on the small and resident population of harbor porpoises identified by LaBrecque et al. (2015a) (see Section 5.4.2, Mitigation Areas off the Northeastern United States).

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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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 a few PTS per year under Alternative 2. See Figure 3.7-82 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the Gulf of Maine/Bay of Fundy stock.

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

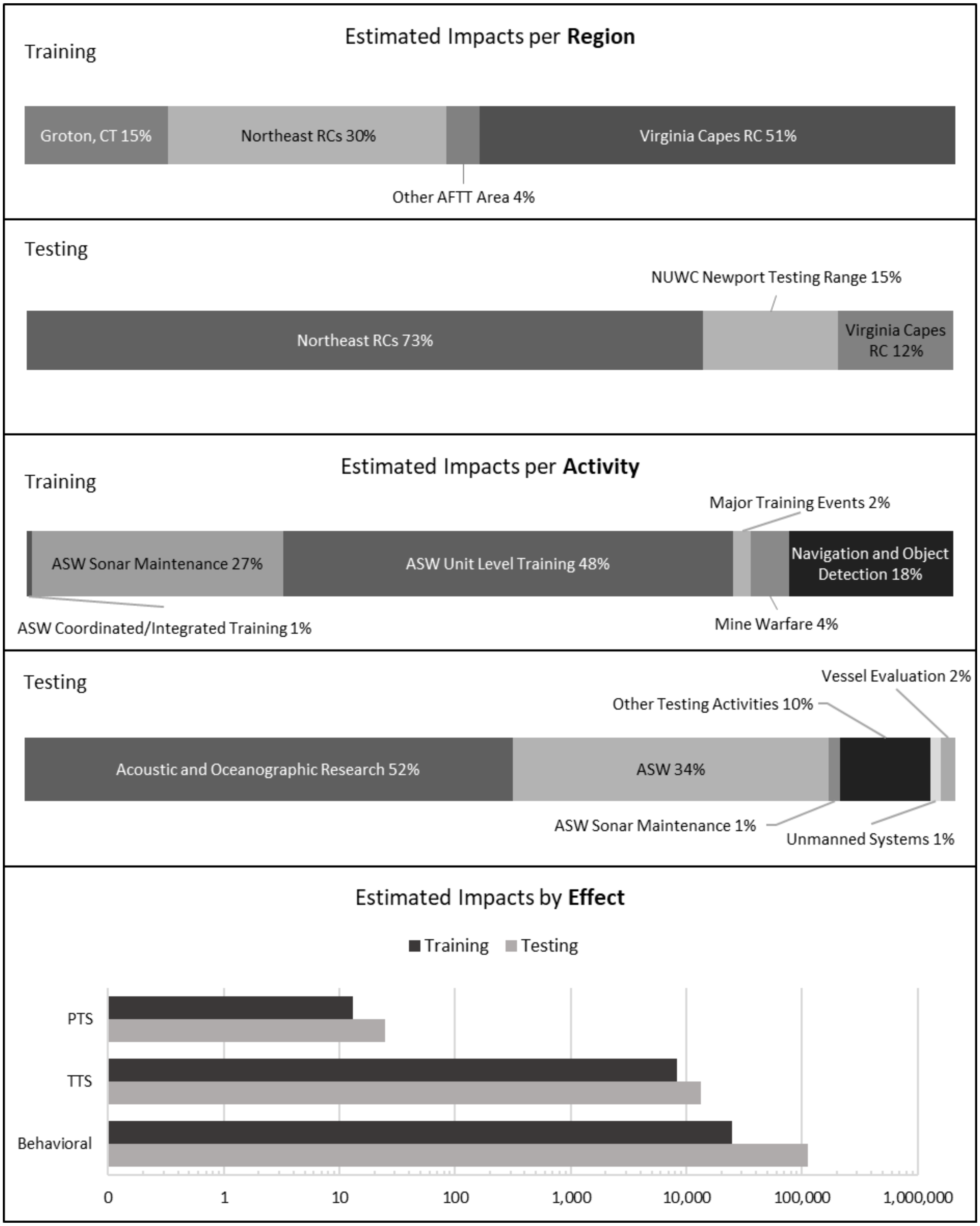
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of harbor porpoises incidental to those activities.

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 a few PTS per year under Alternative 2. See Figure 3.7-82 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the Gulf of Maine/Bay of Fundy stock.

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. 100 percent Gulf of Maine/Bay of Fundy stock. ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-82: Harbor Porpoise Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Phocid Seals

Phocid seals in AFTT Study Area include harbor seals, gray seals, harp seals, hooded seals, bearded seals and ringed seals. Most of these species primary ranges are north of the AFTT Study Area.

Phocid seals may be exposed to sound from sonar and other transducers associated with training activities throughout the year. Low- (less than 1 kHz), mid- (1 to 10 kHz), and high-frequency (10 to 100 kHz) sonars produce sounds that are likely to be within the audible range of phocid seals (see Section 3.7.2.1.4, 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.

A few behavioral reactions in phocid seals 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 3.7.3.1.1.5, 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. Almost all of the impacts estimated by the quantitative assessment are due to navigation and object avoidance (detection) activities in navigation lanes entering Groton, Connecticut. Navigation and object avoidance (detection) activities normally involve a single ship or submarine using a limited amount of sonar, therefore significant reaction are unlikely, especially in phocid seals. Research shows that pinnipeds in the water are generally tolerant of human made sound and activity (see Section 3.7.3.1.1.5, Behavioral Reactions). If seals are exposed to sonar or other active acoustic sources, 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. Seals 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. The use of sonar from navigation and object avoidance in Groton, Connecticut likely exposes the same sub-population of animals multiple times throughout the year. However, as discussed above phocid seals do not appear sensitive to sound in the water so few of the impacts estimated by the quantitative analysis are likely to be significant. Significant behavioral reactions would not be expected in most cases, and long-term consequences for individual seals from a single or several impacts per year are unlikely.

Behavioral research indicates that most phocid seals 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 phocid seal had TTS, social calls from conspecifics could be more difficult to detect or interpret. Killer whales are a primary predator of phocid seals. Some TTS could make killer whale calls more difficult to detect at further ranges until hearing recovers. Phocid seals probably use sound and vibrations to find and capture prey underwater. Therefore, it could be more difficult for phocid seals 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 3.7.3.1.1.4 (Masking). Many low- (less than 1 kHz), mid- (1 to 10 kHz), and high-frequency (10 to 100 kHz) sonars produce sounds that are likely to be within the hearing range of phocid seals. 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 phocid seals due to exposure to sonar used during anti-submarine warfare activities. Phocid seals 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 phocid seals 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, phocid seals 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. Phocid seals probably use sound and vibrations to find and capture prey underwater. Therefore, it could be more difficult for phocid seals 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 phocid per year are unlikely to have any long-term consequences for that individual.

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

Phocid seals 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 under Alternative 1. See Figure 3.7-83 through Figure 3.7-86 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stocks of gray, harbor, harp, and hooded seals.

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.

It is likely that the same sub-population of seals that are resident during all or part of the year at Groton, Connecticut are exposed to navigation and object detection (avoidance) sonar and other transducers multiple times per year; however, phocid seals are likely to only have minor and short-term behavioral reactions to these types of activities. Considering these factors and the mitigation measures that will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

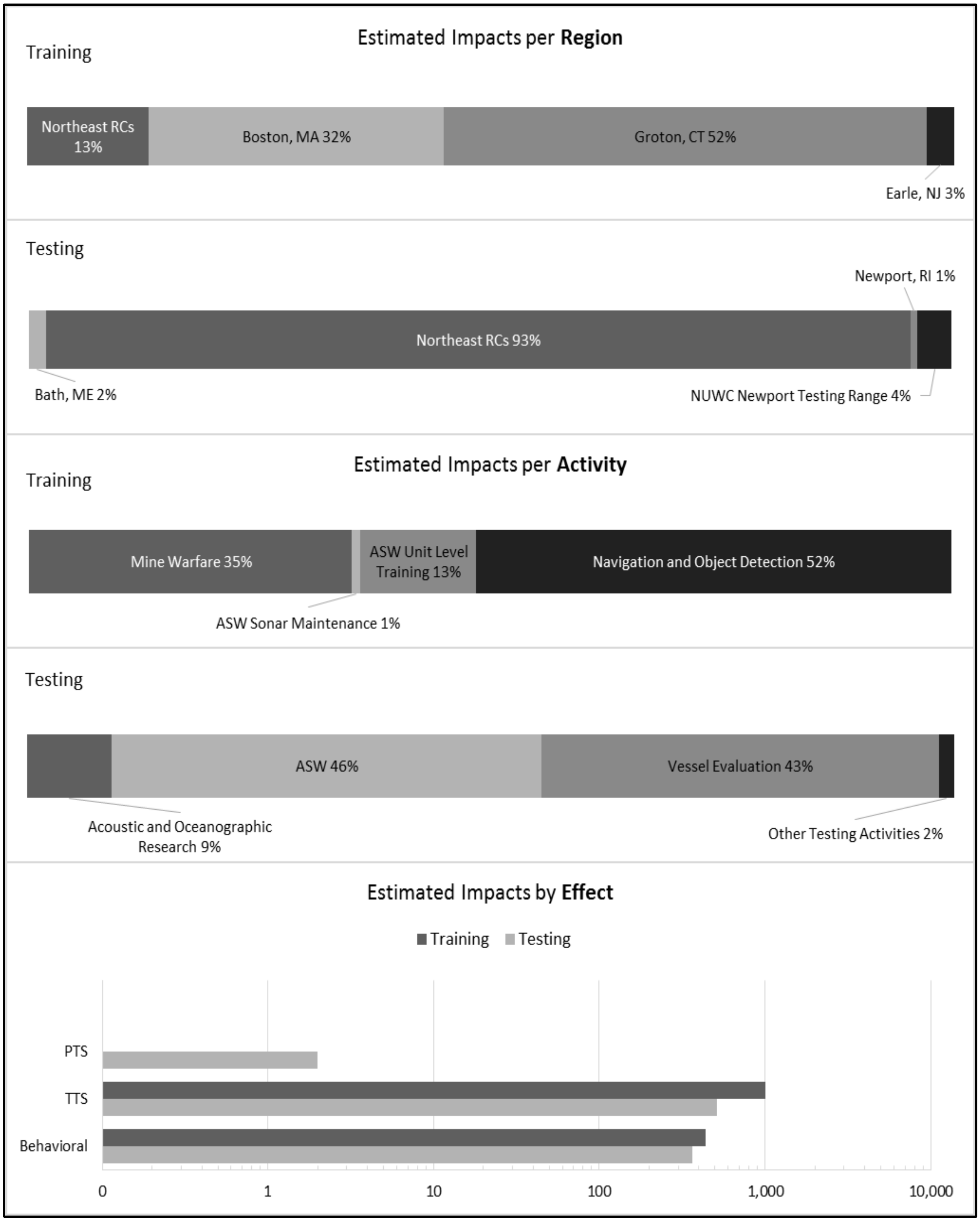
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will result in the unintentional taking of phocid seals incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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

Phocid seals 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 under Alternative 1. See Figure 3.7-83 through Figure 3.7-86 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stocks of gray, harbor, harp, and hooded seals.

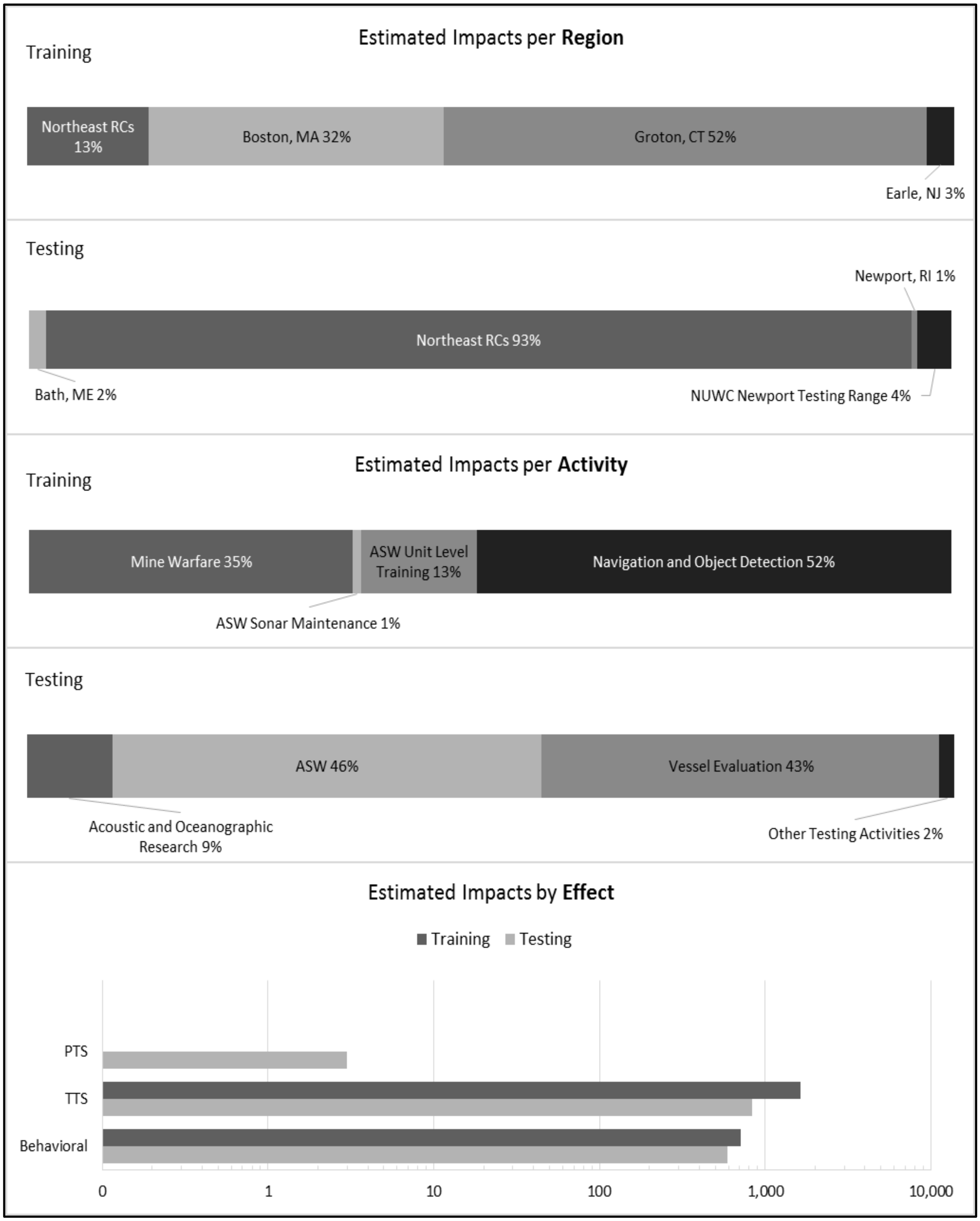
As described above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. PTS could reduce an animal's ability to detect biologically important sounds; however, as discussed 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 will 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 phocid seals incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



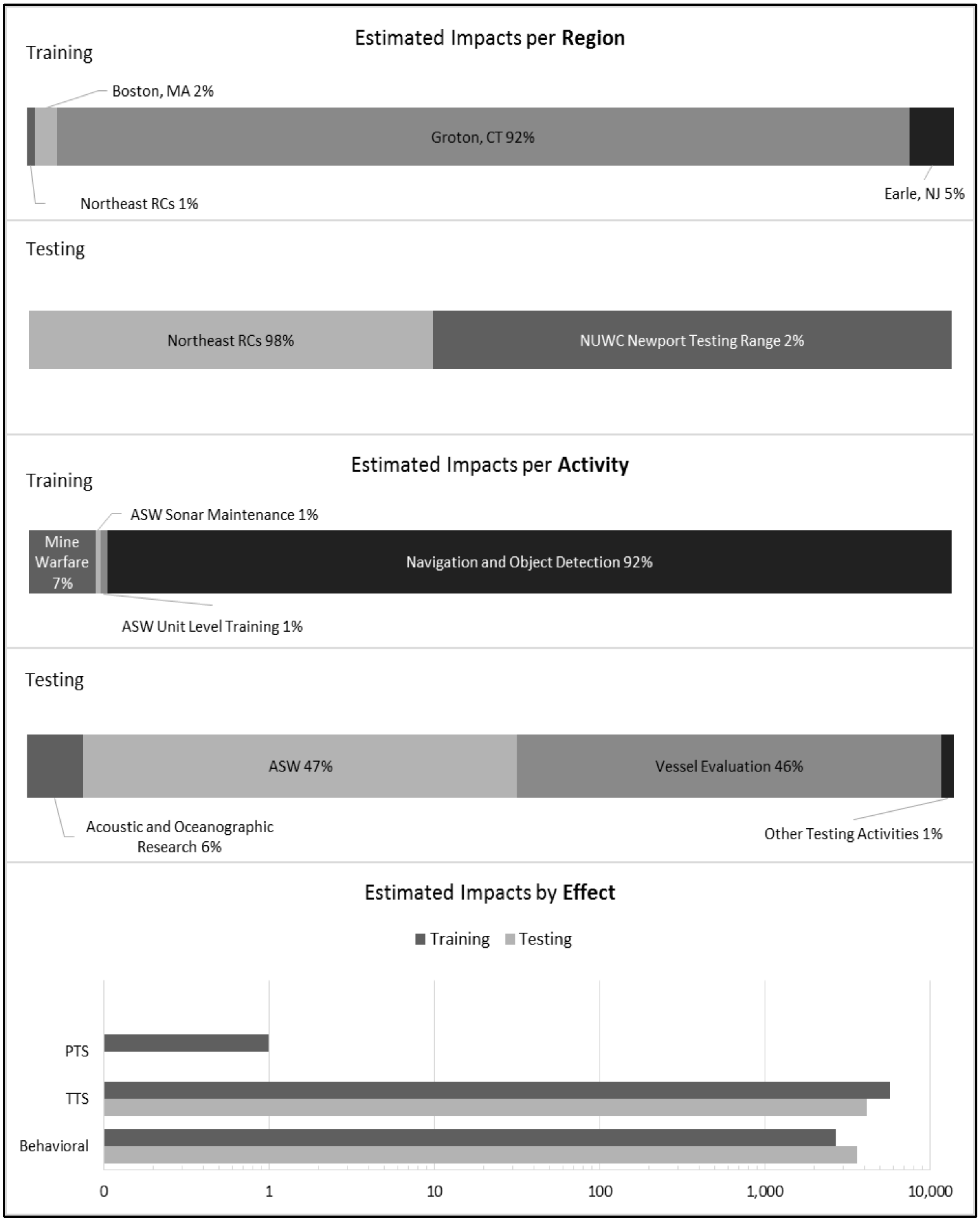
Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-83: Gray Seal Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1



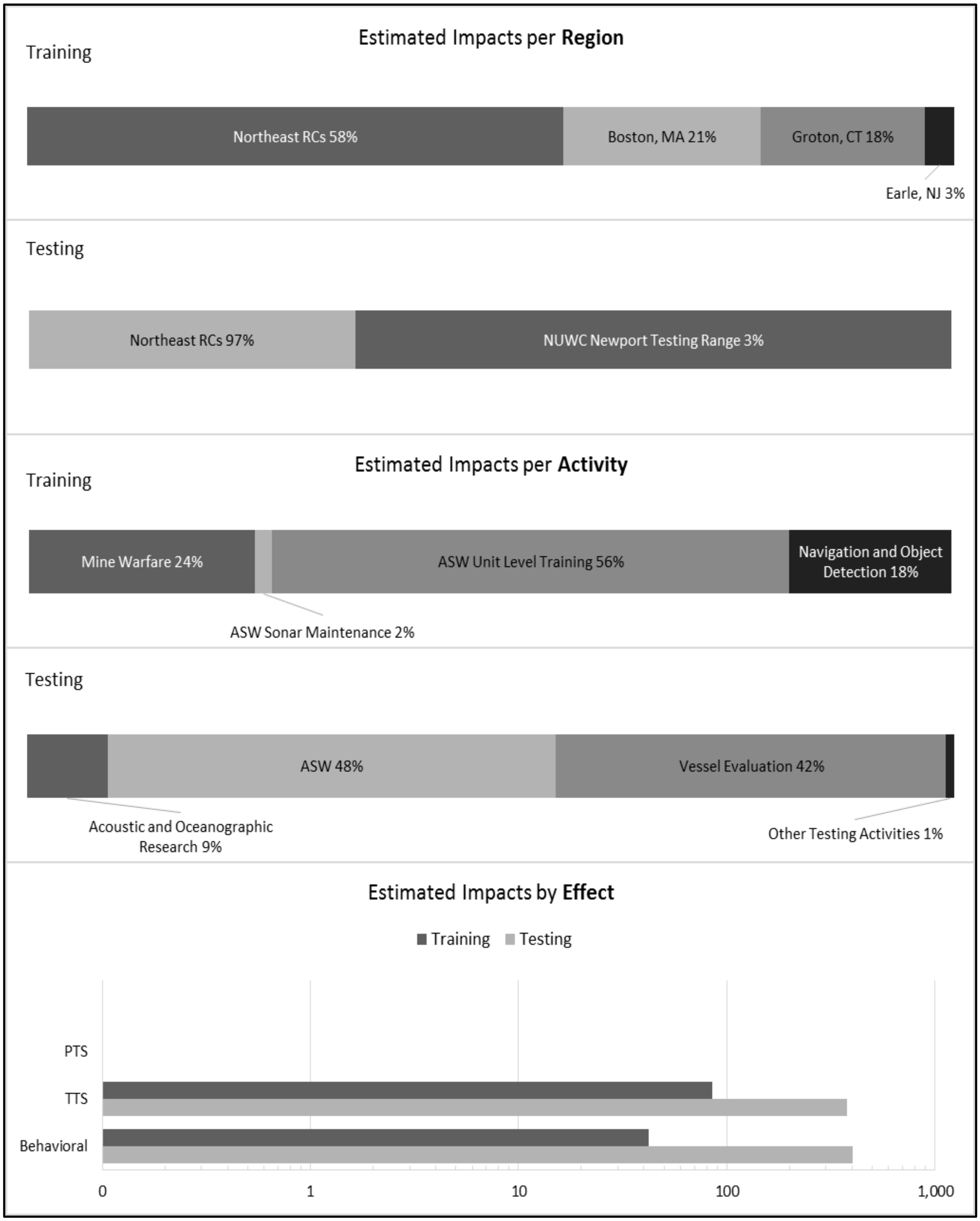
Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-84: Harbor Seal Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; SFOMF: South Florida Ocean Measurement Facility; TTS: temporary threshold shift

Figure 3.7-85: Harp Seal Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-86: Hooded Seal Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 1

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

Phocid seals 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 under Alternative 2. See Figure 3.7-87 through Figure 3.7-90 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stocks of gray, harbor, harp, and hooded seals.

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

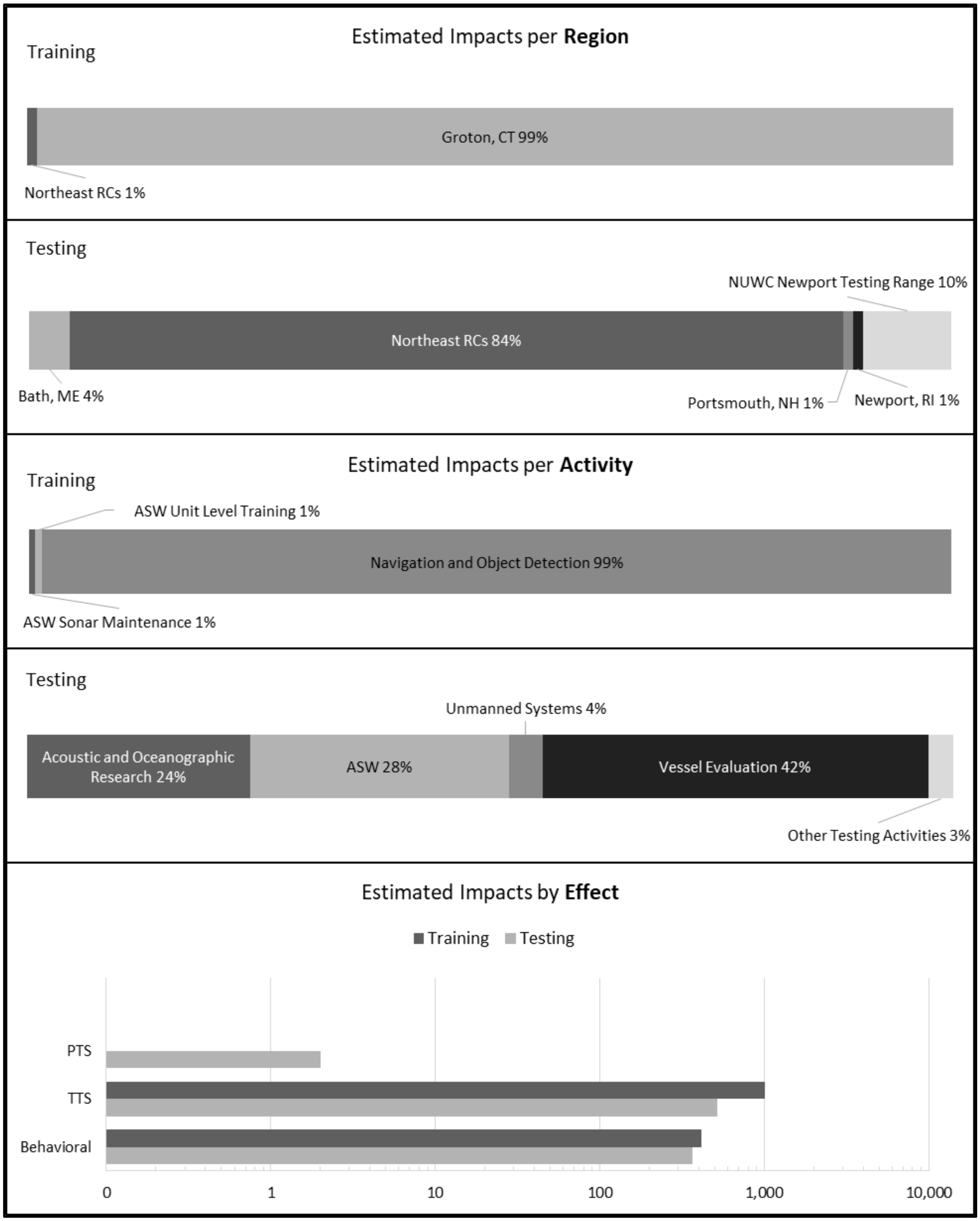
Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will result in the unintentional taking of phocid seals incidental to those activities.

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

Phocid seals 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 under Alternative 2. See Figure 3.7-87 through Figure 3.7-90 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers). Estimated impacts apply to the western North Atlantic stocks of gray, harbor, harp, and hooded seals.

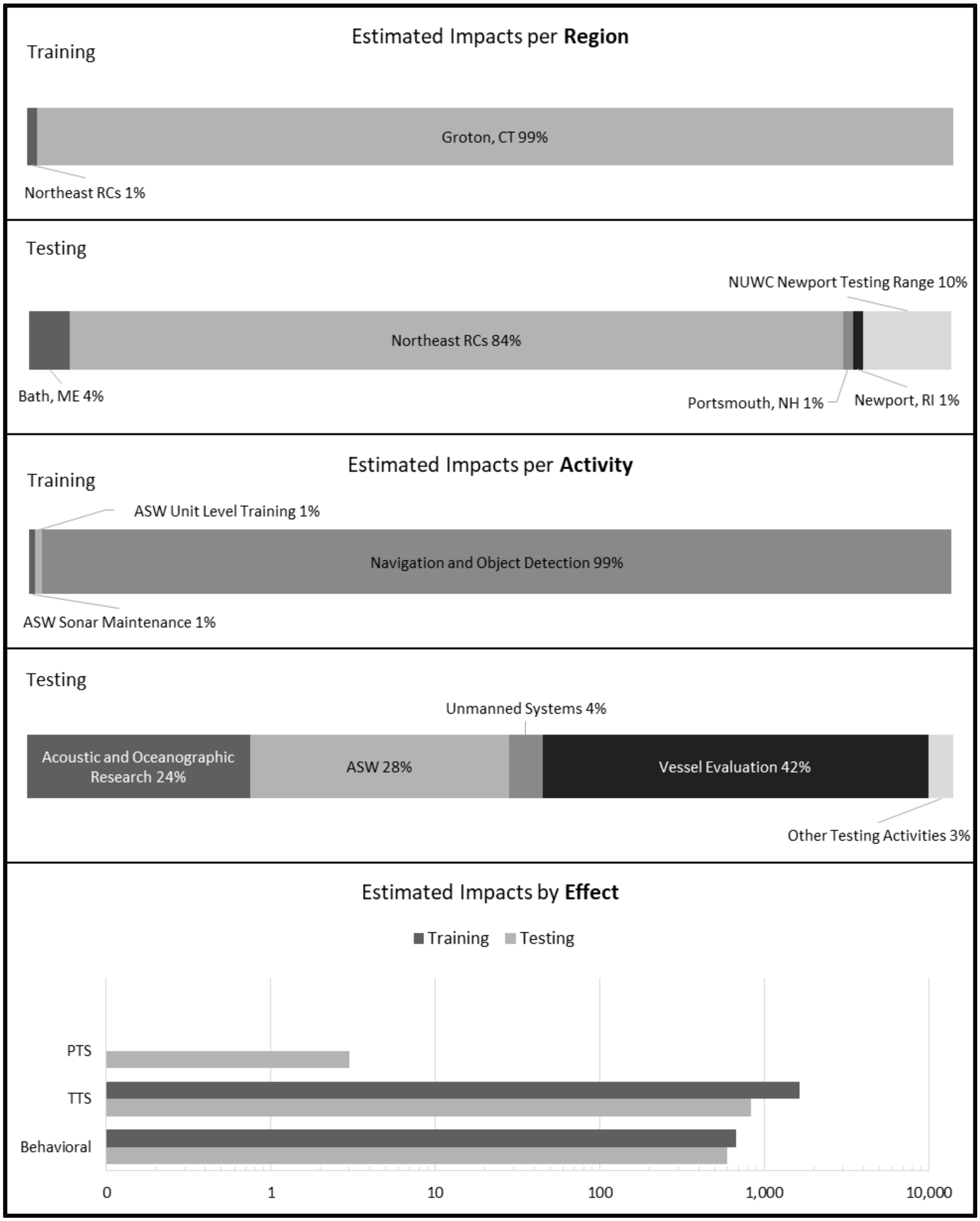
Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

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 phocid seals incidental to those activities.



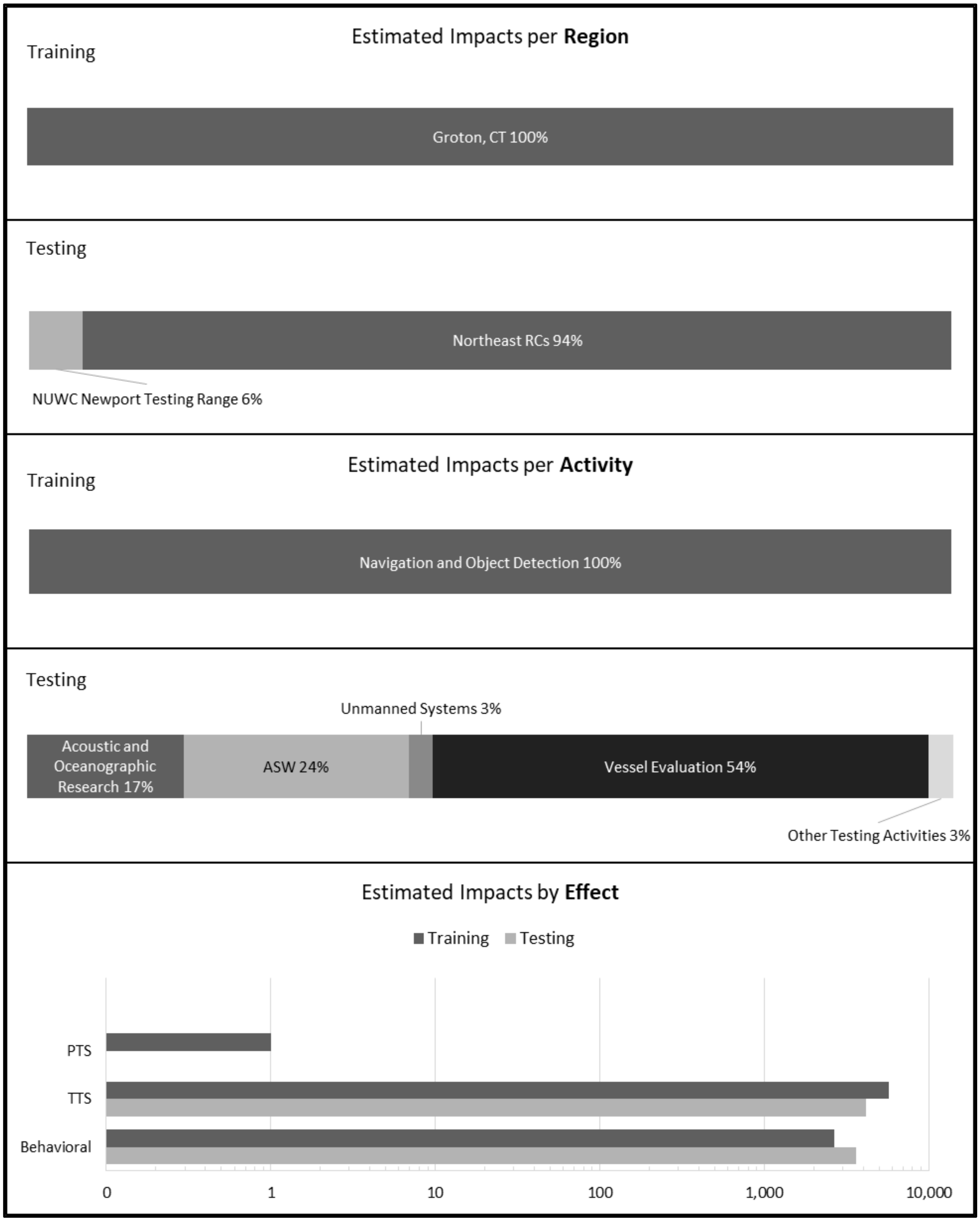
Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-87: Gray Seal Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2



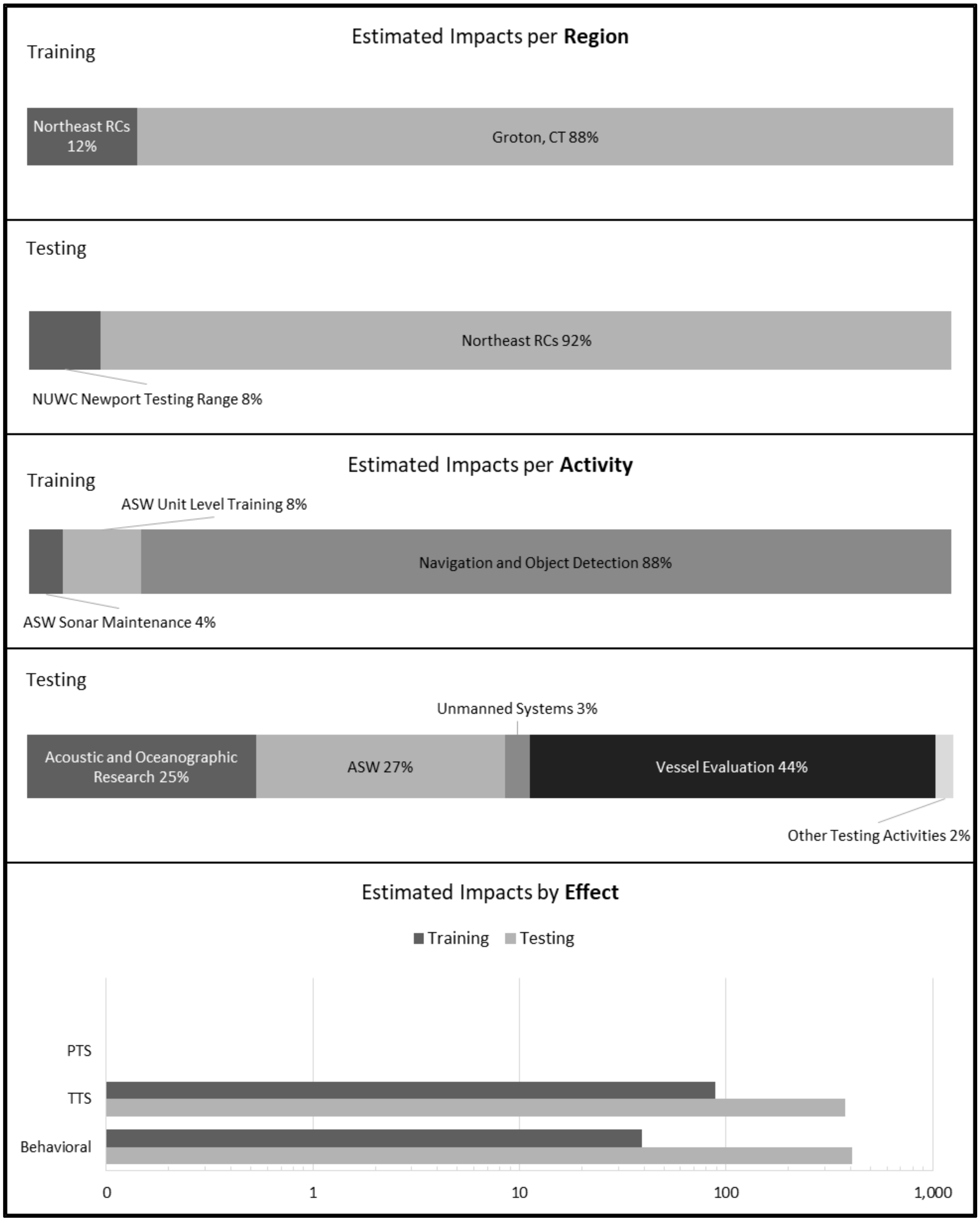
Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-88: Harbor Seal Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-89: Harp Seal Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. No PTS is estimated for this species. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; NUWC: Naval Undersea Warfare Center; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-90: Hooded Seal Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing Under Alternative 2

Manatees (Endangered Species Act-Listed)

Manatees may be exposed to sound from sonar and other transducers associated with training activities throughout the year. Low- (less than 1 kHz), mid- (1 to 10 kHz), and high-frequency (10 to 100 kHz) sonars produce sounds that are likely to be within the audible range of manatees (see Section 3.7.2.1.4, 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.

It is assumed in the quantitative analysis that a few behavioral reactions in manatees resulting from exposure to sonar or other transducers could take place at distances of up to 20 km, although manatees typically live in inshore water with limited open water. 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, especially for manatees. Most manatee impacts are estimated due to navigation and object detection (avoidance) training and testing since these activities typically occur entering and leaving Navy homeports that overlap the distribution of coastal populations of this species. Navigation and object detection (avoidance) activities normally involve a single ship or submarine using a limited amount of sonar, therefore significant reactions are unlikely. Reactions to anti-submarine warfare activities are more likely; however, research shows that manatees are generally tolerant, or perhaps habituated, to high levels of human-made noise and activity. Manatees that have been observed reacting have done so by alerting and swimming to deeper water. Manatees may not react at all until the sound source is approaching within a few hundred meters. Animals disturbed while engaged in important behaviors such as feeding or mating may be more likely to ignore or tolerate the disturbance and continue their natural behavior patterns. Therefore, the quantitative analysis overestimates the number of behavioral reaction in manatees and behavioral reactions, if they were to occur, are likely to be short term and low severity.

As with other marine mammals, manatees are likely to avoid sound sources at levels that would cause any hearing loss (i.e., TTS) and would certainly avoid sound levels that could cause higher levels of TTS (greater than 20 dB of TTS). 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. Manatees that do experience TTS from sonar sounds 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 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 mysticete had TTS, social calls from conspecifics could be more difficult to detect or interpret. Manatees feed on sea grass and macroalgae, so it unlikely that they use sound for feeding; therefore, a TTS would not affect a manatee's ability to feed. A single or even a few minor TTS (less than 20 dB of TTS) to an individual manatee 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 3.7.3.1.1.4 (Masking). Many low- (less than 1 kHz), mid- (1 to 10 kHz), and high-frequency (10 to 100 kHz) sonars produce sounds that are likely to be within the audible range of manatees. Many anti-submarine warfare (anti-submarine warfare) sonars and countermeasures use these frequency ranges. Most mid- and low-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 manatees. High-frequency (greater than 10 kHz) sonars fall outside of the best hearing and vocalization ranges of manatees (Section 3.7.2.1.4, Hearing and Vocalization). Furthermore, high frequencies (above 10 kHz) attenuate more rapidly in the water than do lower-frequency signals, thus producing only a small zone of potential masking. Sonars that employ high frequencies are typically used for mine hunting, navigation, and object detection (avoidance). Masking in manatees due to exposure to high-frequency sonar is unlikely. Potential costs to manatees 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.

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

Manatees may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. Impact ranges for this species are discussed in Section 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers).

As described above, even a few 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. Mitigation measures that will be implemented as described in Chapter 5 (Mitigation) will help avoid or reduce the probability or severity of potential impacts. For example, the Navy will power down or cease the transmission of active sonar in response to a sighting of a marine mammal with an applicable mitigation zone whenever and wherever active sonar activities occur. The Navy will implement additional procedural mitigation measures for active sonar at Kings Bay, Georgia, and Port Canaveral, Florida, to further avoid or reduce potential impacts on manatees at these locations (see Section 5.3.2.1, Active Sonar). For example, the Navy will equip Lookouts with polarized sunglasses and conduct active sonar activities during daylight hours to ensure adequate sightability of manatees. The Navy will reduce mid-frequency active sonar transmissions at Kings Bay by at least 36 dB from full power, which will reduce the level of potential active sonar exposure.

Manatees within the Port Canaveral, Mayport, and Kings Bay portions of the designated West Indian manatee critical habitat areas may be exposed to sound from sonar and other active acoustic sources. Important elements of the habitat required by the West Indian manatee for feeding and breeding have been reported as the presence of seagrasses and warm water refuges, which would not be affected by these proposed activities.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 1 will not result in the unintentional taking of manatee incidental to those activities.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 1 may affect ESA-listed manatees and will have no effect on manatee critical habitat. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in that regard.

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

Manatees may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 1. See Figure 3.7-91 below or Appendix E (Estimated Marine Mammals 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 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers).

As described above, even a few 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. Mitigation measures that will be implemented as described in Chapter 5 (Mitigation) will help avoid or reduce the probability or severity of potential impacts. For example, the Navy will power down or cease the transmission of active sonar in response to a sighting of a marine mammal with an applicable mitigation zone whenever and wherever active sonar activities occur. The Navy will implement additional procedural mitigation measures for active sonar at Kings Bay, Georgia, and Port Canaveral, Florida, to further avoid or reduce potential impacts on manatees at these locations (see Section 5.3.2.1, Active Sonar). For example, the Navy will equip Lookouts with polarized sunglasses and conduct active sonar activities during daylight hours to ensure adequate sightability of manatees. The Navy will reduce mid-frequency active sonar transmissions at Kings Bay by at least 36 dB from full power, which will reduce the level of potential active sonar exposure.

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Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 1 will not result in the unintentional taking of manatee incidental to those activities.

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

Manatees may be exposed to sound from sonar and other transducers used during training activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. Impact ranges for this species are discussed in Section 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with training activities under Alternative 2 versus Alternative 1.

Pursuant to the MMPA, the use of sonar and other transducers during training activities as described under Alternative 2 will not result in the unintentional taking of manatee 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 manatees and will have no effect on manatee critical habitat.

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

Manatees may be exposed to sound from sonar and other transducers used during testing activities throughout the year. The quantitative analysis estimates behavioral reactions and TTS under Alternative 2. Impact ranges for this species are discussed in Section 3.7.3.1.2.2 (Impact Ranges from Sonar and Other Transducers).

Potential impacts under Alternative 2 from sonar and other transducers would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in sonar use associated with testing activities under Alternative 2 versus Alternative 1.

Pursuant to the MMPA, the use of sonar and other transducers during testing activities as described under Alternative 2 will not result in the unintentional taking of manatee 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 manatees and will have no effect on manatee critical habitat.

Impacts from Sonar and Other Transducers Under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, training or testing activities associated with the Proposed Action would not be conducted in the AFTT Study Area. Based on the analysis presented in Section 3.7.3.1.2.3 (Impacts from Sonar and Other Transducers Under the Action Alternatives), impacts on individual marine mammals from activities that use sonar and other transducers could occur under either alternative, but impacts on marine mammal populations are not anticipated. Therefore, discontinuing activities that use sonar and other transducers under the No Action Alternative would remove the potential for impacts on individual marine mammals, but would not measurably improve the status of marine mammal populations or otherwise contribute to the recovery of threatened or endangered species that occur in the Study Area.

3.7.3.1.3 Impacts from Air Guns

Air guns use bursts of pressurized air to create broadband, impulsive sounds. Any use of air guns would typically be transient and temporary. Section 3.0.3.3.1.2 (Air Guns) provides additional details on the use and acoustic characteristics of the small air guns used in these activities.

3.7.3.1.3.1 Methods for Analyzing Impacts from Air Guns

The Navy performed a quantitative analysis to estimate the number times that marine mammals could be affected by air guns used during Navy 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 animals that may experience these effects; these estimates are further refined by considering animal avoidance of sound-producing activities and implementation of mitigation. The steps of this quantitative analysis are described in Section 3.0.1.2 (Navy's Quantitative Analysis to Determine Impacts to Sea Turtles and Marine Mammals), which takes into account:

- criteria and thresholds used to predict impacts from air guns (see below)
- the density and spatial distribution of 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 further detailed explanation of this analysis is provided in the technical report *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2018).

Criteria and Thresholds used to Predict Impacts on Marine Mammals from Air Guns

See 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) for detailed information on how the criteria and thresholds were derived.

Auditory Weighting Functions

Weighting functions are specific to each hearing group, but are the same across all noise types (e.g., sonar, air guns, and pile driving). See Auditory Weighting Functions under Section 3.7.3.1.2.1 (Methods for Analyzing Impacts from Sonars and Other Transducers), for information on the weighting thresholds used for analyzing sound from air guns.

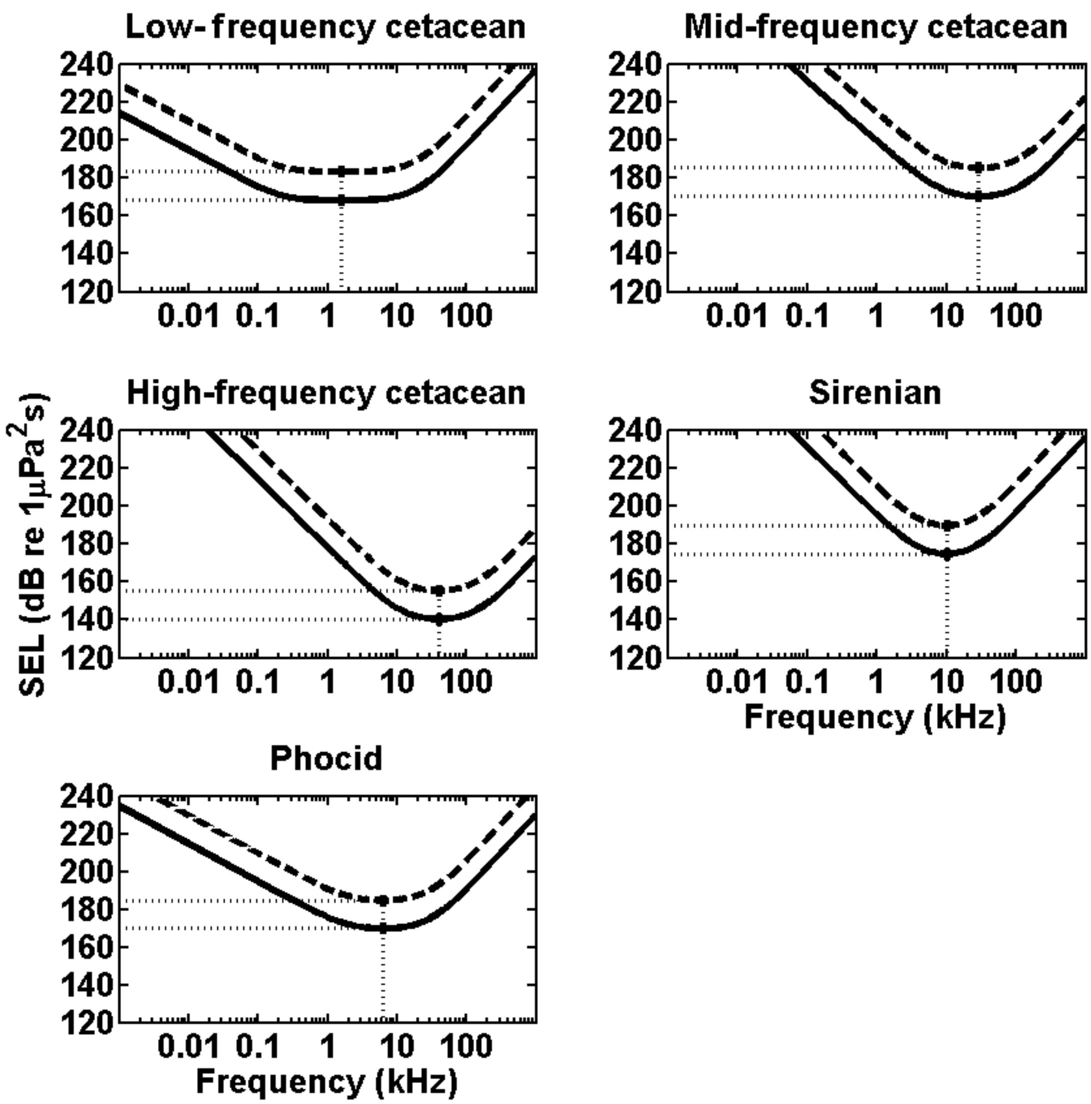
Hearing Loss from Air Guns

Criteria used to define threshold shifts from impulsive sound sources were 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 onset TTS SEL threshold for impulsive sources and 6 dB to the onset TTS peak SPL thresholds. This relationship was derived by Southall et al. (2007). These frequency dependent thresholds are depicted by the exposure functions for each group's range of best hearing (see Table 3.7-57 and Figure 3.7-91).

Table 3.7-57: Thresholds for Onset of TTS and PTS for Underwater Air Gun Sounds

Hearing Group	***Onset TTS***		***Onset PTS***	
	SEL dB re 1 μPa²s (weighted)	***SPL peak dB re 1 μPa (unweighted)***	***SEL dB re 1 μPa²s (weighted)***	***SPL peak dB re 1 μPa (unweighted)***
Low-frequency Cetaceans	168	213	183	219
Mid-frequency Cetaceans	170	224	185	230
High-frequency Cetaceans	140	196	155	202
Sirenians (Manatees)	175	220	190	226
Phocid seals in water	170	212	185	218

PTS: permanent threshold shift; SEL: sound exposure level; SPL: sound pressure level; TTS: temporary threshold shift



The solid dark curve is the exposure function for TTS onset and the large dashed curve is the exposure function for PTS onset. Small dashed lines indicate the SEL threshold for TTS and PTS onset at each group's most sensitive frequency (i.e., the weighted SEL threshold).

Figure 3.7-91: Temporary Threshold Shift and Permanent Threshold Shift Exposure Functions for Air Guns

Behavioral Responses from Air Guns

The existing NMFS Level B disturbance threshold of 160 dB re 1 µPa (root mean square) is applied to the unique sounds generated by air guns. The root mean square calculation for air guns is based on the duration defined by 90 percent of the cumulative energy in the impulse.

3.7.3.1.3.2 Impact Ranges for Air Guns

Table 3.7-58 and Table 3.7-59 present the approximate ranges in meters to PTS, TTS, and potential behavioral reactions for air guns for 10 and 100 pulses, respectively. Ranges are specific to the AFTT Study area and also specific to each marine mammal hearing group, dependent upon their criteria and the specific locations where animals from the hearing groups and the air gun activities could overlap.

Table 3.7-58: Range to Effects from Air Guns for 10 pulses

Range to Effects for Air Guns[1] for 10 pulses (m)					
Hearing Group	***PTS (SEL)***	***PTS (Peak SPL)***	***TTS (SEL)***	***TTS (Peak SPL)***	***Behavioral[2]***
High-Frequency Cetacean	0 (0—0)	15 (15—15)	0 (0—0)	25 (25—25)	700 (250—1,025)
Low-Frequency Cetacean	13 (12—13)	2 (2—2)	72 (70—80)	4 (4—4)	685 (170—1,025)
Mid-Frequency Cetacean	0 (0—0)	0 (0—0)	0 (0—0)	0 (0—0)	680 (160—2,275)
Phocids	0 (0—0)	2 (2—2)	3 (3—3)	4 (4—4)	708 (220—1,025)
Sirenians	0 (0—0)	0 (0—0)	0 (0—0)	0 (0—0)	493 (100—2,275)

[1]Average distance (m) to PTS, TTS, and behavioral thresholds are depicted above the minimum and maximum distances which are in parentheses. PTS and TTS values depict the range produced by SEL and Peak SPL (as noted) hearing threshold criteria levels.
[2] Behavioral values depict the ranges produced by RMS hearing threshold criteria levels.
m: meters; PTS: permanent threshold shift; SEL: sound exposure level; SPL: sound pressure level; TTS: temporary threshold shift

Table 3.7-59: Range to Effects from Air Guns for 100 pulses

Range to Effects for Air Guns[1] for 100 pulses (m)					
Hearing Group	***PTS (SEL)***	***PTS (Peak SPL)***	***TTS (SEL)***	***TTS (Peak SPL)***	***Behavioral[2]***
High-Frequency Cetacean	4 (4—4)	40 (40—40)	48 (45—50)	66 (65—70)	2,546 (1,025—5,525)
Low-Frequency Cetacean	122 (120—130)	3 (3—3)	871 (600—1,275)	13 (12—13)	2,546 (1,025—5,525)
Mid-Frequency Cetacean	0 (0—0)	0 (0—0)	0 (0—0)	0 (0—0)	2,546 (1,025—5,525)
Phocids	3 (2—3)	3 (3—3)	25 (25—25)	14 (14—15)	2,546 (1,025—5,525)
Sirenians	0 (0—0)	0 (0—0)	0 (0—0)	2 (2—2)	2,545 (900—6,275)

[1]Average distance (m) to PTS, TTS, and behavioral thresholds are depicted above the minimum and maximum distances which are in parentheses. PTS and TTS values depict the range produced by SEL and Peak SPL (as noted) hearing threshold criteria levels.
[2]Behavioral values depict the ranges produced by RMS hearing threshold criteria levels.
m: meters; PTS: permanent threshold shift; SEL: sound exposure level; SPL: sound pressure level; TTS: temporary threshold shift

3.7.3.1.3.3 Impacts from Air Guns Under Alternative 1

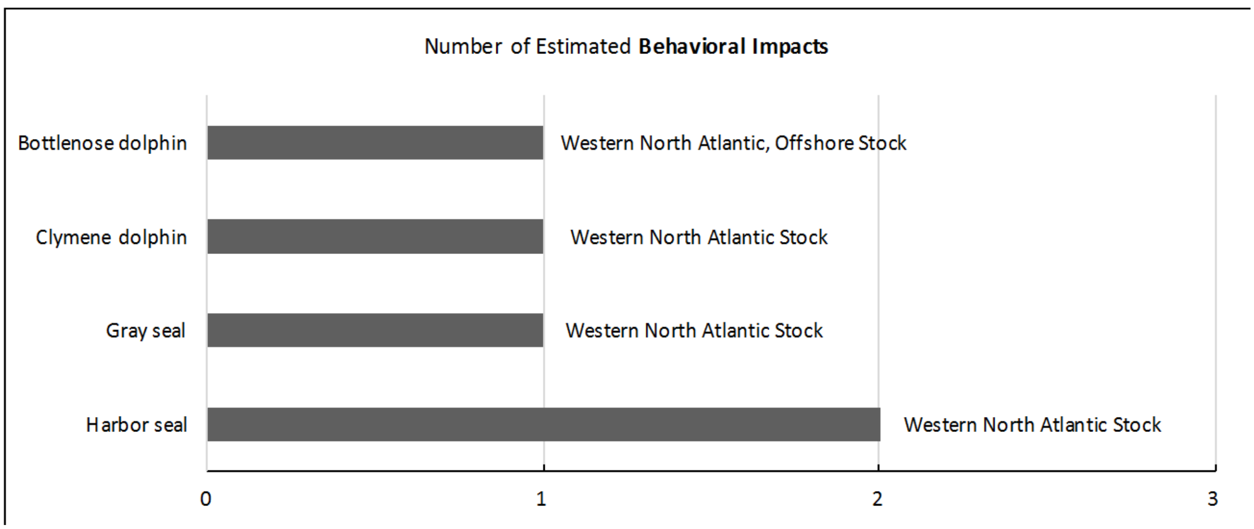
Impacts from Air Guns Under Alternative 1 for Training Activities

Training activities do not include the use of air guns.

Impacts from Air Guns Under Alternative 1 for Testing Activities

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

Single, small air guns lack the peak pressures that could cause non-auditory injury (see Finneran et al. (2015); also Section 3.7.3.2.1.1, Injury, in Section 3.7.3.2, Explosive Stressors). Potential impacts could include temporary hearing loss, behavioral reactions, physiological stress and masking, although the quantitative analysis only estimates behavioral responses (see Figure 3.7-92 and Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities, for tabular results).



No TTS or PTS is estimated for any species. No impacts are anticipated for any other species within the AFTT Study Area. See Appendix E (Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities) for tabular results.

Figure 3.7-92: Estimated Annual Behavioral Responses from Air Gun Use

Research and observations (see Section 3.7.3.1.1.5, Behavioral Reactions) show that if marine mammals are exposed to sounds from air guns they could potentially react with short-term behavioral reactions and physiological stress. It is important to point out that many observations of marine mammal reactions to air guns are from oil and gas exploration activities that use large air gun arrays and operate continuously for multiple weeks to cover large areas of the ocean. Navy activities, in contrast, only use single air guns over a much shorter period over a limited area. Reactions to single air guns, which are used in a limited fashion, are less likely to occur or rise to the same level of severity. Cetaceans (both mysticetes and odontocetes) may react in a variety of ways to impulsive sounds, which may include alerting, startling, breaking off feeding dives and surfacing, diving or swimming away, changing vocalization, or showing no response at all. Research shows that pinnipeds may be the least sensitive taxonomic group to most noise sources, and are likely to respond to loud impulsive sound sources only at close ranges by startling or ceasing foraging, but only for brief periods before returning to their previous behavior. Pinnipeds may even experience mild TTS before exhibiting a behavioral response (Southall et al., 2007). Marine mammals disturbed while engaged in 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 air gun activities is short term and intermittent, it is unlikely that a marine mammal would be exposed to noise that would result in any more than a short-term and mild to moderate behavioral responses.

The sound from air gun shots is broadband, but they have a very short duration, lasting for less than a second each, and are used intermittently. This limits the potential for any significant masking in marine mammals. The effects of masking are only present when the sound source is actively producing sound and the effect is over the moment the sound has ceased. Given these factors, significant masking is unlikely to occur in marine mammals due to exposure to sound from air guns.

As discussed above, estimated impacts on marine mammals from air gun sounds associated with testing activities are likely to consist of a small number of behavioral responses. Because these activities only occur a few times per year, have a small footprint of potential impacts with no impacts estimated for most species, and mitigation measures will be implemented as discussed in Section 5.3.2.2 (Air Guns), long-term consequences for any marine mammal species or stocks would be unlikely.

LaBrecque et al. (2015a) identified a North Atlantic right whale migration area, a reproduction area, and feeding areas, which overlap the Northeast and Virginia Capes Range Complexes. Although use of air guns would occur in these range complexes, the quantitative analysis estimates that no North Atlantic right whales would be exposed to levels of air gun sound that would result in any behavioral responses.

Feeding areas for sei, humpback, minke, and fin whales identified by LaBrecque et al. (2015a) overlap the Northeast Range Complexes within the Study Area. Similarly, the quantitative analysis estimates that no fin, humpback, or minke whales would be exposed to levels of air gun sound that would result in any behavioral responses.

LaBrecque et al. (2015a) identified a small resident population area for harbor porpoises that overlaps the Northeast Range Complexes. Navy air gun testing activities could occur year-round within the identified area. Similarly, the quantitative analysis estimates that no harbor porpoises would be exposed to levels of air gun sound that would result in any behavioral responses.

There are 21 small and resident population areas for common bottlenose dolphins identified by LaBrecque et al. (2015a, 2015b) that overlap or are directly adjacent to the AFTT Study Area. The quantitative analysis estimates behavioral responses in bottlenose dolphins from air gun sounds; however, as discussed above for marine mammals overall, behavioral reactions to single air guns are likely to be minor and short term. Therefore, it is unlikely that the sound from single air guns would affect bottlenose dolphin's natural behavior patterns or cause abandonment of the small and resident population areas identified by LaBrecque et al. (2015a, 2015b).

Pursuant to the MMPA, the use of air guns during testing activities as described under Alternative 1 will result in the unintentional taking of bottlenose dolphins, clymene dolphins, gray seals, and harbor seals incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Pursuant to the ESA, air gun use during testing activities as described under Alternative 1 may affect ESA-listed fin whales, Bryde's whales (Gulf of Mexico stock), and West Indian manatees, but would not affect North Atalantic right whales, blue whales, sei whales, or sperm whales. Air gun use would not take place within designated West Indian manatee critical habitat. Some use could take place with the Northeast North Atlantic right whale critical habitat; although, sound from air guns would not affect the biological or physical features that are essential for the reproduction, rest and refuge, health, continued survival, conservation and recovery of the North Atlantic right whale population. The Navy has consulted with the NMFS and USFWS as required by section 7(a)(2) of the ESA in that regard.

3.7.3.1.3.4 Impacts from Air Guns Under Alternative 2

Impacts from Air Guns Under Alternative 2 for Training Activities

Training activities do not include the use of air guns.

Impacts from Air Guns Under Alternative 2 for Testing Activities

Air gun activities planned under Alternative 2 are identical to those planned under Alternative 1; therefore, the estimated impacts would be identical.

Pursuant to the MMPA, the use of air guns during testing activities as described under Alternative 2 will result in the unintentional taking of bottlenose dolphins, clymene dolphins, gray seals, and harbor seals incidental to those activities.

Pursuant to the ESA, air gun use during testing activities as described under Alternative 2 may affect ESA-listed fin whale, Bryde's whales (Gulf of Mexico stock), and West Indian manatees, but would not affect other ESA-listed marine mammals. Air gun use would not take place within designated West Indian manatee critical habitat. Some use could take place with the Northeast North Atlantic right whale critical habitat; although, sound from air guns would not affect the biological or physical features that are essential for the reproduction, rest and refuge, health, continued survival, conservation and recovery of the North Atlantic right whale population.

3.7.3.1.3.5 Impacts from Air Guns Under the No Action Alternative

Impacts from Air Guns Under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, training or testing activities associated with the Proposed Action would not be conducted in the AFTT Study Area. Based on the analysis presented in Sections 3.7.3.1.3.3 (Impacts from Air Guns Under Alternative 1) and 3.7.3.1.3.4 (Impacts from Air Guns Under Alternative 2), impacts on individual marine mammals from air gun activities could occur under either action alternative, but impacts on marine mammal populations are not anticipated. Therefore, discontinuing air gun activities under the No Action Alternative would remove the potential for impacts on individual marine mammals, but would not measurably improve the status of marine mammal populations or otherwise contribute to the recovery of threatened or endangered species that occur in the Study Area.

3.7.3.1.4 Impacts from Pile Driving

Marine mammals could be exposed to sounds from impact and vibratory pile driving during the construction and removal phases of the Elevated Causeway System described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.3-2 (Proposed Training Activities). The training involves the use of an impact hammer to drive the 24-inch (in.) steel piles into the sediment followed by a vibratory hammer to remove the piles that support the causeway structure. Impact pile driving operations to install the piles averages about 20 days, and removal of the piles at the end of the exercise takes approximately 10 days. Section 3.0.3.3.1.3 (Pile Driving) provides additional details on pile driving and noise levels measured from similar operations.

3.7.3.1.4.1 Methods for Analyzing Impacts from Pile Driving

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

- criteria and thresholds used to predict impacts from pile driving (see below)
- 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 further detailed explanation of this analysis is provided in the technical report titled *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2018).

Criteria and Thresholds Used to Estimate Impacts on Marine Mammals from Pile Driving

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) for detailed information on how the criteria and thresholds were derived.

Auditory Weighting Functions

Weighting functions are specific to each hearing group, but are the same across all noise types (e.g., sonar, air guns, and pile driving). See Auditory Weighting Functions under Section 3.7.3.1.2.1 (Methods for Analyzing Impacts from Sonars and Other Transducers) for information on the weighting functions used for analyzing sound from pile driving.

Hearing Loss from Pile Driving

Because vibratory pile removal produces continuous, non-impulsive noise, the criteria used to assess the onset of TTS and PTS due to exposure to sonars are used to assess auditory impacts on marine mammals (see Hearing Loss from Sonar and Other Transducers in Section 3.7.3.1.2.1, Methods for Analyzing Impacts from Sonars and Other Transducers).

Because impact pile driving produces impulsive noise, the criteria used to assess the onset of TTS and PTS are identical to those used for air guns (see Hearing Loss from Air Guns in Section 3.7.3.1.3.1, Methods for Analyzing Impacts from Air Guns).

Behavioral Responses from Pile Driving

Existing NMFS risk criteria are applied to estimate behavioral effects from impact and vibratory pile driving (Table 3.7-60).

Table 3.7-60: Pile Driving Level B Thresholds Used in this Analysis to Predict Behavioral Responses from Marine Mammals.

Pile Driving Level B Disturbance Threshold (Sound Pressure Level, dB re 1 µPa)	
Underwater Vibratory	*Underwater Impact*
120 dB rms	160 dB rms

Note: Root mean square calculation for impact pile driving is based on the duration defined by 90 percent of the cumulative energy in the impulse. Root mean square for vibratory pile driving is calculated based on a representative time series long enough to capture the variation in levels, usually on the order of a few seconds.
dB: decibel; dB re 1 µPa: decibel referenced to 1 micro pascal; rms: root mean square

Modeling of Pile Driving Noise

Underwater noise effects from pile driving and vibratory pile extraction were modeled using actual measures of impact pile driving and vibratory removal during construction of an Elevated Causeway System (Illingworth and Rodkin, 2015, 2017). A conservative estimate of spreading loss of sound in shallow coastal waters (i.e., transmission loss = 16.5*Log10[radius]) was applied based on spreading loss observed in actual measurements. Inputs used in the model are provided in Section 3.0.3.3.1.3 (Pile Driving), including source levels; the number of strikes required to drive a pile and the duration of vibratory removal per pile; the number of piles driven or removed per day; and the number of days of pile driving and removal.

The exposures predicted from Elevated Causeway System assessment rely on the assumption that marine mammals are uniformly distributed within the ocean waters adjacent the proposed event locations. In fact, animal presence in the surf zone and nearshore waters of Joint Expeditionary Base Little Creek-Fort Story and Camp Lejeune (within a few kilometers) is known to be patchy and infrequent with the exception of a few coastal species (e.g., bottlenose dolphins).

3.7.3.1.4.2 Impact Ranges for Pile Driving

Table 3.7-61 and Table 3.7-62 present the approximate ranges in meters to PTS, TTS, and potential behavioral reactions for impact pile driving and vibratory pile removal, respectively.

Table 3.7-61: Average Ranges to Effects from Impact Pile Driving Based on a Single Pile.

Hearing Group	*PTS (m)*	*TTS (m)*	*Behavioral (m)*
Low-frequency Cetaceans	65	529	870
Mid-frequency Cetaceans	2	16	870
High-frequency Cetaceans	65	529	870
Phocids	19	151	870

PTS: permanent threshold shift; TTS: temporary threshold shift

Table 3.7-62: Average Ranges to Effect from Vibratory Pile Extraction Based on a Single Pile.

Hearing Group	*PTS (m)*	*TTS (m)*	*Behavioral (m)*
Low-frequency Cetaceans	0	3	376
Mid-frequency Cetaceans	0	4	376
High-frequency Cetaceans	7	116	376
Phocids	0	2	376

PTS: permanent threshold shift; TTS: temporary threshold shift

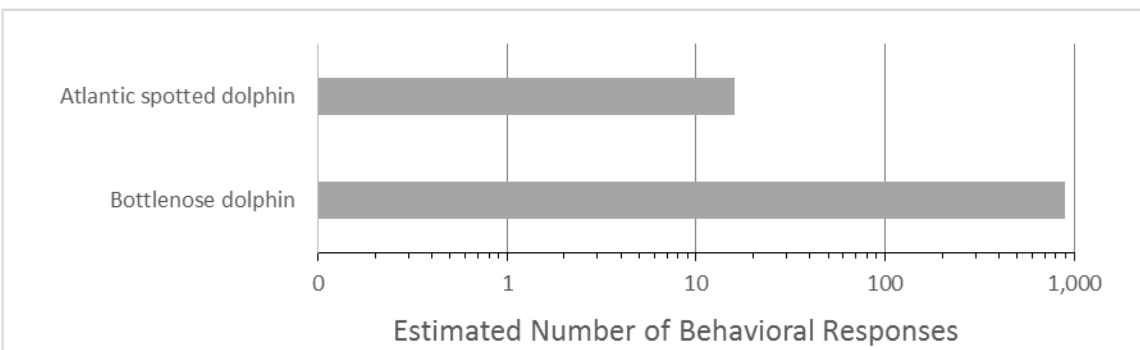
3.7.3.1.4.3 Impacts from Pile Driving Under Alternative 1

Impacts from Pile Driving Under Alternative 1 for Training Activities

Characteristics of pile driving and the number of times pile driving for the Elevated Causeway System would occur during training under Alternative 1 are described in Section 3.0.3.3.1 (Acoustic Stressors). Activities with pile driving would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). This activity would take place nearshore and within the surf zone, up to two times per year, once at Joint Expeditionary Base Little Creek/Fort Story, Virginia, and once at Marine Corps Base Camp Lejeune, North Carolina.

These coastal areas tend to have high ambient noise levels due to natural and anthropogenic sources and typically have limited numbers of sensitive marine mammal species present. The quantitative analysis (see Figure 3.7-93 and Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities) for tabular results) estimates only behavioral reactions in a few species due to exposure to pile driving activities associated with the construction and removal of the Elevated Causeway System.

Sounds from the impact hammer are impulsive, broadband and dominated by lower frequencies. The impulses are within the hearing range of marine mammals. Sounds produced from a vibratory hammer are similar in frequency range as that of the impact hammer, except the levels are much lower than for the impact hammer and the sound is continuous while operating.



No impacts are anticipated for any other species within the AFTT Study Area. See Appendix E (Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities) for tabular results.

Figure 3.7-93: Estimated Annual Impacts (Assuming Two Events per Year) from Pile Driving and Extraction Associated with the Construction and Removal of the Elevated Causeway.

Behavioral responses due to impact pile driving could occur out to a distance of approximately 1 km. The vibratory hammer produces a much lower source level than the impact hammer, especially when extracting piles from sandy, nearshore ground; therefore, the potential for reactions in marine mammals due to vibratory pile extraction are unlikely. Short-term behavioral reactions to impact pile driving are much more likely.

Research and observations (see 3.7.3.1.1.5, Behavioral Reactions) show that if marine mammals are exposed to sounds from pile driving or extraction they could potentially react with short-term behavioral reactions and physiological stress. Mysticetes 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 source is located directly on their migration route, although training associated with the Elevated Causeway System is conducted nearshore, outside of any migratory paths for mysticetes. Odontocete reactions could include alerting, startling, breaking off feeding dives and surfacing, diving or swimming away, change in vocalization, or showing no response at all. Research shows that pinnipeds may be the least sensitive taxonomic group to most noise sources, and are likely to respond to loud impulsive sound sources only at close ranges by startling or ceasing foraging, but only for brief periods before returning to their previous behavior. Pinnipeds may even experience mild TTS before exhibiting a behavioral response (Southall et al., 2007). Marine mammals disturbed while engaged in 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 pile driving activities is short term, intermittent, and occurs in a nearshore environment with high levels of ambient noise, it is unlikely that a marine mammal would be exposed to noise that would result in any more than a short-term and mild to moderate behavioral responses. The Navy will implement mitigation measures to avoid or reduce potential impacts from pile driving on marine mammals, as discussed in Section 5.3.2.3 (Pile Driving).

The vibratory hammer produces sounds that are broadband and continuous, creating the potential to cause some masking in marine mammals, but the effect would be temporary because extracting a pile only takes about 6 minutes, with a pause between each pile. Due to the low source level of vibratory pile extraction, the zone for potential masking would only extend a few hundred meters from where the hammer is operating. For impact pile driving, the rate of strikes (30 to 50 per minute) has the potential to result in some masking in marine mammals. The effect would be temporary as each pile only takes about 15 minutes to drive, with a pause of up to an hour before the next pile is driven. Furthermore, the Elevated Causeway System is constructed in shallow, nearshore areas where ambient noise levels are already typically high. The effects of masking are only present when the sound source is actively producing sound and the effect is over the moment the sound has ceased. Given these factors, significant masking is unlikely to occur in marine mammals due to exposure to sound from impact pile driving or vibratory pile extraction.

As discussed above, estimated impacts on marine mammals from pile driving and extraction associated with the construction and removal of the Elevated Causeway System consist of primarily short-term behavioral reactions and potentially a few minor to moderate TTS (6 to 20 dB measured directly after exposure). Because these activities only occur a few weeks per year and have a small footprint of potential impacts, the same animal would not be expected to be impacted more than a few times in a given year due to exposure pile driving sound. A single TTS or behavioral reaction in an individual animal within a given year is very unlikely to have any long-term consequences for that individual. Considering these factors, and the low number of overall estimated impacts, long-term consequences for marine mammal species or stocks would be unlikely.

Construction and removal of the Elevated Causeway System at Marine Corps Base Camp Lejeune, North Carolina would take place within the North Atlantic right whale reproduction area, which is active mid-November through April, or within the North Atlantic right whale migration area identified by LaBrecque et al. (2015a). Animals could be exposed to sound from pile driving within these identified areas; however, the quantitative analysis estimates no impacts on North Atlantic right whales due to exposure to pile driving activities. As discussed above for marine mammals overall, behavioral reactions to limited amount of pile driving in the nearshore and surf zones are likely to be minor and short term. Therefore, sounds from pile driving associated with Navy training activities are unlikely to significantly impact North Atlantic right whale reproductive (calving) behaviors in the reproductive area or migratory behaviors in the migration area identified by LaBrecque et al. (2015a).

Construction and removal of the Elevated Causeway System at Marine Corps Base Camp Lejeune, North Carolina would take place within 2 of the 21 small and resident population areas for common bottlenose dolphins identified by LaBrecque et al. (2015a, 2015b). Construction and removal of the Elevated Causeway System could occur during any time of year at Camp Lejeune. Bottlenose dolphins in the identified small and resident population areas identified by LaBrecque et al. (2015a, 2015b) may be exposed to sound or energy from pile driving. The quantitative analysis estimates behavioral reactions. Odontocete reactions to impulsive sound would most likely be short term and mild to moderate, especially when sound sources are located more than a few kilometers away and when the animals are engaged in important biological behaviors such as feeding. Therefore, it is unlikely that pile-driving noise would affect bottlenose dolphins' natural behavior patterns or cause abandonment of these small and resident population areas identified by LaBrecque et al. (2015a) as a result of pile driving and extraction associated with the construction and removal of the Elevated Causeway System.

Pursuant to the MMPA, the pile driving and removal during training activities as described under Alternative 1 will result in the unintentional taking of Atlantic spotted dolphins and bottlenose dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Pursuant to the ESA, pile driving and removal during training activities as described under Alternative 1 may affect ESA-listed North Atlantic right whales, fin whales, and West Indian manatees, but would not affect other ESA-listed marine mammals. Pile driving and removal would not take place within designated North Atlantic right whale or West Indian manatee critical habitat. The Navy has consulted with the NMFS and USFWS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Pile Driving Under Alternative 1 for Testing Activities

Testing activities do not include pile driving.

3.7.3.1.4.4 Impacts from Pile Driving Under Alternative 2

Impacts from Pile Driving Under Alternative 2 for Training Activities

Pile driving activities planned under Alternative 2 are identical to those planned under Alternative 1; therefore, the estimated impacts would be identical.

Pursuant to the MMPA, the pile driving and removal during training activities as described under Alternative 2 will result in the unintentional taking of Atlantic spotted dolphins and bottlenose dolphins incidental to those activities.

Pursuant to the ESA, pile driving and removal during training activities as described under Alternative 2 may affect ESA-listed North Atlantic right whales, fin whales, and West Indian manatees, but would not affect other ESA-listed marine mammals. Pile driving and removal would not take place within designated North Atlantic right whale or West Indian manatee critical habitat.

Impacts from Pile Driving Under Alternative 2 for Testing Activities

Testing activities do not include pile driving.

3.7.3.1.4.5 Impacts from Pile Driving Under the No Action Alternative

Impacts from Pile Driving Under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, training or testing activities associated with the Proposed Action would not be conducted in the AFTT Study Area. Based on the analysis presented in Sections 3.7.3.1.4.3 (Impacts from Pile Driving Under Alternative 1) and 3.7.3.1.4.4 (Impacts from Pile Driving Under Alternative 2), impacts on individual marine mammals from pile driving activities could occur under either action alternative, but impacts on marine mammal populations are not anticipated. Therefore, discontinuing pile driving activities under the No Action Alternative would remove the potential for impacts on individual marine mammals, but would not measurably improve the status of marine mammal populations or otherwise contribute to the recovery of threatened or endangered species that occur in the Study Area.

3.7.3.1.5 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 3.0.3.3.1.4 (Vessel Noise). Vessel movements involve transits to and from ports to various locations within the Study Area. 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).

Noise from vessels generally lacks the amplitude and duration to cause any hearing loss in marine mammals under realistic conditions. Noise from vessels is generally low-frequency (10 to hundreds Hz), although at close range or in shallow water it can extend above 100 kHz at received levels above 100 dB re 1 µPa (Hermannsen et al., 2014). Although periods of broadband noise tend to be brief, occurring only as a vessel is passing within a few hundred meters, vessel noise could lead to short-term masking for all marine mammal species (Section 3.7.3.1.1.4, Masking). Vessel noise has been linked to behavioral responses (Section 3.7.3.1.1.5, Behavioral Reactions), although it is difficult to separate responses to the noise from reactions to the physical presence of the vessel. Physiological stress has also been linked to chronic vessel noise, such as that in shipping lanes or heavily trafficked whale-watch areas (Section 3.7.3.1.1.3, Physiological Stress). However, based on the generally short duration, relatively low source levels of many Navy vessels, and the transient nature of Navy vessel noise, behavioral, physiological stress and masking reactions, if they occur, are unlikely to be significant.

3.7.3.1.5.1 Methods for Analyzing Impacts from Vessel Noise

Responses to vessel noise have been observed for marine mammals when the noise is chronic and persistent such as near constricted ocean shipping lanes, and while Navy vessels do transit over regular areas, the number of ships is several magnitudes smaller than found in shipping lanes. Navy vessels also maneuver to avoid marine mammals when possible; therefore, significant responses to passing vessels are unlikely. The amount of radiated sound from Navy vessels is based on measured levels (see Section 3.0.3.3.1.4, Vessel Noise). These sound levels, along with operational characteristics of the vessel (e.g., source level due to cavitation, speed), are compared to situations where researchers have observed behavioral reactions (see Behavioral Responses to Vessel Noise under Section 3.7.3.1.1.5, Behavioral Reactions) or masking (see Section 3.7.3.1.1.4, Masking) in marine mammals. The likelihood of behavioral and physiological stress reactions or masking due to Navy vessel noise is then discussed in light of this research.

3.7.3.1.5.2 Impacts from Vessel Noise Under Alternative 1

Impacts from Vessel Noise Under Alternative 1 for Training Activities

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

Activities involving vessel movements are variable in duration, ranging from a few hours up to 2 weeks, but are typically episodic. During training, speeds generally range from 10 to 14 knots; however, vessels can and will, on occasion, operate within the entire spectrum of their specific operational capabilities. In addition, a variety of smaller craft will be operated within the Study Area. Small craft types, sizes, and speeds vary. In all cases, the vessels will be operated in a safe manner consistent with the local conditions. Section 3.7.3.1.1.5 (Behavioral Reactions) discusses scientific studies and observations of marine mammal reactions, while potential masking from vessel noise is discussed in Section 3.7.3.1.1.4 (Masking).

Vessel traffic related to the proposed activity would pass near marine mammals only on an incidental basis. Navy ports such as Mayport and Norfolk are heavily trafficked with private and commercial vessels in addition to naval vessels. Because Navy ships make up only a small proportion of the total ship traffic, even in the most concentrated port and inshore areas, proposed Navy vessel transits are unlikely to cause significant behavioral responses or long-term abandonment of habitat by a marine mammal. 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 Movements). The mitigation for vessel movements (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.

Vessel noise can potentially mask vocalizations and other biologically important sounds (e.g., sounds of prey or predators) that marine mammals may rely on. Potential masking can vary depending on the ambient noise level within the environment, the received level and frequency of the vessel noise, and the received level and frequency of the sound of biological interest. In the open ocean, ambient noise levels are between about 60 and 80 dB re 1 µPa in the band between 10 Hz and 10 kHz due to a combination of natural (e.g., wind) and anthropogenic sources (Urick, 1983), while inshore noise levels, especially around busy ports, can exceed 120 dB re 1 µPa. When the noise level is above the sound of interest, and in a similar frequency band, masking could occur (Section 3.7.3.1.1.4, Masking). This analysis assumes that any sound that is above ambient noise levels and within an animal's hearing range may potentially cause masking. However, the degree of masking increases with increasing noise levels; a noise that is just detectable over ambient levels is unlikely to cause any substantial masking. Masking by passing ships or other sound sources transiting the Study Area would be short term and intermittent, and therefore unlikely to result in any substantial costs or consequences to individual animals or populations. Areas with increased levels of ambient noise from anthropogenic noise sources such as areas around busy shipping lanes and near harbors and ports may cause sustained levels of masking for marine mammals, which could reduce an animal's ability to find prey, find mates, socialize, avoid predators, or navigate. However, Navy vessels make up a very small percentage of the overall traffic (two orders of magnitude lower than commercial ship traffic in the Study Area), and the rise of ambient noise levels in these areas is a problem related to all ocean users, including commercial and recreational vessels and shoreline development and industrialization.

Surface combatant ships (e.g., guided missile destroyer, guided missile cruiser, and Littoral Combat Ship) and submarines are designed to be very quiet to evade enemy detection and typically travel at speeds of 10 or more knots. Actual acoustic signatures and source levels of combatant ships and submarines are classified; however, they are quieter than most other motorized ships. Still, these surface combatants and submarines are likely to be detectable by marine mammals over open-ocean ambient noise levels at distances of up to a few kilometers, which could cause some masking to marine mammals for a few minutes as the vessel passes by. Other Navy ships and small vessels have higher source levels, similar to equivalently sized commercial ships and private vessels. Ship noise tends to be low-frequency and broadband; therefore, it may have the largest potential to mask mysticetes that vocalize and hear at lower frequencies than other marine mammals. Noise from large vessels and outboard motors on small craft can produce source levels of 160 to over 200 dB re 1 µPa at 1 m. Therefore, in the open ocean, noise from noncombatant Navy vessels may be detectable over ambient levels for tens of kilometers, and some masking, especially for mysticetes, is possible. In noisier inshore areas around Navy ports and ranges, vessel noise may be detectable above ambient for only several hundred meters. Some masking to marine mammals is likely from noncombatant Navy vessels, on par with similar commercial and recreational vessels, especially in quieter, open-ocean environments.

Vessel noise has the potential to disturb marine mammals and elicit an alerting, avoidance, or other behavioral reaction. Most studies have reported that marine mammals react to vessel sounds and traffic with short-term interruption of feeding, resting, or social interactions (Magalhães et al., 2002; Richardson et al., 1995b; Watkins, 1981). Some species respond negatively by retreating or responding to the vessel antagonistically, while other animals seem to ignore vessel noises altogether or are attracted to the vessel (Watkins, 1986). Marine mammals are frequently exposed to vessels due to research, ecotourism, commercial and private vessel traffic, and government activities. It is difficult to differentiate between responses to vessel sound and visual cues associated with the presence of a vessel; thus, it is assumed that both play a role in prompting reactions from animals.

Based on studies of a number of species, mysticetes are not expected to be disturbed by vessels that maintain a reasonable distance from them, which varies with vessel size, geographic location, and tolerance levels of individuals. Odontocetes could have a variety of reactions to passing vessels, including attraction, increased traveling time, decreased feeding behaviors, diving, or avoidance of the vessel, which may vary depending on their prior experience with vessels. Kogia species, harbor porpoises, and beaked whales have been observed avoiding vessels. For pinnipeds, data indicate tolerance of vessel approaches, especially for animals in the water. Navy vessels do not purposefully approach marine mammals and are not expected to elicit significant behavioral responses. Most Navy activities occur more than 3 NM offshore, where manatees are uncommon; however, at pierside locations and within inshore waters along the southeastern United States and in the Gulf of Mexico, manatees could co-occur with Navy vessels. In studies, manatees have reacted to vessels by moving away from the approaching vessel, increasing their swimming speed, and moving toward deeper water. Overall, marine mammal reactions to vessel noise associated with training activities are likely to be minor and short term, leading to no significant reactions and no long-term consequences.

LaBrecque et al. (2015a) identified a North Atlantic right whale migration area, reproduction areas, and feeding areas, which overlap with the Northeast, Virginia Capes, Navy Cherry Point, and Jacksonville Range Complexes within the Study Area. Vessel noise from Navy training activities could occur throughout the Study Area. As discussed above for marine mammals overall, behavioral reactions to vessel noise are likely to be short term and minor if they occurred at all. Therefore, it is unlikely that Navy vessel noise would significantly impact North Atlantic right whale feeding, reproduction or migrating behavior on those respective areas identified by LaBrecque et al. (2015a).

Feeding areas for sei, humpback, minke, and fin whales identified by LaBrecque et al. (2015a) overlap the Northeast Range Complexes within the Study Area. Vessel noise from Navy training activities could occur throughout the Study Area. As discussed above for marine mammals overall, behavioral reactions to vessel noise are likely to be short term and minor if they occurred at all. Therefore, it is unlikely that vessel noise would affect the feeding behaviors of sei, humpback, minke, or fin whales on their respective feeding areas identified by LaBrecque et al. (2015a).

An area for the small resident Bryde's whale population in the Gulf of Mexico was identified by LaBrecque et al. (2015b). Vessel noise from Navy training activities could occur throughout the Study Area. As discussed above for marine mammals overall, behavioral reactions to vessel noise are likely to be short term and minor if they occurred at all. Therefore, it is unlikely that vessel noise would affect Bryde's whale natural behavior patterns or cause abandonment of this small and resident population area identified by LaBrecque et al. (2015b).

Vessel noise may overlap with 21 habitats that have been identified by LaBrecque et al. (2015a, 2015b) adjacent to or within the Study Area for small resident populations of bottlenose dolphins. However, most vessel noise radiated into these habitat areas will be from distant Navy vessel traffic. As discussed above for marine mammals overall, behavioral reactions to vessel noise are likely to be short term and minor if they occurred at all. Therefore, it is unlikely that vessel noise would affect bottlenose dolphin's natural behavior patterns or cause abandonment of these small and resident population areas identified by LaBrecque et al. (2015a, 2015b).

LaBrecque et al. (2015a) identified a small resident population for harbor porpoises that overlaps the Northeast Range Complexes within the Study Area. Vessel noise from Navy training activities could occur throughout the Study Area. As discussed above for marine mammals overall, behavioral reactions to vessel noise are likely to be short term and minor if they occurred at all. Therefore, it is unlikely that vessel noise would significantly impact harbor porpoise natural behavior patterns or cause abandonment of these small and resident population areas identified by LaBrecque et al. (2015a).

Vessel noise would be generated within designated West Indian manatee critical habitat and Northeast North Atlantic right whale critical habitat; although, sound from vessels would not affect the biological or physical features that are essential for the reproduction, rest and refuge, health, continued survival, conservation and recovery of these species.

Pursuant to the MMPA, vessel noise generated during training activities as described under Alternative 1 will not result in the unintentional taking of marine mammals incidental to those activities.

Pursuant to the ESA, vessel noise during training activities as described under Alternative 1 may affect ESA-listed marine mammals. Vessel noise would not affect the designated critical habitat of the North Atlantic right whale or the West Indian manatee. The Navy has consulted with the NMFS and USFWS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Vessel Noise Under Alternative 1 for Testing Activities

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

Activities involving vessel movements occur intermittently and are variable in duration, ranging from a few hours up to 2 weeks, but are typically episodic. In addition, a variety of smaller craft will be operated within the Study Area. Small craft types, sizes, and speeds vary. During testing, speeds generally range from 10 to 14 knots; however, vessels can and will, on occasion, operate within the entire spectrum of their specific operational capabilities. In all cases, the vessels will be operated in a safe manner consistent with the local conditions.

Based on studies on a number of species, mysticetes are not expected to be disturbed by vessels that maintain a reasonable distance from them, which varies with vessel size, geographic location, and tolerance levels of individuals. Odontocetes could have a variety of reactions to passing vessels, including attraction, increased traveling time, decreased feeding behaviors, diving, or avoidance of the vessel, which may vary depending on their prior experience with vessels. Kogia whales, harbor porpoises, and beaked whales have been observed avoiding vessels. For pinnipeds, data indicate tolerance of vessel approaches, especially for animals in the water. Navy vessels do not purposefully approach marine mammals and are not expected to elicit significant behavioral responses. Most Navy activities occur more than 3 NM offshore, where manatees are uncommon; however, at pierside locations and within inshore waters along the southeastern United States and in the Gulf of Mexico, manatees could co-occur with Navy vessels. In studies, manatees have reacted to vessels by moving away from the approaching vessel, increasing their swimming speed, and moving toward deeper water. Overall, marine mammal reactions to vessel noise associated with testing activities are likely to be minor and short term, leading to no significant reactions and no long-term consequences.

Proposed testing activities under Alternative 1 that involve vessel movement differ in number and location from training activities under Alternative 1; however the types and severity of impacts would not be discernible from those described above in Alternative 1 for Training Activities.

LaBrecque et al. (2015a) identified a North Atlantic right whale migration area, reproduction areas, and feeding areas, which overlap with the Northeast, Virginia Capes, Navy Cherry Point, and Jacksonville Range Complexes within the Study Area. Vessel noise from Navy testing activities could occur throughout the Study Area. As discussed above for marine mammals overall, behavioral reactions to vessel noise are likely to be short term and minor if they occurred at all. Therefore, it is unlikely that Navy vessel noise would significantly impact North Atlantic right whale feeding, reproduction or migrating behavior on those respective areas identified by LaBrecque et al. (2015a).

Feeding areas for sei, humpback, minke, and fin whales identified by LaBrecque et al. (2015a) overlap the Northeast Range Complexes within the Study Area. Vessel noise from Navy testing activities could occur throughout the Study Area. As discussed above for marine mammals overall, behavioral reactions to vessel noise are likely to be short term and minor if they occurred at all. Therefore, it is unlikely that vessel noise would affect the feeding behaviors of sei, humpback, minke, or fin whales on their respective feeding areas identified by LaBrecque et al. (2015a).

An area for the small resident Bryde's whale population in the Gulf of Mexico was identified by LaBrecque et al. (2015b). Vessel noise from Navy testing activities could occur throughout the Study Area. As discussed above for marine mammals overall, behavioral reactions to vessel noise are likely to be short term and minor if they occurred at all. Therefore, it is unlikely that vessel noise would affect Bryde's whale natural behavior patterns or cause abandonment of this small and resident population area identified by LaBrecque et al. (2015b).

Vessel noise may overlap with 21 habitats that have been identified by LaBrecque et al. (2015a, 2015b) adjacent to or within the Study Area for small resident populations of bottlenose dolphins. However, most vessel noise radiated into these habitat areas will be from distant Navy vessel traffic. As discussed above for marine mammals overall, behavioral reactions to vessel noise are likely to be short term and minor if they occurred at all. Therefore, it is unlikely that vessel noise would affect bottlenose dolphin's natural behavior patterns or cause abandonment of these small and resident population areas identified by LaBrecque et al. (2015a, 2015b).

LaBrecque et al. (2015a) identified a small resident population for harbor porpoises that overlaps the Northeast Range Complexes within the Study Area. Vessel noise from Navy testing activities could occur throughout the Study Area. As discussed above for marine mammals overall, behavioral reactions to vessel noise are likely to be short term and minor if they occurred at all. Therefore, it is unlikely that vessel noise would significantly impact harbor porpoise natural behavior patterns or cause abandonment of these small and resident population areas identified by LaBrecque et al. (2015a).

Vessel noise would be generated within designated West Indian manatee critical habitat and Northeast North Atlantic right whale critical habitat; although, sound from vessels would not affect the biological or physical features that are essential for the reproduction, rest and refuge, health, continued survival, conservation and recovery of these species.

Pursuant to the MMPA, vessel noise generated during testing activities as described under Alternative 1 will not result in the unintentional taking of marine mammals incidental to those activities.

Pursuant to the ESA, vessel noise during testing activities as described under Alternative 1 may affect ESA-listed marine mammals. Vessel noise would not affect the designated critical habitat of the North Atlantic right whale or the West Indian manatee. The Navy has consulted with the NMFS and USFWS as required by section 7(a)(2) of the ESA in that regard.

3.7.3.1.5.3 Impacts from Vessel Noise Under Alternative 2

Impacts from Vessel Noise Under Alternative 2 for Training Activities

Proposed Training Activities under Alternative 2 that involve vessel movement would increase compared to Alternative 1. Under Alternative 2, the maximum number of major training exercises could occur every year, an additional major training exercise would be conducted in the Gulf of Mexico Range Complex annually, and only the number of Civilian Port Defense activities would fluctuate annually. In addition, all unit level training requirements would be completed at sea rather than synthetically. Still, the locations, types, and severity of impacts would be similar to those described above in Section 3.7.3.1.5.2 (Impacts from Vessel Noise Under Alternative 1 for Training Activities).

Vessel noise would be generated within designated West Indian manatee critical habitat and northeast North Atlantic right whale critical habitat; although, sound from vessels would not affect the biological or physical features that are essential for the reproduction, rest and refuge, health, continued survival, conservation and recovery of these species.

Pursuant to the MMPA, vessel noise generated during training activities as described under Alternative 2 will not result in the unintentional taking of marine mammals incidental to those activities.

Pursuant to the ESA, vessel noise during training activities as described under Alternative 2 may affect ESA-listed marine mammals. Vessel noise would not affect the designated critical habitat of the North Atlantic right whale or the West Indian manatee.

Impacts from Vessel Noise Under Alternative 2 for Testing Activities

Proposed Testing Activities under Alternative 2 that involve vessel movement slightly increase from Testing Activities proposed under Alternative 1, but the locations, types, and severity of impacts would not be discernible from those described above in Section 3.7.3.1.5.2 (Impacts from Vessel Noise Under Alternative 1 for Testing Activities).

Vessel noise would be generated within designated West Indian manatee critical habitat and northeast North Atlantic right whale critical habitat; although, sound from vessels would not affect the biological or physical features that are essential for the reproduction, rest and refuge, health, continued survival, conservation and recovery of these species.

Pursuant to the MMPA, vessel noise generated during testing activities as described under Alternative 2 will not result in the unintentional taking of marine mammals incidental to those activities.

Pursuant to the ESA, vessel noise during testing activities as described under Alternative 2 may affect ESA-listed marine mammals. Vessel noise would not affect the designated critical habitat of the North Atlantic right whale or the West Indian manatee. The Navy has consulted with the NMFS and USFWS as required by section 7(a)(2) of the ESA in that regard.

3.7.3.1.5.4 Impacts from Vessel Noise Under the No Action Alternative

Impacts from Vessel Noise Under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, training or testing activities associated with the Proposed Action would not be conducted in the AFTT Study Area. Based on the analysis presented in Sections 3.7.3.1.5.2 (Impacts from Vessel Noise Under Alternative 1) and 3.7.3.1.5.3 (Impacts from Vessel Noise Under Alternative 2), impacts on individual marine mammals from vessel noise could occur under either action alternative, but impacts on marine mammal populations are not anticipated. Therefore, discontinuing activities involving vessel noise under the No Action Alternative would remove the potential for impacts on individual marine mammals, but would not measurably improve the status of marine mammal populations or otherwise contribute to the recovery of threatened or endangered species that occur in the Study Area.

3.7.3.1.6 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 (helicopters) produce low-frequency sound and vibration (Pepper et al., 2003). A detailed description of aircraft noise as a stressor is in Section 3.0.3.3.1.5 (Aircraft Noise).

Sound from aircraft noise, including occasional sonic booms, lack the amplitude or duration to cause any hearing loss in marine mammals underwater (see Section 3.0.3.3.1.5, Aircraft Noise). Aircraft would pass quickly overhead and rotary-wing aircraft (e.g., helicopters) may hover at lower altitudes for longer durations, though still for relatively brief periods, considering the transient nature of both the aircraft and marine mammals. Potential impacts from aircraft noise are limited to masking of other biologically relevant sounds, and brief behavioral and physiological stress reactions as aircraft passes overhead. Based on the short duration of potential exposure to aircraft noise, behavioral and physiological stress reactions, if they did occur, are unlikely to be significant. The duration of masking due to hovering rotary-wing aircraft would be limited to the short duration of hovering events.

3.7.3.1.6.1 Methods for Analyzing Impacts from Aircraft Noise

Potential impacts on marine mammals due to exposure to aircraft noise are analyzed qualitatively. As mentioned above in the summary, behavioral reactions and physiological stress are the only potential impacts on marine mammals from aircraft noise; therefore, the analysis focuses on the potential for those impacts. The amount of sound entering the water from aircraft is based on measured and modeled levels (see Section 3.0.3.3.1.5, Aircraft Noise). These sound levels, along with the operational characteristics of the aircraft (e.g., altitude, speed), are compared to situations where researchers have observed behavioral responses in marine mammals (see Behavioral Reactions to Aircraft Noise under Section 3.7.3.1.1.5, Behavioral Reactions). The likelihood of behavioral and physiological stress reactions due to Navy aircraft noise is then discussed in light of this research.

3.7.3.1.6.2 Impacts from Aircraft Noise Under Alternative 1

Impacts from Aircraft Noise Under Alternative 1 for Training Activities

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

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

Transmission of sound from a moving airborne source to a receptor underwater is influenced by numerous factors, but significant acoustic energy is primarily transmitted into the water directly below the craft in a narrow cone, as discussed in detail in Appendix D (Acoustic and Explosive Concepts). Underwater sounds from aircraft are strongest just below the surface and directly under the aircraft. Section 3.0.3.3.1.5 (Aircraft Noise) provides additional information on aircraft noise characteristics.

Section 3.7.3.1.1.5 (Behavioral Reactions) reviews research and observations regarding marine mammal behavioral reactions to aircraft overflights; many of the observations cited in this section are of marine mammal reactions to aircraft flown for whale-watching and marine research purposes. Marine mammal survey aircraft are typically used to locate, photograph, track, and sometimes follow animals for long distances or for long periods of time, all of which results in the animal being much more frequently located directly beneath the aircraft (in the cone of the loudest noise and potentially in the shadow of the aircraft) for extended periods. Navy aircraft would not follow marine mammals. In contrast to whale-watching excursions or research efforts, Navy overflights would not result in prolonged exposure of marine mammals to overhead noise or encroachment.

In most cases, exposure of a marine mammal to fixed-wing aircraft presence and noise would be brief as the aircraft quickly passes overhead. Animals would have to be at or near the surface at the time of an overflight to be exposed to appreciable sound levels. Takeoffs and landings occur at established airfields as well as on vessels at sea at unspecified locations across the Study Area. Takeoffs and landings from Navy vessels could startle marine mammals; however, these events only produce in-water noise at any given location for a brief period as the aircraft climbs to cruising altitude. Some sonic booms from aircraft could startle marine mammals, but these events are transient and happen infrequently at any given location within the Study Area. Repeated exposure to most individuals over short periods (days) is extremely unlikely, except for animals that are resident in inshore areas around Navy ports, on Navy fixed ranges (e.g., the Undersea Warfare Training Range), or during major training exercises. These animals could be subjected to multiple overflights per day; however, aircraft would pass quickly overhead, typically at altitudes above 3,000 ft., which would make marine mammals unlikely to respond. No long-term consequences for individuals or populations would be expected.

Daytime and nighttime activities involving helicopters may occur for extended periods of time, typically 1 to 3 hours in some areas. During these activities, helicopters would typically transit throughout an area and may hover over the water. Longer activity durations and periods of time where helicopters hover may increase the potential for behavioral reactions, startle reactions, and physiological stress. Low-altitude flights of helicopters during some activities, often under 100 ft., may elicit a somewhat stronger behavioral response due to the proximity to marine mammals, the slower airspeed and therefore longer exposure duration, and the downdraft created by the helicopter’s rotor. Marine mammals would likely avoid the area under the helicopter.

Most fixed-wing aircraft and helicopter activities are transient in nature, although helicopters could also hover for extended periods (5 to 15 minutes). The likelihood that marine mammals would occur or remain at the surface while an aircraft or helicopter transits directly overhead would be low. Helicopters that hover in a fixed location for an extended period of time could increase the potential for exposure. However, impacts from training and testing activities would be highly localized and concentrated in space and duration. The consensus of all the studies reviewed is that aircraft noise would cause only small temporary changes in the behavior of marine mammals. Specifically, marine mammals at or near the surface when an aircraft flies overhead at low altitude may startle, divert their attention to the aircraft, or avoid the immediate area by swimming away or diving. No more than short-term reactions are likely. No long-term consequences for individuals, species, or stocks would be expected.

LaBrecque et al. (2015a) identified a North Atlantic right whale migration area, reproduction areas, and feeding areas, which overlap with the Northeast, Virginia Capes, Navy Cherry Point, and Jacksonville Range Complexes within the Study Area. Aircraft noise from Navy training activities could occur throughout the Study Area. As discussed above for marine mammals overall, behavioral reactions to aircraft noise are likely to be brief and minor if they occurred at all. Therefore, it is unlikely that aircraft noise would significantly impact North Atlantic right whale feeding, reproduction or migrating behavior on those respective areas identified by LaBrecque et al. (2015a).

Feeding areas for sei, humpback, minke, and fin whales identified by LaBrecque et al. (2015a) overlap the Northeast Range Complexes within the Study Area. Aircraft noise from Navy training activities could occur throughout the Study Area. As discussed above for marine mammals overall, behavioral reactions to aircraft noise are likely to be brief and minor if they occurred at all. Therefore, it is unlikely that aircraft noise would affect the feeding behaviors of sei, humpback, minke, or fin whales on their respective feeding areas identified by LaBrecque et al. (2015a).

An area for the small resident Bryde's whale population in the Gulf of Mexico was identified by LaBrecque et al. (2015b). Aircraft noise from Navy training activities could occur throughout the Study Area. As discussed above for marine mammals overall, behavioral reactions to aircraft noise are likely to be brief and minor if they occurred at all. Therefore, it is unlikely that aircraft noise would affect Bryde's whale natural behavior patterns or cause abandonment of this small and resident population area identified by LaBrecque et al. (2015b).

Aircraft noise may overlap with 21 habitats that have been identified by LaBrecque et al. (2015a, 2015b) adjacent to or within the Study Area for small resident populations of bottlenose dolphins. Aircraft noise from Navy training activities could occur throughout the Study Area. As discussed above for marine mammals overall, behavioral reactions to aircraft noise are likely to be brief and minor if they occurred at all. Therefore, it is unlikely that aircraft noise would affect bottlenose dolphin's natural behavior patterns or cause abandonment of these small and resident population areas identified by LaBrecque et al. (2015a, 2015b).

LaBrecque et al. (2015a) identified a small resident population for harbor porpoises that overlaps the Northeast Range Complexes within the Study Area. Aircraft noise from Navy training activities could occur throughout the Study Area. As discussed above for marine mammals overall, behavioral reactions to aircraft noise are likely to be brief and minor if they occurred at all. Therefore, it is unlikely that aircraft noise would significantly impact harbor porpoise natural behavior patterns or cause abandonment of these small and resident population areas identified by LaBrecque et al. (2015a).

Aircraft noise would be generated within designated West Indian manatee critical habitat and Northeast North Atlantic right whale critical habitat; although, sound from aircraft would not affect the biological or physical features that are essential for the reproduction, rest and refuge, health, continued survival, conservation and recovery of these species.

Pursuant to the MMPA, aircraft noise generated during training activities as described under Alternative 1 will not result in the unintentional taking of marine mammals incidental to those activities.

Pursuant to the ESA, aircraft noise during training activities as described under Alternative 1 may affect ESA-listed marine mammals. Aircraft noise would not affect the designated critical habitat of the North Atlantic right whale or the West Indian manatee. The Navy has consulted with the NMFS and USFWS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Aircraft Noise Under Alternative 1 for Testing Activities

Characteristics of aircraft noise are described in Section 3.0.3.3.1 (Acoustic Stressors) and the number of testing activities with aircraft under Alternative 1 are shown in Section 3.0.3.3.4.4 (Aircraft). Testing activities using aircraft would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). Aircraft overflights would usually occur near Navy airfields, installations, and in special use airspace within Navy range complexes. Testing activities with aircraft would be most concentrated in the Virginia Capes Range Complex. The types and severity of impacts would be similar to those described above in Impacts from Aircraft Noise Under Alternative 1 for Training Activities.

Aircraft noise would be generated within designated West Indian manatee critical habitat and Northeast North Atlantic right whale critical habitat; although, sound from aircraft would not affect the biological or physical features that are essential for the reproduction, rest and refuge, health, continued survival, conservation and recovery of these species.

Pursuant to the MMPA, aircraft noise generated during testing activities as described under Alternative 1 will not result in the unintentional taking of marine mammals incidental to those activities.

Pursuant to the ESA, aircraft noise during testing activities as described under Alternative 1 may affect ESA-listed marine mammals. Aircraft noise would not affect the designated critical habitat of the North Atlantic right whale or the West Indian manatee. The Navy has consulted with the NMFS and USFWS as required by section 7(a)(2) of the ESA in that regard.

3.7.3.1.6.3 Impacts from Aircraft Noise Under Alternative 2

Impacts from Aircraft Noise Under Alternative 2 for Training Activities

There would be a minor increase in aircraft overflights during training activities under Alternative 2 compared to Alternative 1; however, the types of impacts would not be discernible from those described for training under Alternative 1.

Aircraft noise would be generated within designated West Indian manatee critical habitat and Northeast North Atlantic right whale critical habitat; although, sound from aircraft would not affect the biological or physical features that are essential for the reproduction, rest and refuge, health, continued survival, conservation and recovery of these species.

Pursuant to the MMPA, aircraft noise generated during training activities as described under Alternative 2 will not result in the unintentional taking of marine mammals incidental to those activities.

Pursuant to the ESA, aircraft noise during training activities as described under Alternative 2 may affect ESA-listed marine mammals. Aircraft noise would not affect the designated critical habitat of the North Atlantic right whale or the West Indian manatee.

Impacts from Aircraft Noise Under Alternative 2 for Testing Activities

There would be a minor increase in aircraft overflights under Alternative 2 compared to Alternative 1; however, the types of impacts would not be discernible from those described for testing under Alternative 1.

Aircraft noise would be generated within designated West Indian manatee critical habitat and Northeast North Atlantic right whale critical habitat; although, sound from aircraft would not affect the biological or physical features that are essential for the reproduction, rest and refuge, health, continued survival, conservation and recovery of these species.

Pursuant to the MMPA, aircraft noise generated during testing activities as described under Alternative 2 will not result in the unintentional taking of marine mammals incidental to those activities.

Pursuant to the ESA, aircraft noise during testing activities as described under Alternative 2 may affect ESA-listed marine mammals. Aircraft noise would not affect the designated critical habitat of the North Atlantic right whale or the West Indian manatee.

3.7.3.1.6.4 Impacts from Aircraft Noise Under the No Action Alternative

Impacts from Aircraft Noise Under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, training or testing activities associated with the Proposed Action would not be conducted in the AFTT Study Area. Based on the analysis presented in Sections 3.7.3.1.6.2 (Impacts from Aircraft Noise Under Alternative 1) and 3.7.3.1.6.3 (Impacts from Aircraft Noise Under Alternative 2), impacts on individual marine mammals from activities that produce aircraft noise could occur under either action alternative, but impacts on marine mammal populations are not anticipated. Therefore, discontinuing activities involving aircraft noise under the No Action Alternative would remove the potential for impacts on individual marine mammals, but would not measurably improve the status of marine mammal populations or otherwise contribute to the recovery of threatened or endangered species that occur in the Study Area.

3.7.3.1.7 Impacts from Weapons 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 3.0.3.3.1.6 (Weapon Noise). In general, these are impulsive sounds generated in close vicinity to or at the water surface, with the exception of items that are launched underwater. The 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.

Reactions by marine mammals to these specific stressors have not been recorded; however, marine mammals would be expected to react to weapons noise as they would other transient sounds (Section 3.7.3.1.1.5, Behavioral Reactions).

3.7.3.1.7.1 Methods for Analyzing Impacts from Weapons Noise

Potential impacts on marine mammals due to exposure to weapons noise are analyzed qualitatively. Observations of behavioral reactions to these specific types of noise do not exist; however, observations of marine mammal reactions to other impulsive and transient sounds give some indication as to how marine mammals may react to weapons noise. The amount of sound entering the water from various types of weapons noise is based on measured levels (see Section 3.0.3.3.1.6, Weapon Noise). These sound levels are compared to situations where researchers have observed behavioral responses in marine mammals (see Section 3.7.3.1.1.5, Behavioral Reactions). The likelihood of behavioral and physiological stress reactions due to exposure to weapons noise is then discussed in light of this research.

3.7.3.1.7.2 Impacts from Weapons Noise Under Alternative 1

Impacts from Weapons Noise Under Alternative 1 for Training Activities

Activities using weapons and deterrents would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). General characteristics of types of weapons noise are described in Section 3.0.3.3.1.6 (Weapon Noise), and quantities and locations of expended non-explosive practice munitions and explosives (fragment-producing) for training under Alternative 1 are shown in Section 3.0.3.3.4.2 (Military Expended Materials). For explosive munitions, only associated firing noise is considered in the analysis of weapons noise. The noise produced by the detonation of explosive weapons is analyzed in Section 3.7.3.2 (Explosive Stressors).

Use of weapons during training would occur in the range complexes, with greatest use of most types of munitions in the Virginia Capes, Navy Cherry Point, and Jacksonville Range Complexes. Most activities involving large-caliber naval gunfire or the launching of targets, missiles, bombs, or other munitions are conducted more than 12 NM from shore. The Navy will implement mitigation measures to avoid or reduce potential impacts from weapons firing noise during large-caliber gunnery activities, as discussed in Section 5.3.2.4 (Weapons Firing Noise).

A gun fired from a ship on the surface of the water propagates a blast wave away from the gun muzzle into the water (see Section 3.0.3.3.1.6, Weapon Noise). Average peak sound pressure in the water measured directly below the muzzle of the gun and under the flight path of the shell (assuming it maintains an altitude of only a few meters above the water's surface) was approximately 200 dB re 1 µPa. Animals at the surface of the water, in a narrow footprint under a weapons trajectory, could be exposed to naval gunfire noise and may exhibit brief startle reactions, avoidance, diving, or no reaction at all. Due to the short term, transient nature of gunfire noise, animals are unlikely to be exposed multiple times within a short period. Behavioral reactions would likely be short term (minutes) and are unlikely to lead to substantial costs or long-term consequences for individuals, species, or stocks.

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. These sounds would be transient and of short duration, lasting no more than a few seconds at any given location. Many missiles and targets are launched from aircraft, which would produce minimal noise in the water due to the altitude of the aircraft at launch. Missiles and targets launched by ships or near the water's surface may expose marine mammals to levels of sound that could produce brief startle reactions, avoidance, or diving. Due to the short-term, transient nature of launch noise, animals are unlikely to be exposed multiple times within a short period. Behavioral reactions would likely be short term (minutes) and are unlikely to lead to long-term consequences for individual, species, or stocks.

Some objects, such as hyperkinetic projectiles and non-explosive practice munitions, could impact the water with great force and produce a large impulse (see Section 3.0.3.3.1.6, Weapon Noise). Marine mammals within a few meters could experience some temporary hearing loss, although the probability is low of the non-explosive ordnance landing within this range while a marine mammal is near the surface. Animals within the area may hear the impact of non-explosive ordnance on the surface of the water and would likely alert, startle, dive, or avoid the immediate area. Significant behavioral reactions from marine mammals would not be expected due to non-explosive ordnance impact noise; therefore, long-term consequences for the individual, species, or stocks are unlikely.

Manatees prefer inshore waters and are unlikely to encounter noise from weapons use associated with proposed Navy training activities that typically occur more than 12 NM from shore.

LaBrecque et al. (2015a) identified a North Atlantic right whale migration area, reproduction areas, and feeding areas, which overlap with the Northeast, Virginia Capes, Navy Cherry Point, and Jacksonville Range Complexes within the Study Area. Weapons noise from Navy training activities could occur throughout the Study Area. As discussed above for marine mammals overall, any behavioral reactions to weapons noise are likely to be brief and minor. Therefore, it is unlikely that weapons noise would significantly impact North Atlantic right whale feeding, reproduction, or migrating behavior on those respective areas identified by LaBrecque et al. (2015a). The Navy will not conduct large-caliber gunnery activities within the Southeast North Atlantic Right Whale Mitigation Area from November 15 through April 15. This mitigation will further avoid or reduce potential impacts from weapons firing noise on North Atlantic right whales in their calving habitat (see Section 5.4.3, Mitigation Areas off the Mid-Atlantic and Southeastern United States).

Feeding areas for sei, humpback, minke, and fin whales identified by LaBrecque et al. (2015a) overlap the Northeast Range Complexes within the Study Area. Weapons noise from Navy training activities could occur throughout the Study Area. As discussed above for marine mammals overall, behavioral reactions to weapons firing, launch, and impact noise are likely to be brief and minor if they occurred at all. Therefore, it is unlikely that weapons noise would affect the feeding behaviors of sei, humpback, minke, or fin whales on their respective feeding areas identified by LaBrecque et al. (2015a).

An area for the small resident Bryde’s whale population in the Gulf of Mexico was identified by LaBrecque et al. (2015b). Weapons noise from Navy training activities could occur throughout the Study Area. As discussed above for marine mammals overall, any behavioral reactions to weapons noise are likely to be brief and minor. Therefore, it is unlikely that weapons noise would affect Bryde’s whale natural behavior patterns or cause abandonment of this small and resident population area identified by LaBrecque et al. (2015b).

Twenty-one habitats have been identified by LaBrecque et al. (2015a, 2015b) adjacent to or within the Study Area for small resident populations of bottlenose dolphins. Navy training activities involving weapons noise could occur throughout the Study Area; however, these activities typically occur at 3 NM or greater from shore and not within the nearshore and inshore habitats that comprise the bottlenose dolphin identified areas. As discussed above for marine mammals overall, behavioral reactions to weapons noise are likely to be brief and minor if they occurred at all. Therefore, weapons noise would not affect bottlenose dolphins’ natural behavior patterns or cause abandonment of these small and resident population areas identified by LaBrecque et al. (2015a, 2015b).

LaBrecque et al. (2015a) identified a small resident population for harbor porpoises that overlaps the Northeast Range Complexes within the Study Area. Weapons noise from Navy training activities could occur throughout the Study Area. As discussed above for marine mammals overall, behavioral reactions to weapons noise are likely to be brief and minor if they occurred at all. Therefore, it is unlikely that weapons noise would significantly impact harbor porpoise natural behavior patterns or cause abandonment of these small and resident population areas identified by LaBrecque et al. (2015a).

Weapons noise would not be generated within designated West Indian manatee critical habitat. Some weapons noise could be generated within Northeast North Atlantic right whale critical habitat; although, sound from weapons would not affect the biological or physical features that are essential for the reproduction, rest and refuge, health, continued survival, conservation and recovery of this species.

Pursuant to the MMPA, weapons noise generated during training activities as described under Alternative 1 will not result in the unintentional taking of marine mammals incidental to those activities.

Pursuant to the ESA, weapons noise generated during training activities as described under Alternative 1 may affect ESA-listed North Atlantic right whales, blue whales, Bryde's whales (Gulf of Mexico stock), fin whales, sei whales, and sperm whales, but would have no effect on West Indian manatees. Weapons noise would not affect the designated critical habitat of the North Atlantic right whale or the West Indian manatee. The Navy has consulted with the NMFS and USFWS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Weapons Noise Under Alternative 1 for Testing Activities

Activities using weapons and deterrents would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). General characteristics of types of weapons noise are described in Section 3.0.3.3.1.6 (Weapon Noise), and quantities and locations of expended non-explosive practice munitions and explosives (fragment-producing) for testing under Alternative 1 are shown in Section 3.0.3.3.4.2 (Military Expended Materials). (For explosive munitions, only associated firing noise is considered in the analysis of weapons noise. The noise produced by the detonation of explosive weapons is analyzed in Section 3.7.3.2, Explosive Stressors).

Use of weapons during testing would typically occur on the range complexes, with some activity also occurring on testing ranges. Most activities involving large-caliber naval gunfire or the launching of targets, missiles, bombs, or other munitions are typically conducted more than 12 NM from shore. The Navy will implement mitigation measures to avoid or reduce potential impacts from weapons firing noise during large-caliber gunnery activities, as discussed in Section 5.3.2.4 (Weapons Firing Noise).

The associated impacts would differ in quantity and location from training activities; however, the types and severity of impacts would not be discernible from those described above for training activities.

LaBrecque et al. (2015a) identified a North Atlantic right whale migration area, reproduction areas, and feeding areas, which overlap with the Northeast, Virginia Capes, Navy Cherry Point, and Jacksonville Range Complexes within the Study Area. Weapons noise from Navy testing activities could occur throughout the Study Area. As discussed above for marine mammals overall, behavioral reactions to weapons noise are likely to be brief and minor if they occurred at all. Therefore, it is unlikely that weapons noise would significantly impact North Atlantic right whale feeding, reproduction or migrating behavior on those respective areas identified by LaBrecque et al. (2015a). The Navy will not conduct large-caliber gunnery activities within the Southeast North Atlantic Right Whale Mitigation Area from November 15 through April 15. This mitigation will further avoid or reduce potential impacts from weapons firing noise on North Atlantic right whales in their calving habitat (see 5.4.3, Mitigation Areas off the Mid-Atlantic and Southeastern United States).

Feeding areas for sei, humpback, minke, and fin whales identified by LaBrecque et al. (2015a) overlap the Northeast Range Complexes within the Study Area. Weapons noise from Navy testing activities could occur throughout the Study Area. As discussed above for marine mammals overall, behavioral reactions to weapons noise are likely to be brief and minor if they occurred at all. Therefore, it is unlikely that weapons noise would affect the feeding behaviors of sei, humpback, minke, or fin whales on their respective feeding areas identified by LaBrecque et al. (2015a).

An area for the small resident Bryde's whale population in the Gulf of Mexico was identified by LaBrecque et al. (2015b). Weapons noise from Navy testing activities could occur throughout the Study

Area. As discussed above for marine mammals overall, behavioral reactions to weapons noise are likely to be brief and minor if they occurred at all. Therefore, it is unlikely that weapons noise would affect Bryde's whale natural behavior patterns or cause abandonment of this small and resident population area identified by LaBrecque et al. (2015b).

Twenty-one habitats have been identified by LaBrecque et al. (2015a, 2015b) adjacent to or within the Study Area for small resident populations of bottlenose dolphins. Navy testing activities involving weapons noise could occur throughout the Study Area; however, these activities typically occur at 3 NM or greater from shore and not within the nearshore and inshore habitats that comprise the bottlenose dolphin identified areas. As discussed above for marine mammals overall, behavioral reactions to weapons noise are likely to be brief and minor if they occurred at all. Therefore, weapons noise would not affect bottlenose dolphin's natural behavior patterns or cause abandonment of these small and resident population areas identified by LaBrecque et al. (2015a, 2015b).

LaBrecque et al. (2015a) identified a small resident population for harbor porpoises that overlaps the Northeast Range Complexes within the Study Area. Weapons noise from Navy testing activities could occur throughout the Study Area. As discussed above for marine mammals overall, behavioral reactions to weapons noise are likely to be brief and minor if they occurred at all. Therefore, it is unlikely that weapons noise would significantly impact harbor porpoise natural behavior patterns or cause abandonment of these small and resident population areas identified by LaBrecque et al. (2015a).

Weapons noise would not be generated within designated West Indian manatee critical habitat. Some weapons noise could be generated within Northeast North Atlantic right whale critical habitat; although, sound from weapons would not affect the biological or physical features that are essential for the reproduction, rest and refuge, health, continued survival, conservation and recovery of this species.

Pursuant to the MMPA, weapons noise generated during testing activities as described under Alternative 1 will not result in the unintentional taking of marine mammals incidental to those activities.

Pursuant to the ESA, weapons noise generated during testing activities as described under Alternative 1 may affect ESA-listed North Atlantic right whales, blue whales, Bryde's whales (Gulf of Mexico stock), fin whales, sei whales, and sperm whales, but would have no effect on West Indian manatees. Weapons noise would not affect the designated critical habitat of the North Atlantic right whale or the West Indian manatee. The Navy has consulted with the NMFS and USFWS as required by section 7(a)(2) of the ESA in that regard.

3.7.3.1.7.3 Impacts from Weapons Noise Under Alternative 2

Impacts from Weapons Noise Under Alternative 2 for Training Activities

Activities using weapons and deterrents would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). General characteristics of types of weapons noise are described in Section 3.0.3.3.1.6 (Weapon Noise), and quantities and locations of expended non-explosive practice munitions and explosives (fragment-producing) for training under Alternative 2 are shown in Section 3.0.3.3.4.2 (Military Expended Materials). (For explosive munitions, only associated firing noise is considered in the analysis of weapons noise. The noise produced by the detonation of explosive weapons is analyzed in Section 3.7.3.2, Explosive Stressors).

There would be a minor increase in these activities under Alternative 2 compared to Alternative 1; however, the types and severity of impacts would not be discernible from those described above in Impacts from Aircraft Noise Under Alternative 1 for Training Activities.

Weapons noise would not be generated within designated West Indian manatee critical habitat. Some weapons noise could be generated within Northeast North Atlantic right whale critical habitat; although, sound from weapons would not affect the biological or physical features that are essential for the reproduction, rest and refuge, health, continued survival, conservation and recovery of this species.

Pursuant to the MMPA, weapons noise generated during training activities as described under Alternative 2 will not result in the unintentional taking of marine mammals incidental to those activities.

Pursuant to the ESA, weapons noise generated during training activities as described under Alternative 2 may affect ESA-listed marine mammals. Weapons noise would not affect the designated critical habitat of the North Atlantic right whale or the West Indian manatee.

Impacts from Weapons Noise Under Alternative 2 for Testing Activities

Activities using weapons and deterrents would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). General characteristics of types of weapons noise are described in Section 3.0.3.3.1.6 (Weapon Noise), and quantities and locations of expended non-explosive practice munitions and explosives (fragment-producing) for testing under Alternative 2 are shown in Section 3.0.3.3.4.2 (Military Expended Materials). (For explosive munitions, only associated firing noise is considered in the analysis of weapons noise. The noise produced by the detonation of explosive weapons is analyzed in Section 3.7.3.2, Explosive Stressors).

There would be a minor increase in these activities under Alternative 2 compared to Alternative 1; however, the types and severity of impacts would not be discernible from those described above in Impacts from Aircraft Noise Under Alternative 1 for Training Activities.

Weapons noise would not be generated within designated West Indian manatee critical habitat. Some weapons noise could be generated within Northeast North Atlantic right whale critical habitat; although, sound from weapons would not affect the biological or physical features that are essential for the reproduction, rest and refuge, health, continued survival, conservation and recovery of this species.

Pursuant to the MMPA, weapons noise generated during testing activities as described under Alternative 2 will not result in the unintentional taking of marine mammals incidental to those activities.

Pursuant to the ESA, weapons noise generated during testing activities as described under Alternative 2 may affect ESA-listed marine mammals. Weapons noise would not affect the designated critical habitat of the North Atlantic right whale or the West Indian manatee.

3.7.3.1.7.4 Impacts from Weapons Noise Under the No Action Alternative

Impacts from Weapons Noise Under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, training or testing activities associated with the Proposed Action will not be conducted in the AFTT Study Area. Based on the analysis presented in Sections 3.7.3.1.7.2 (Impacts from Weapons Noise Under Alternative 1) and 3.7.3.1.7.3 (Impacts from Weapons Noise Under Alternative 2), impacts on individual marine mammals from activities that produce weapons noise could occur under either alternative, but impacts on marine mammal populations are not anticipated. Therefore, discontinuing activities that involve weapons noise under the No Action Alternative would remove the potential for impacts on individual marine mammals, but would not measurably improve the status of marine mammal populations or otherwise contribute to the recovery of threatened or endangered species that occur in the Study Area.

3.7.3.2 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 the Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities (Section 3.0.3.6.1). The following Background section discusses what is currently known about explosive effects to marine mammals.

The use of any explosive stressor during training and testing activities would have no effect on bowhead whales or ringed seals due to the lack in overlap of habitat and areas where explosive stressors are used and the impacts on bowhead whales and ringed seals will not be analyzed further.

3.7.3.2.1 Background

3.7.3.2.1.1 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 explosives. The Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities (see Section 3.0.3.6.1) 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 Explosive 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 to 150 long-beaked common dolphins entered the mitigation zone surrounding an area where a time-delayed firing device had been initiated, that could not be deactivated, on an explosive with a net explosive weight (NEW) of 8.76 pounds (lb.) (3.97 kilograms [kg]) placed at a depth of 48 ft. (14.6 m). Although the dive boat was placed between the pod and the explosive in an effort to guide the dolphins away from the area, that effort was unsuccessful. Approximately 1 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 3 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).

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 3.7.3.2.1.2, 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 to 27 psi-ms (170 to 190 Pa-s). Lung injuries were found to be slightly more prevalent than GI 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 to 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 GI 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.

3.7.3.2.1.2 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. The Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities (see Section 3.0.3.6.1) 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 3.7.3.1.1.2 (Hearing Loss) under Section 3.7.3.1 (Acoustic Stressors).

3.7.3.2.1.3 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). The Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities (see Section 3.0.3.6.1) 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 3.7.3.1.1.3 (Physiological Stress) under Section 3.7.3.1 (Acoustic Stressors). 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.

3.7.3.2.1.4 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 3.0.3.6.1), 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 may lead to a change in vocalizations or a change in behavior (e.g., cessation of foraging, leaving an area).

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 3.7.3.1.1.4 (Masking) under Section 3.7.3.1 (Acoustic Stressors). Potential masking from explosive sounds is likely to be similar to masking studied for other impulsive sounds such as air guns.

3.7.3.2.1.5 Behavioral Reactions

As discussed in the Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities (Section 3.0.3.6.1), 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). Behavioral reactions from explosive sounds are likely to be similar to reactions studied for other impulsive sounds such as those produced by air guns. 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. Most data has 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 air gun data (as presented in 3.7.3.1 Acoustic Stressors) provides the best available science for assessing behavioral responses to impulsive sounds (i.e., sounds from explosives) by marine mammals, it is likely that these responses represent a worst-case scenario compared to most Navy explosive noise sources.

General research findings regarding behavioral reactions from marine mammals due to exposure to impulsive sounds, such as those associated with explosions, are discussed in detail in Section 3.7.3.1.1.5 (Behavioral Reactions) under Section 3.7.3.1 (Acoustic Stressors).

3.7.3.2.1.6 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).

3.7.3.2.1.7 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 Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities (Section 3.0.3.6.1). 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 measureable 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.

3.7.3.2.2 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 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 explosions could also mask biologically important sounds; however, the duration of individual sounds is very short, reducing the likelihood of substantial auditory masking.

3.7.3.2.2.1 Methods for Analyzing Impacts from Explosives

The Navy performed a quantitative analysis to estimate the number 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 animals that 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, 2018).

Criteria and Thresholds used to Estimate Impacts on Marine Mammals from Explosives

See the *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* technical report for detailed information on how the criteria and thresholds were derived.

Mortality and Injury from Explosives

As discussed above in Section 3.7.3.2.1.1 (Injury), two metrics have been identified as predictive of injury: impulse and peak pressure. Peak pressure contributes to the "crack" or "stinging" sensation of a blast wave, compared to the "thump" associated with received impulse. Older military reports documenting exposure of human divers to blast exposure generally describe peak pressure exposures around 100 psi (237 dB re 1 µPa SPL peak) to feel like slight pressure or stinging sensation on skin, with no enduring effects (Christian & Gaspin, 1974).

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 3.7-63). 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 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 3.7-63: Criteria to Quantitatively Assess Non-Auditory Injury Due to Underwater Explosions

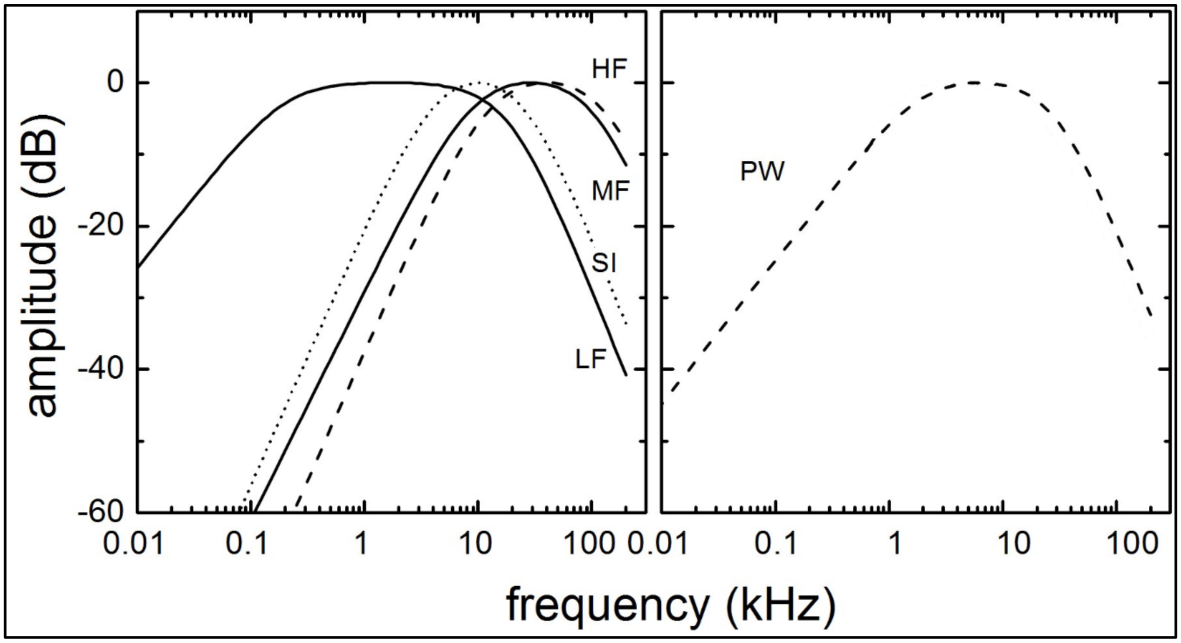
Impact Category	*Impact Threshold*	*Threshold for Farthest Range to Effect*[2]
Mortality[1]	$144M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/6}$ Pa-s	$103M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/6}$ Pa-s
Injury[1]	$65.8M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/6}$ Pa-s	$47.5M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/6}$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

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

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 threshold 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 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. Auditory weighting functions for all species groups are presented in Figure 3.7-94.



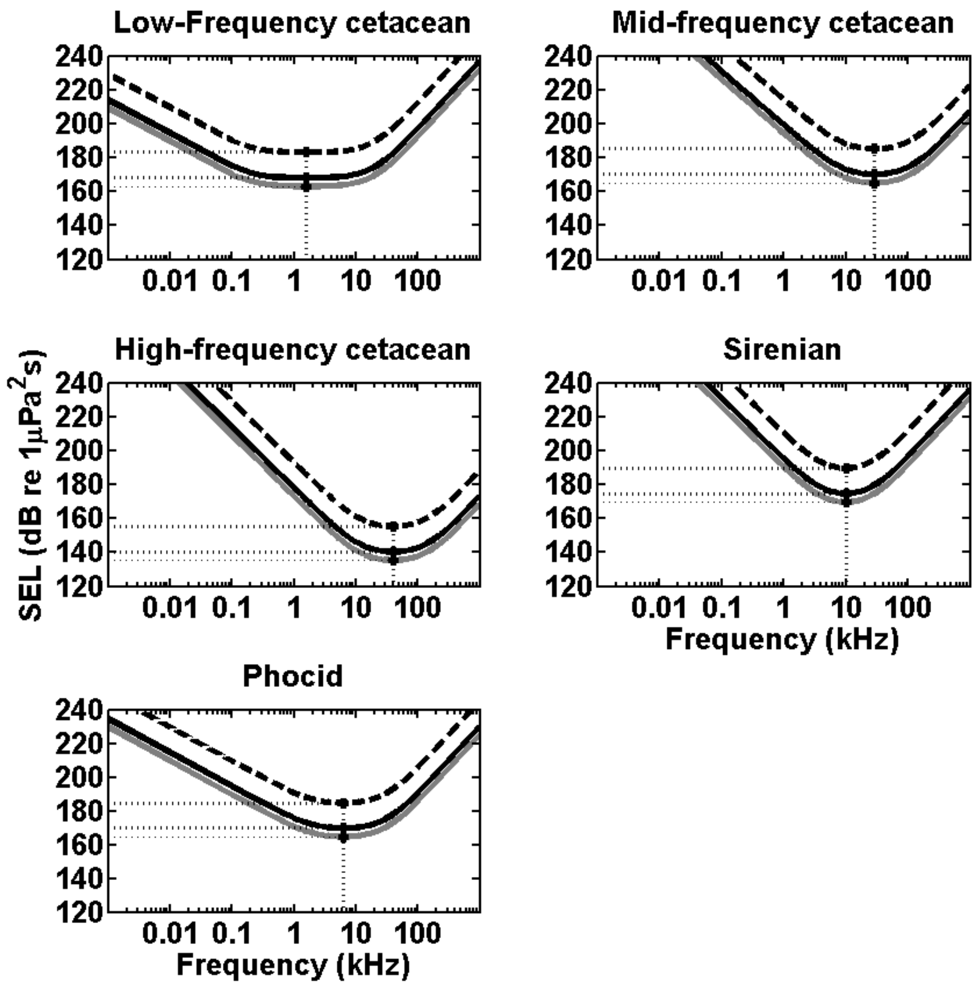
For parameters used to generate the functions and more information on weighting function derivation see U.S. Department of the Navy (2017a).

MF: Mid-Frequency Cetacean; HF: High-Frequency Cetacean; LF: Low-Frequency Cetacean; SI: Sirenian; PW: Phocid (in-water). 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 3.7-94: 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 3.7-95 and Table 3.7-64).



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 3.7-95: Navy Phase III Behavioral, TTS and PTS Exposure Functions for Explosives

Table 3.7-64: 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	163	168	213	183	219
Mid-frequency Cetacean	165	170	224	185	230
High-frequency Cetacean	135	140	196	155	202
Sirenian (Manatee)	170	175	220	190	226
Phocid seal in water	165	170	212	185	218

dB: decibels; PTS: permanent threshold shift; SEL: sound exposure level; SPL: sound pressure level; TTS: temporary threshold shift

Behavioral Responses from Explosives

If more than one explosion or explosive cluster 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 procedural mitigation measures to avoid or reduce potential impacts from explosives, as described in Section 5.3.3 (Explosive Stressors). 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 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, 2018).

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 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 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. 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.

The Navy also implements mitigation measures for certain explosive activities within mitigation areas, as described in Section 5.4.2 (Mitigation Areas off the Northeastern United States), Section 5.4.3 (Mitigation Areas off the Mid-Atlantic and Southeastern United States), and Section 5.4.4 (Mitigation Areas in the Gulf of Mexico). 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.

3.7.3.2.2.2 Impact Ranges from Explosives

The following section provides the range (distance) over which specific physiological or behavioral effects are expected to occur based on the explosive criteria (Section 3.7.3.2.2.1, Methods for Analyzing Impacts from Explosives: Criteria and Thresholds Used to Estimate Impacts to Marine Mammals from Explosives) and the explosive propagation calculations from the Navy Acoustic Effects Model (Section 3.7.3.2.2.1, Methods for Analyzing Impacts from Explosives: The Navy's Acoustic Effects Model). The range to effects are shown for a range of explosive bins (Section 3.7.3.2.2.2, Impact Ranges from Explosives), from E1 (up to 0.25 lb. NEW) to E17 (up to 58,000 lb. NEW). 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 be mitigated within applicable mitigation zones.

Table 3.7-65 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 (i.e., NEW). 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 3.7-66.

The following tables (Table 3.7-67 to Table 3.7-76) show the minimum, average, and maximum ranges to onset of auditory and behavioral effects based on the thresholds described in Section 3.7.3.2.2.1, (Methods for Analyzing Impacts from Explosives: Criteria and Thresholds Used to Estimate Impacts to Marine Mammals from Explosives). Ranges are provided for a representative source depth and cluster size 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* (U.S. Department of the Navy, 2018).

Table 3.7-65: Ranges[1] to 50 Percent Non-Auditory Injury Risk for All Marine Mammal Hearing Groups

Bin	*Range (m)*
E1	12 (11—13)
E2	15 (15—16)
E3	25 (25—40)
E4	31 (0—70)
E5	41 (30—70)
E6	52 (30—170)
E7	174 (110—200)
E8	112 (3—240)
E9	118 (75—330)
E10	175 (85—550)
E11	447 (310—1,525)
E12	314 (95—750)
E16	1,484 (925—2,025)
E17	2,692 (925—10,025)

[1] Distances in meters (m). Average distance to mortality is depicted above the minimum and maximum distances which are in parentheses. Average distance is shown with the minimum and maximum distances due to varying propagation environments. Modeled ranges based on peak pressure for a single explosion generally exceed the modeled ranges based on impulse (related to animal mass and depth); therefore, ranges shown are not animal mass-dependent.

Table 3.7-66: Ranges[1] to 50 Percent Mortality Risk for All Marine Mammal Hearing Groups as a Function of Animal Mass

Bin	*Animal Mass Intervals (kg)*[1]					
	10	***250***	***1,000***	***5,000***	***25,000***	***72,000***
E1	3 (2—4)	0 (0—3)	0 (0—0)	0 (0—0)	0 (0—0)	0 (0—0)
E2	4 (3—5)	1 (0—3)	0 (0—0)	0 (0—0)	0 (0—0)	0 (0—0)
E3	8 (6—11)	4 (2—8)	1 (0—3)	0 (0—0)	0 (0—0)	0 (0—0)
E4	15 (0—30)	8 (0—23)	3 (0—9)	2 (0—4)	0 (0—0)	0 (0—0)
E5	13 (11—35)	7 (4—25)	3 (2—8)	2 (0—4)	0 (0—2)	0 (0—2)
E6	19 (14—55)	11 (0—35)	5 (0—13)	3 (2—7)	0 (0—2)	0 (0—2)
E7	73 (55—95)	34 (19—65)	15 (12—21)	9 (8—10)	5 (4—5)	4 (3—4)
E8	48 (0—100)	26 (0—75)	12 (0—21)	8 (0—12)	4 (0—6)	3 (0—5)
E9	33 (30—55)	20 (13—35)	10 (8—14)	7 (5—8)	4 (3—4)	3 (2—3)
E10	63 (35—230)	25 (16—130)	13 (11—25)	9 (7—13)	5 (4—5)	4 (3—4)
E11	220 (180—490)	118 (60—280)	51 (40—110)	32 (25—60)	18 (15—25)	14 (11—23)
E12	141 (50—350)	44 (20—250)	16 (13—22)	11 (9—13)	6 (5—7)	5 (4—5)
E16	942 (800—1,025)	602 (390—975)	308 (260—400)	202 (170—220)	102 (90—110)	73 (60—85)
E17	1,364 (925—2,025)	1,005 (650—1,775)	636 (525—900)	436 (360—550)	238 (210—250)	179 (150—210)

[1] Distances in meters (m). Average distance to mortality is depicted above the minimum and maximum distances which are in parentheses. Average distance is shown with the minimum and maximum distances due to varying propagation environments.

Kg: kilograms

Table 3.7-67: SEL-Based Ranges to Onset PTS, Onset TTS, and Behavioral Reaction for High-Frequency Cetaceans

Range to Effects for Explosives: High Frequency Cetaceans[1]					
Bin	*Source Depth (m)*	*Cluster Size*	*PTS*	*TTS*	*Behavioral*
E1	0.1	1	446 (180—975)	1,512 (525—3,775)	2,591 (800—6,775)
		20	1,289 (440—3,025)	4,527 (1,275—10,775)	6,650 (1,525—16,525)
E2	0.1	1	503 (200—1,025)	1,865 (600—3,775)	3,559 (1,025—6,775)
		2	623 (250—1,275)	2,606 (750—5,275)	4,743 (1,275—8,525)
E3	18.25	1	865 (525—2,525)	3,707 (1,025—6,775)	5,879 (1,775—10,025)
		50	4,484 (1,275—7,775)	10,610 (2,275—19,775)	13,817 (2,275—27,025)
E4	15	1	1,576 (1,025—2,275)	6,588 (4,525—8,775)	9,744 (7,275—13,025)
		5	3,314 (2,275—4,525)	10,312 (7,525—14,775)	14,200 (9,775—20,025)
	19.8	2	1,262 (975—2,025)	4,708 (1,775—7,525)	6,618 (2,025—11,525)
	198	2	1,355 (875—2,775)	4,900 (2,525—8,275)	6,686 (3,025—11,275)
E5	0.1	25	3,342 (925—8,025)	8,880 (1,275—20,525)	11,832 (1,525—25,025)
E6	0.1	1	1,204 (550—3,275)	4,507 (1,275—10,775)	6,755 (1,525—16,525)
	30	1	2,442 (1,525—5,025)	7,631 (4,525—10,775)	10,503 (4,775—15,025)
E7	15	1	3,317 (2,525—4,525)	10,122 (7,775—13,275)	13,872 (9,775—17,775)
E8	0.1	1	1,883 (675—4,525)	6,404 (1,525—14,525)	9,001 (1,525—19,775)
	45.75	1	2,442 (1,025—5,525)	7,079 (2,025—12,275)	9,462 (2,275—17,025)
	305	1	3,008 (2,025—4,025)	9,008 (6,025—10,775)	12,032 (8,525—14,525)
E9	0.1	1	2,210 (800—4,775)	6,088 (1,525—13,275)	8,299 (1,525—19,025)
E10	0.1	1	2,960 (875—7,275)	8,424 (1,525—19,275)	11,380 (1,525—24,275)
E11	18.5	1	4,827 (1,525—8,775)	11,231 (2,525—20,025)	14,667 (2,525—26,775)
	45.75	1	3,893 (1,525—7,525)	9,320 (2,275—17,025)	12,118 (2,525—21,525)
E12	0.1	1	3,046 (1,275—6,775)	7,722 (1,525—18,775)	10,218 (2,025—22,525)
E16	61	1	5,190 (2,275—9,775)	7,851 (3,525—19,525)	9,643 (3,775—25,775)
E17	61	1	6,173 (2,525—12,025)	11,071 (3,775—29,275)	13,574 (4,025—37,775)

[1] Distances in meters (m). Average distance is shown with the minimum and maximum distances due to varying propagation environments in parentheses.

Table 3.7-68: Peak Pressure Based Ranges to Onset PTS and Onset TTS for High-Frequency Cetaceans

Range to Effects for Explosives: High Frequency Cetaceans[1]			
Bin	***Source Depth (m)***	***PTS***	***TTS***
E1	0.1	579 (200—975)	883 (300—3,025)
E2	0.1	493 (230—1,275)	879 (360—3,525)
E3	18.25	2,052 (950—5,025)	3,580 (1,025—8,275)
E4	15	3,324 (2,025—5,025)	7,679 (3,775—12,775)
	19.8	2,205 (1,275—4,275)	3,549 (2,275—5,525)
	198	2,841 (1,775—6,275)	4,009 (2,775—7,275)
E5	0.1	1,459 (490—7,775)	2,805 (875—17,775)
E6	0.1	1,956 (800—7,775)	4,071 (1,275—23,025)
	30	4,339 (2,025—10,025)	7,633 (3,025—17,025)
E7	15	9,900 (5,025—18,025)	15,456 (8,775—27,775)
E8	0.1	4,312 (1,025—26,775)	7,430 (1,525—53,275)
	45.75	6,941 (1,775—20,275)	11,610 (1,775—36,525)
	305	6,518 (3,275—10,775)	9,129 (4,525—18,025)
E9	0.1	4,129 (1,525—40,275)	6,770 (1,525—71,275)
E10	0.1	7,509 (1,525—53,775)	12,597 (1,775—76,775)
E11	18.5	14,627 (2,275—44,775)	22,673 (4,025—68,275)
	45.75	13,105 (2,025—41,775)	22,150 (2,775—65,775)
E12	0.1	6,551 (1,525—71,275)	11,162 (2,275—85,275)
E16	61	29,544 (17,525—59,275)	39,829 (24,525—92,775)
E17	61	39,317 (18,775—99,275)	52,954 (23,025—98,775)

[1] Distances in meters (m). Average distance is shown with the minimum and maximum distances due to varying propagation environments in parentheses.

Table 3.7-69: SEL-Based Ranges to Onset PTS, Onset TTS, and Behavioral Reaction for Low-Frequency Cetaceans

Range to Effects for Explosives: Low Frequency Cetaceans[1]					
Bin	***Source Depth (m)***	***Cluster Size***	***PTS***	***TTS***	***Behavioral***
E1	0.1	1	54 (45—80)	259 (130—390)	137 (90—210)
		20	211 (110—320)	787 (340—1,525)	487 (210—775)
E2	0.1	1	64 (55—75)	264 (150—400)	154 (100—220)
		2	87 (70—110)	339 (190—500)	203 (120—300)
E3	18.25	1	211 (190—390)	1,182 (600—2,525)	588 (410—1,275)
		50	1,450 (675—3,275)	8,920 (1,525—24,275)	4,671 (1,025—10,775)
E4	15	1	424 (380—550)	3,308 (2,275—4,775)	1,426 (1,025—2,275)
		5	1,091 (950—1,525)	6,261 (3,775—9,525)	3,661 (2,525—5,275)
	19.8	2	375 (350—400)	1,770 (1,275—3,025)	1,003 (725—1,275)
	198	2	308 (280—380)	2,275 (1,275—3,525)	1,092 (850—2,275)
E5	0.1	25	701 (300—1,525)	4,827 (750—29,275)	1,962 (575—22,525)
E6	0.1	1	280 (150—450)	1,018 (460—7,275)	601 (300—1,525)
	30	1	824 (525—1,275)	4,431 (2,025—7,775)	2,334 (1,275—4,275)
E7	15	1	1,928 (1,775—2,275)	8,803 (6,025—14,275)	4,942 (3,525—6,525)
E8	0.1	1	486 (220—1,000)	3,059 (575—20,525)	1,087 (440—7,775)
	45.75	1	1,233 (675—3,025)	7,447 (1,275—19,025)	3,633 (1,000—9,025)
	305	1	937 (875—975)	6,540 (3,025—12,025)	3,888 (2,025—6,525)
E9	0.1	1	655 (310—1,275)	2,900 (650—31,025)	1,364 (500—8,525)
E10	0.1	1	786 (340—7,275)	7,546 (725—49,025)	3,289 (550—26,525)
E11	18.5	1	3,705 (925—8,775)	16,488 (2,275—40,275)	9,489 (1,775—22,775)
	45.75	1	3,133 (925—8,275)	16,365 (1,775—50,275)	8,701 (1,275—23,775)
E12	0.1	1	985 (400—6,025)	7,096 (800—72,775)	2,658 (625—46,525)
E16	61	1	10,155 (2,025—21,525)	35,790 (18,025—69,775)	25,946 (14,025—58,775)
E17	61	1	17,464 (8,275—39,525)	47,402 (21,025—93,275)	34,095 (16,275—86,275)

[1] Distances in meters (m). Average distance is shown with the minimum and maximum distances due to varying propagation environments in parentheses.

Table 3.7-70: Peak Pressure Based Ranges to Onset PTS and Onset TTS for Low-Frequency Cetaceans

Range to Effects for Explosives: Low Frequency Cetaceans[1]			
Bin	***Source Depth (m)***	***PTS***	***TTS***
E1	0.1	127 (75—170)	226 (100—270)
E2	0.1	120 (85—150)	189 (110—270)
E3	18.25	336 (260—1,275)	674 (420—2,275)
E4	15	522 (410—875)	1,159 (775—2,025)
	19.8	431 (390—575)	892 (700—1,275)
	198	401 (360—490)	840 (650—1,775)
E5	0.1	387 (150—500)	622 (210—1,275)
E6	0.1	459 (230—625)	724 (370—1,525)
	30	871 (550—1,775)	1,519 (925—2,525)
E7	15	1,914 (1,525—2,275)	3,643 (3,025—4,525)
E8	0.1	703 (360—1,525)	1,062 (525—5,275)
	45.75	1,438 (675—3,525)	2,443 (975—7,025)
	305	1,153 (975—2,025)	3,210 (1,525—5,025)
E9	0.1	926 (480—3,775)	1,409 (600—5,025)
E10	0.1	997 (500—5,275)	1,993 (650—11,025)
E11	18.5	2,855 (950—7,525)	5,356 (1,025—15,525)
	45.75	2,642 (975—7,525)	4,485 (1,025—14,025)
E12	0.1	1,294 (575—4,775)	2,216 (750—17,275)
E16	61	5,118 (1,275—15,275)	12,416 (4,025—25,275)
E17	61	11,226 (3,525—22,775)	18,059 (8,275—37,275)

[1] Distances in meters (m). Average distance is shown with the minimum and maximum distances due to varying propagation environments in parentheses.

Table 3.7-71: SEL-Based Ranges to Onset PTS, Onset TTS, and Behavioral Reaction for Mid-Frequency Cetaceans

Range to Effects for Explosives: Mid-Frequency Cetaceans[1]					
Bin	***Source Depth (m)***	***Cluster Size***	***PTS***	***TTS***	***Behavioral***
E1	0.1	1	26 (25—50)	139 (95—370)	218 (120—550)
		20	113 (80—290)	539 (210—1,025)	754 (270—1,525)
E2	0.1	1	35 (30—45)	184 (100—300)	276 (130—490)
		2	51 (40—70)	251 (120—430)	365 (160—700)
E3	18.25	1	40 (35—45)	236 (190—800)	388 (280—1,275)
		50	304 (230—1,025)	1,615 (750—3,275)	2,424 (925—5,025)
E4	15	1	74 (60—100)	522 (440—750)	813 (650—1,025)
		5	192 (140—260)	1,055 (875—1,525)	1,631 (1,275—2,525)
	19.8	2	69 (65—70)	380 (330—470)	665 (550—750)
	198	2	48 (0—55)	307 (260—380)	504 (430—700)
E5	0.1	25	391 (170—850)	1,292 (470—3,275)	1,820 (575—5,025)
E6	0.1	1	116 (90—290)	536 (310—1,025)	742 (380—1,525)
	30	1	110 (85—310)	862 (600—2,275)	1,281 (975—3,275)
E7	15	1	201 (190—220)	1,067 (1,025—1,275)	1,601 (1,275—2,025)
E8	0.1	1	204 (150—500)	802 (400—1,525)	1,064 (470—2,275)
	45.75	1	133 (120—200)	828 (525—2,025)	1,273 (775—2,775)
	305	1	58 (0—110)	656 (550—750)	1,019 (900—1,025)
E9	0.1	1	241 (200—370)	946 (450—1,525)	1,279 (500—2,275)
E10	0.1	1	339 (230—750)	1,125 (490—2,525)	1,558 (550—4,775)
E11	18.5	1	361 (230—750)	1,744 (800—3,775)	2,597 (925—5,025)
	45.75	1	289 (230—825)	1,544 (800—3,275)	2,298 (925—5,025)
E12	0.1	1	382 (270—550)	1,312 (525—2,775)	1,767 (600—4,275)
E16	61	1	885 (650—1,775)	3,056 (1,275—5,025)	3,689 (1,525—6,525)
E17	61	1	1,398 (925—2,275)	3,738 (1,525—6,775)	4,835 (1,775—9,275)

Table 3.7-72: Peak Pressure Based Ranges to Onset PTS and Onset TTS for Mid-Frequency Cetaceans

Range to Effects for Explosives: Mid-Frequency Cetaceans[1]			
Bin	***Source Depth (m)***	***PTS***	***TTS***
E1	0.1	44 (35—75)	80 (60—110)
E2	0.1	52 (45—70)	82 (70—95)
E3	18.25	101 (95—220)	188 (170—600)
E4	15	139 (120—230)	278 (230—500)
	19.8	123 (120—130)	243 (230—300)
	198	113 (0—160)	229 (180—270)
E5	0.1	142 (85—170)	252 (110—320)
E6	0.1	175 (100—220)	306 (160—390)
	30	268 (190—575)	514 (370—1,275)
E7	15	415 (330—470)	924 (650—1,025)
E8	0.1	290 (140—350)	476 (230—925)
	45.75	433 (340—1,525)	890 (575—2,275)
	305	333 (250—420)	649 (575—800)
E9	0.1	418 (260—500)	676 (380—1,025)
E10	0.1	457 (220—775)	732 (370—2,025)
E11	18.5	904 (525—2,275)	1,686 (750—4,275)
	45.75	978 (600—2,525)	1,713 (675—5,525)
E12	0.1	608 (340—975)	940 (460—3,775)
E16	61	3,143 (1,000—7,525)	4,580 (1,025—11,025)
E17	61	4,035 (1,025—11,025)	6,005 (1,275—15,275)

[1] Distances in meters (m). Average distance is shown with the minimum and maximum distances due to varying propagation environments in parentheses.

Table 3.7-73: SEL-Based Ranges to Onset PTS, Onset TTS, and Behavioral Reaction for Phocids

Range to Effects for Explosives: Phocids[1]					
Bin	*Source Depth (m)*	*Cluster Size*	*PTS*	*TTS*	*Behavioral*
E1	0.1	1	50 (45—85)	242 (120—470)	360 (160—650)
		20	197 (110—380)	792 (300—1,275)	1,066 (410—2,275)
E2	0.1	1	65 (55—85)	267 (140—430)	378 (190—675)
		2	85 (65—100)	345 (180—575)	476 (230—875)
E3	18.25	1	121 (110—220)	689 (500—1,525)	1,074 (725—2,525)
		50	859 (600—2,025)	4,880 (1,525—10,525)	7,064 (1,775—16,275)
E4	15	1	213 (190—260)	1,246 (1,025—1,775)	2,006 (1,525—3,025)
		5	505 (450—600)	2,933 (2,275—4,275)	4,529 (3,275—6,775)
	19.8	2	214 (210—220)	1,083 (900—2,025)	1,559 (1,025—2,525)
	198	2	156 (150—180)	1,141 (825—2,275)	2,076 (1,275—3,525)
E5	0.1	25	615 (250—1,025)	2,209 (850—9,775)	3,488 (1,025—15,275)
E6	0.1	1	210 (160—380)	796 (480—1,275)	1,040 (600—3,275)
	30	1	359 (280—625)	1,821 (1,275—2,775)	2,786 (1,775—4,275)
E7	15	1	557 (525—650)	3,435 (2,775—4,525)	5,095 (3,775—6,775)
E8	0.1	1	346 (230—600)	1,136 (625—4,025)	1,708 (850—6,025)
	45.75	1	469 (380—1,025)	2,555 (1,275—6,025)	3,804 (1,525—9,775)
	305	1	322 (310—330)	3,222 (1,775—4,525)	4,186 (2,275—5,775)
E9	0.1	1	441 (330—575)	1,466 (825—5,775)	2,142 (950—9,775)
E10	0.1	1	539 (350—900)	1,914 (875—8,525)	3,137 (1,025—15,025)
E11	18.5	1	1,026 (700—2,025)	5,796 (1,525—12,775)	8,525 (1,775—19,775)
	45.75	1	993 (675—2,275)	4,835 (1,525—13,525)	7,337 (1,775—18,775)
E12	0.1	1	651 (420—900)	2,249 (950—11,025)	3,349 (1,275—16,025)
E16	61	1	2,935 (1,775—5,025)	6,451 (2,275—16,275)	10,619 (3,275—24,025)
E17	61	1	3,583 (1,775—7,525)	12,031 (3,275—29,275)	18,396 (7,275—41,025)

[1] Distances in meters (m). Average distance is shown with the minimum and maximum distances due to varying propagation environments in parentheses.

Table 3.7-74: Peak Pressure Based Ranges to Onset PTS and Onset TTS for Phocids

Range to Effects for Explosives: Phocids[1]			
Bin	***Source Depth (m)***	***PTS***	***TTS***
E1	0.1	141 (80—200)	250 (100—310)
E2	0.1	129 (90—170)	204 (120—300)
E3	18.25	377 (290—1,275)	762 (575—2,025)
E4	15	591 (450—1,000)	1,280 (850—2,025)
	19.8	499 (460—625)	1,046 (775—2,025)
	198	458 (430—650)	1,011 (775—2,025)
E5	0.1	430 (150—725)	695 (220—1,275)
E6	0.1	509 (250—775)	791 (410—2,025)
	30	996 (575—2,025)	1,677 (975—2,775)
E7	15	2,109 (1,775—3,025)	3,803 (3,025—4,525)
E8	0.1	775 (390—2,025)	1,211 (575—5,275)
	45.75	1,630 (1,025—4,275)	2,814 (1,275—7,025)
	305	1,793 (1,025—3,275)	3,800 (2,025—5,775)
E9	0.1	1,045 (575—3,775)	1,626 (825—7,275)
E10	0.1	1,153 (525—5,275)	2,379 (750—15,775)
E11	18.5	3,232 (1,275—8,275)	5,978 (1,525—15,775)
	45.75	3,072 (1,525—7,775)	5,135 (1,525—14,525)
E12	0.1	1,499 (775—5,025)	2,603 (1,025—17,275)
E16	61	6,256 (2,025—14,775)	13,649 (8,525—25,775)
E17	61	12,665 (5,025—25,775)	19,689 (11,775—36,275)

[1] Distances in meters (m). Average distance is shown with the minimum and maximum distances due to varying propagation environments in parentheses.

Table 3.7-75: SEL-Based Ranges to Onset PTS, Onset TTS, and Behavioral Reaction for Sirenians

Range to Effects for Explosives: Sirenians[1]					
Bin	***Source Depth (m)***	***Cluster Size***	***PTS***	***TTS***	***Behavioral***
E1	0.1	1	26 (25—45)	109 (85—300)	195 (120—550)
		20	90 (75—240)	385 (180—975)	646 (250—1,775)
E2	0.1	1	35 (30—40)	164 (100—250)	288 (140—500)
		2	48 (40—65)	218 (120—370)	375 (170—700)
E3	18.25	1	42 (40—45)	252 (200—460)	532 (370—1,275)
		50	326 (250—625)	1,595 (800—3,525)	2,985 (1,025—6,775)
E4	15	1	76 (65—100)	513 (450—700)	988 (825—1,275)
		5	191 (160—240)	1,080 (925—1,525)	2,118 (1,525—3,275)
	19.8	2	76 (75—80)	461 (400—550)	795 (675—900)
	198	2	0 (0—0)	303 (290—330)	640 (575—775)
E5	0.1	25	280 (150—750)	923 (330—2,775)	1,683 (390—5,525)
E6	0.1	1	95 (75—240)	402 (180—900)	634 (260—1,525)
	30	1	101 (85—120)	697 (550—925)	1,211 (950—2,025)
E7	15	1	199 (190—210)	1,143 (1,025—1,275)	2,254 (1,775—3,025)
E8	0.1	1	156 (100—410)	604 (240—1,525)	937 (340—2,025)
	45.75	1	142 (130—180)	754 (525—1,775)	1,299 (775—3,025)
	305	1	0 (0—12)	620 (600—650)	1,178 (1,025—1,275)
E9	0.1	1	162 (120—290)	638 (290—2,025)	1,033 (400—2,525)
E10	0.1	1	254 (140—625)	840 (310—2,275)	1,450 (410—4,025)
E11	18.5	1	383 (260—725)	1,728 (800—3,275)	3,231 (1,025—6,525)
	45.75	1	271 (240—400)	1,273 (750—3,025)	2,215 (1,025—5,025)
E12	0.1	1	258 (150—480)	909 (370—2,025)	1,561 (420—6,025)
E16	61	1	720 (625—875)	2,131 (1,275—3,275)	3,118 (1,775—4,775)
E17	61	1	1,073 (800—1,275)	2,998 (1,525—4,525)	4,654 (2,275—14,525)

[1] Distances in meters (m). Average distance is shown with the minimum and maximum distances due to varying propagation environments in parentheses.

Table 3.7-76: Peak Pressure Based Ranges to Onset PTS and Onset TTS for Sirenians

Range to Effects for Explosives: Sirenians[1]			
Bin	*Source Depth (m)*	*PTS*	*TTS*
E1	0.1	55 (50—75)	82 (70—150)
E2	0.1	67 (60—85)	110 (80—130)
E3	18.25	148 (120—160)	281 (210—450)
E4	15	200 (190—300)	422 (370—700)
	19.8	193 (190—200)	362 (320—400)
	198	56 (50—60)	293 (290—300)
E5	0.1	150 (100—240)	252 (130—550)
E6	0.1	201 (110—300)	328 (150—725)
	30	296 (250—360)	560 (410—1,000)
E7	15	569 (470—850)	1,740 (1,275—2,025)
E8	0.1	328 (150—525)	533 (210—2,275)
	45.75	509 (370—1,775)	897 (550—2,025)
	305	435 (430—440)	906 (875—950)
E9	0.1	419 (180—750)	713 (260—4,025)
E10	0.1	484 (200—2,025)	771 (280—5,275)
E11	18.5	1,165 (625—3,275)	2,106 (825—8,025)
	45.75	918 (550—2,525)	1,667 (850—5,025)
E12	0.1	655 (230—3,775)	949 (340—5,025)
E16	61	1,782 (1,025—2,775)	3,514 (1,275—10,025)
E17	61	3,009 (1,275—10,025)	9,174 (2,775—20,275)

[1] Distances in meters (m). Average distance is shown with the minimum and maximum distances due to varying propagation environments in parentheses.

3.7.3.2.2.3 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 2.6-2 (Proposed Training Activities per Alternative), and Section 3.0.3.3.2 (Explosive Stressors), training activities under Alternative 1 would use underwater detonations and explosive ordnance. Training activities involving explosions would be conducted throughout the Study Area but would be concentrated in the Virginia Capes Range Complex, followed in descending order of numbers of activities by Jacksonville, Navy Cherry Point, Gulf of Mexico, and the Northeast Range Complexes, although training activities could occur anywhere within the Study Area. Training activities involving the underwater detonation of small (2-lb.) charges in enclosed areas in the Key West Range Complex will specifically take place in Truman Harbor and Demolition Key. Impacts would be minimal due to the low probability of marine mammal occurrence, nature of the confined and restricted detonation locations, and implementation of mitigation. This detonation is enclosed by steel on four sides and concrete on the bottom; therefore, almost all acoustic energy will be vented to the air. Within Alternative 1, most training activities that use explosives reoccur on an annual basis, with some variability year-to-year. Activities that involve underwater detonations and explosive ordnance typically occur more than 3 NM from shore and often in areas designated for explosive use.
- As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.6-3 (Naval Air Systems Command Proposed Testing Activities per Alternative) through Table 2.6-4 (Office of Naval Research Proposed Testing Activities per Alternative), and Section 3.0.3.3.2 (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. Testing activities using explosions do not normally occur within 3 NM of shore; the exception is the designated underwater detonation area near Naval Surface Warfare Center, Panama City Division Testing Range, which is nearshore, partially within the surf zone. Testing activities under Alternative 1 also include Ship Shock Trials that could occur within offshore locations of the Virginia Range Complex, Jacksonville Range Complex, and the Gulf of Mexico Range Complex.
- As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.6-1 (Proposed Training Activities per Alternative), and Section 3.0.3.3.2 (Explosive Stressors), training activities under Alternative 2 would use underwater detonations and explosive ordnance. Training activities involving explosions would be conducted throughout the Study Area but would be concentrated in the Virginia Capes Range Complex, followed in descending order of numbers of activities by Jacksonville, Navy Cherry Point, Gulf of Mexico, and the Northeast Range Complexes, although training activities could occur anywhere within the Study Area. Within Alternative 2, most training activities that use explosives reoccur on an annual basis, with the same number of exercises planned each year. Activities that involve underwater detonations and explosive ordnance typically occur more than 3 NM from shore and often in areas designated for explosive use.
- As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.6-2 (Naval Air Systems Command Proposed Testing Activities per Alternative) through Table 2.6-4 (Office of

Naval Research Proposed Testing Activities per Alternative), and Section 3.0.3.3.2 (Explosive Stressors), testing activities under Alternative 2 would use underwater detonations and explosive ordnance. Within Alternative 2, most testing activities that use explosives reoccur on an annual basis. Testing activities using explosions do not normally occur within 3 NM of shore; the exception is the designated underwater detonation area near Naval Surface Warfare Center, Panama City Division Testing Range, which is nearshore, partially within the surf zone. Testing activities under Alternative 2 also include Ship Shock Trials that could occur within offshore locations of the Virginia Range Complex, Jacksonville Range Complex, and the Gulf of Mexico Range Complex.

Presentation of Estimated Impacts from the Quantitative Analysis

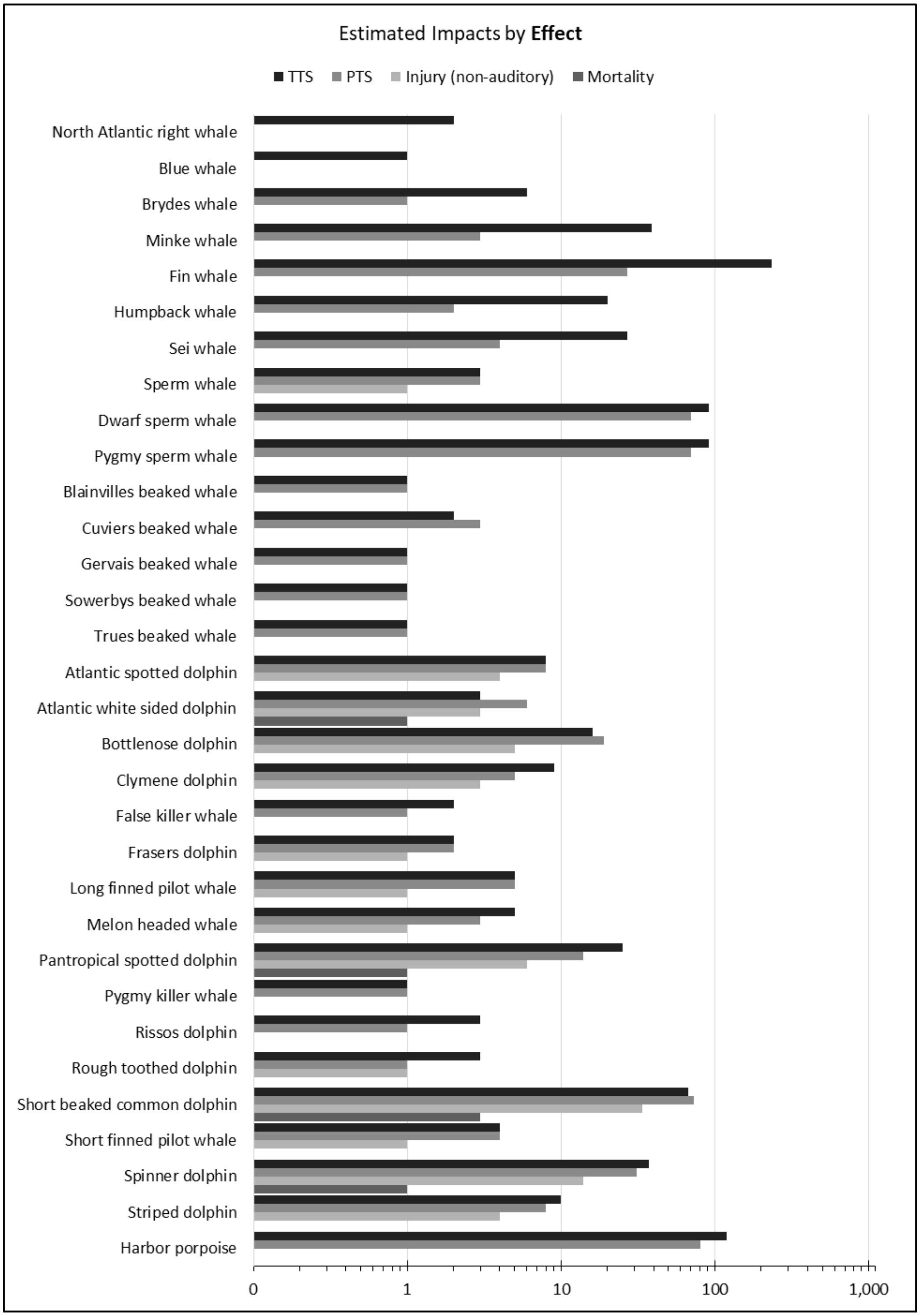
The results of the analysis of potential impacts on marine mammals from explosives (see above Section 3.7.3.2.2.1, Methods for Analyzing Impacts from Explosives) are discussed below. The numbers of potential impacts estimated for individual species of marine mammals from exposure to explosive energy and sound for training activities under Alternative 1 and 2 are shown in Appendix E (Estimated Marine Mammals 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 3.7-98), with the exception of Ship Shock Trial results, which are presented separately, but discussed in each species discussion. 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 below. All (i.e., grand total) estimated impacts are also included, regardless of region or category.

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 number of explosives used under each alternative is described in Section 3.0.3.3.2 (Explosive Stressors).

Estimated Impacts from Ship Shock Trials

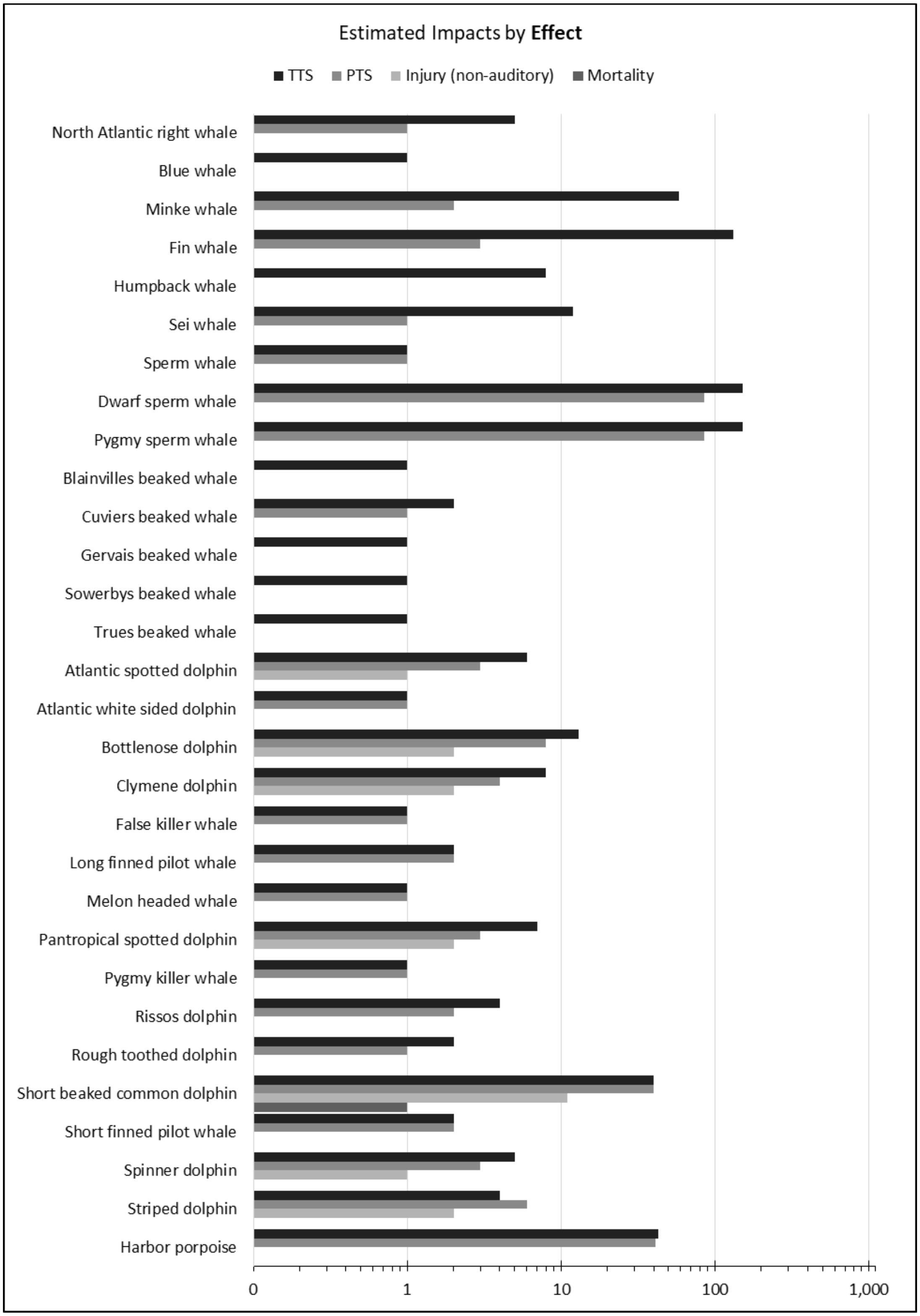
As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.6-2 (Naval Air Systems Command Proposed Testing Activities per Alternative) through Table 2.6-4 (Office of Naval Research Proposed Testing Activities per Alternative), and Section 3.0.3.3.2 (Explosive Stressors), testing activities under Alternative 1 and 2 would use underwater detonations in Large and Small Ship Shock Trials. Results are presented per species in the graphics below (Figure 3.7-96 and Figure 3.7-97). Impacts per species are the maximum impacts for that species for any season and any area for either the large or small ship shock trial. Therefore, the results shown represent the maximum number of estimated impacts that could potentially occur to any species, but over-estimate the overall potential for impact.

Small Ship Shock Trials could take place any season within the deep offshore water of the Virginia Capes Range Complex or in the spring, summer, or fall within the Jacksonville Range Complex and could occur up to three times over a 5-year period. The Large Ship Shock Trial could take place in the Jacksonville Range Complex during the Spring, Summer, or Fall and during any season within the deep offshore water of the Virginia Capes Range Complex or within the Gulf of Mexico. The Large Ship Shock Trial could occur once over 5 years. Potential impacts and any consequences for individuals or populations are discussed below under testing for each species.



Note: This event could occur once over a 5-year period.

Figure 3.7-96: Estimated Maximum Impacts to Each Species Across All Seasons and Locations in Which the Large Ship Shock Trial Could Occur



Note: This event could occur up to three times over a 5-year period.

Figure 3.7-97: Estimated Maximum Impacts to Each Species Across All Seasons and Locations in Which Small Ship Shock Trials Could Occur

Mysticetes

Mysticetes may be exposed to sound and energy from explosions associated with training activities throughout the year. Explosions produce sounds that are within the hearing range of mysticetes (see Section 3.7.2.1.4, 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 3.7.3.2.2.2 (Impact Ranges from 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 3.7.3.1.1.4 (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 the sound from impulsive sounds such as 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.

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 3.7.3.2.1.3 (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 Atlantic Right Whales (Endangered Species Act-Listed)

As discussed in Section 5.4.3 (Mitigation Areas off the Mid-Atlantic and Southeastern United States), the Navy will not use in-water detonations or conduct explosive missile, rocket, gunnery, Improved Extended Echo Ranging sonobuoy, bombing, or torpedo activities in the Southeast North Atlantic Right Whale Mitigation Area during calving season (November 15 to April 15). Before transiting through or conducting training or testing activities within this mitigation area from November 15 to April 15, the Navy will initiate communication with the Fleet Area Control and Surveillance Facility, Jacksonville to obtain Early Warning System North Atlantic right whale sightings data. Vessels will use the sightings information to reduce potential interactions with North Atlantic right whales. In addition, Navy units conducting training or testing activities in the Jacksonville Operating Area will obtain and use Early Warning System North Atlantic right whale sightings data as they plan specific details of events to minimize potential interactions with North Atlantic right whales to the maximum extent practicable. The Navy will use the reported sightings information to assist their visual observation of applicable mitigation zones and to aid in the implementation of procedural mitigation. This high level of awareness will further enhance the Navy's mitigation effectiveness for reducing potential explosive impacts on North Atlantic right whales off the southeastern United States.

The Navy will not use in-water detonations or conduct explosive Improved Extended Echo Ranging sonobuoy, bombing, or torpedo activities in the Northeast North Atlantic Right Whale Mitigation Area year-round. The Navy is expanding this mitigation area to cover the full extent of the northeastern North Atlantic right whale critical habitat, as discussed in Section 5.4.2 (Mitigation Areas off the Northeastern United States). Before transiting through the mitigation area, the Navy will conduct a web query or email inquiry to the National Oceanographic and Atmospheric Administration Northeast Fisheries Science Center's North Atlantic Right Whale Sighting Advisory System to obtain the latest North Atlantic right whale sightings information. Vessels will use the sightings information to reduce potential interactions with North Atlantic right whales. This high level of awareness will further enhance the Navy's mitigation effectiveness for reducing potential explosive impacts on North Atlantic right whales off the northeastern United States.

Impacts from Explosives Under Alternative 1 for Training Activities

North Atlantic right 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 TTS (see Figure 3.7-98 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the western North Atlantic stock.

As described for other mysticetes 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

As previously described in 3.7.2.2.2 (North Atlantic Right Whale [*Eubalaena glacialis*]), a migratory corridor, a calving area, a mating area, and feeding areas for North Atlantic right whales have been identified by LaBrecque et al. (2015a, 2015b) that seasonally overlap with Virginia Capes, Navy Cherry Point, Jacksonville, and the Northeast Range Complexes within the Study Area. Navy training activities that use explosives could occur in these Range Complexes year-round, with exception of the mitigation areas discussed above. Impacts on feeding and mating behaviors are not anticipated for North Atlantic right whales in the Northeast Range Complexes on identified feeding and mating areas due to explosive training activities because these activities within the Northeast Range Complexes are typically conducted within Narragansett Bay, which does not overlap the feeding or mating areas identified by LaBrecque et al. (2015a, 2015b). Estimated impacts on North Atlantic right whale migration and calving behaviors within the Navy Cherry Point Range Complex, which overlaps the identified migration and calving areas, are so low as to be unlikely in any given year. A few TTS and behavioral responses are estimated from training with explosives in the Virginia Capes Range Complex, which overlaps the migratory area, and within the Jacksonville Range Complex, which overlaps the identified migratory and calving areas, however significant impacts on migratory or calving behaviors within the identified areas are unlikely.

As discussed above and in Section 3.7.2.2.2.1 (Status and Management), the Study Area does overlap North Atlantic right whale critical habitat and some limited use of explosive does take place within these areas; however, the sound and energy from explosives would not affect the biological or physical features that are essential for the reproduction, rest and refuge, health, continued survival, conservation and recovery of the North Atlantic right whale population.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will result in the unintentional taking of North Atlantic right whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 1 may affect ESA-listed North Atlantic right whales and will have no effect on North Atlantic right whale critical habitat. The Navy has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Explosives Under Alternative 1 for Testing Activities

North Atlantic right 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 TTS (see Figure 3.7-98 and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the western North Atlantic stock.

As described for other mysticetes 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.

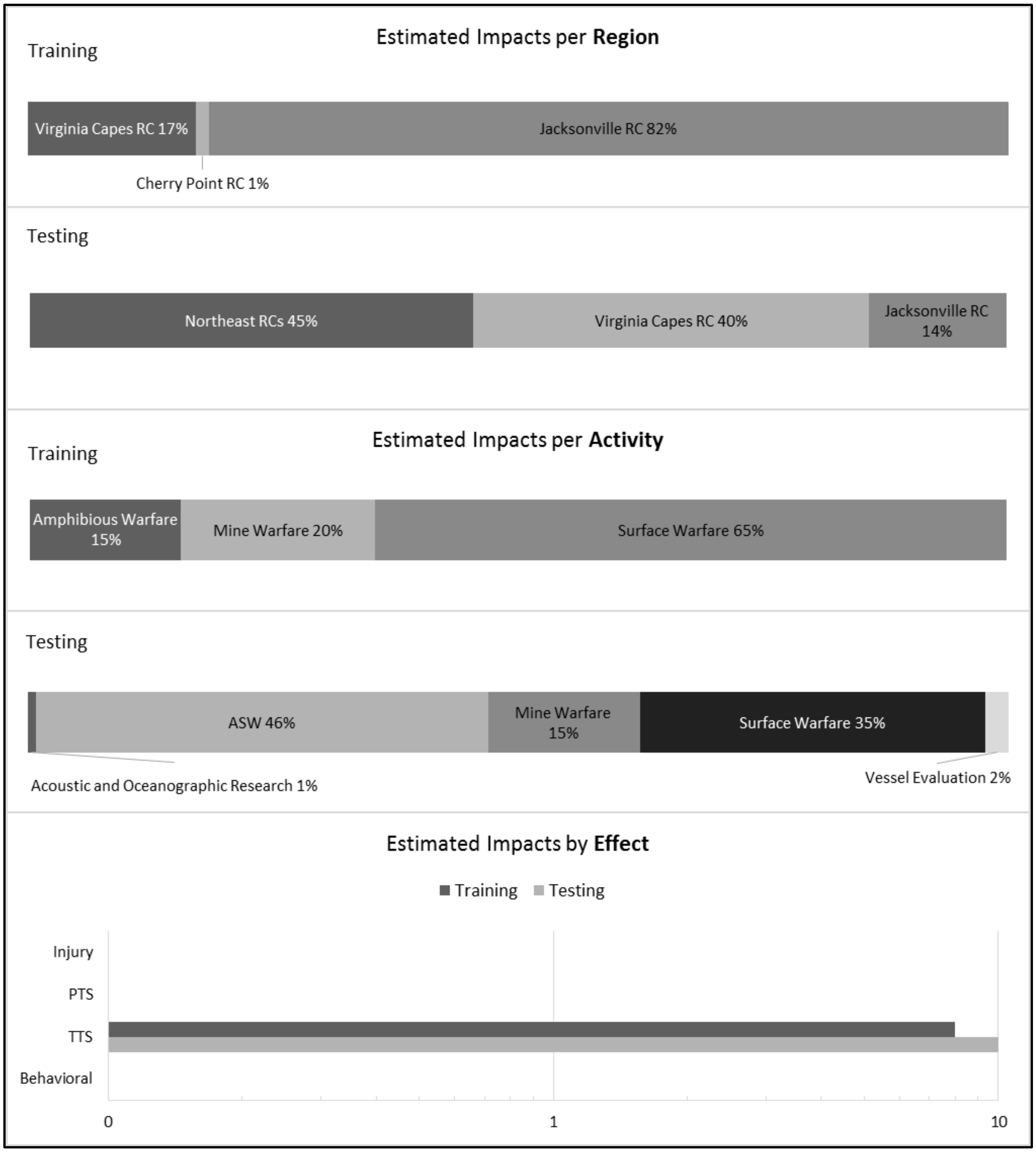
Considering these factors and the mitigation measures that will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

As previously described in Section 3.7.2.2.2 (North Atlantic Right Whale [*Eubalaena glacialis*]) a migratory corridor, a calving area, a mating area, and feeding areas for North Atlantic right whales have been identified by LaBrecque et al. (2015a) that seasonally overlap with Virginia Capes, Navy Cherry Point, Jacksonville, and the Northeast Range Complexes within the Study Area. Navy testing activities that use explosives could occur in these range complexes year-round. A few TTS or behavioral responses are estimated from testing with explosives in the Northeast Range Complexes on identified feeding and mating areas. Few impacts overall are predicted within the entire Study Area due to explosive testing activities; therefore significant impacts on feeding or mating behaviors within the feeding or mating areas identified by LaBrecque et al. (2015a) are not anticipated. Estimated impacts on North Atlantic right whale migration and calving behaviors within the Navy Cherry Point Range Complex, which overlaps the identified migration and calving areas, are so low as to be unlikely in any given year. A few TTS or behavioral responses are estimated from testing with explosives in the Virginia Capes Range Complex, which overlaps the migratory area, and within the Jacksonville Range Complex, which overlaps the identified migratory and calving areas. However, since so few impacts are predicted overall within the Study Area from testing activities that use explosives, significant impacts on migratory or calving behaviors are not anticipated within the designated areas.

As discussed above and in Section 3.7.2.2.2.1 (Status and Management), the Study Area does overlap North Atlantic right whale critical habitat and some limited use of explosive does take place within these areas; however, the sound and energy from explosives would not affect the biological or physical features that are essential for the reproduction, rest and refuge, health, continued survival, conservation and recovery of the North Atlantic right whale population.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 will result in the unintentional taking of North Atlantic right whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 1 may affect ESA-listed North Atlantic right whales and will have no effect on North Atlantic right whale critical habitat. The Navy has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No behavioral responses, PTS, or injury (non-auditory) are estimated for this species. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-98: North Atlantic Right Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

Impacts from Explosives Under Alternative 2 for Training Activities

North Atlantic right 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 2, estimates TTS (see Figure 3.7-99 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the western North Atlantic stock.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of North Atlantic right 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 North Atlantic right whales and will have no effect on North Atlantic right whale critical habitat.

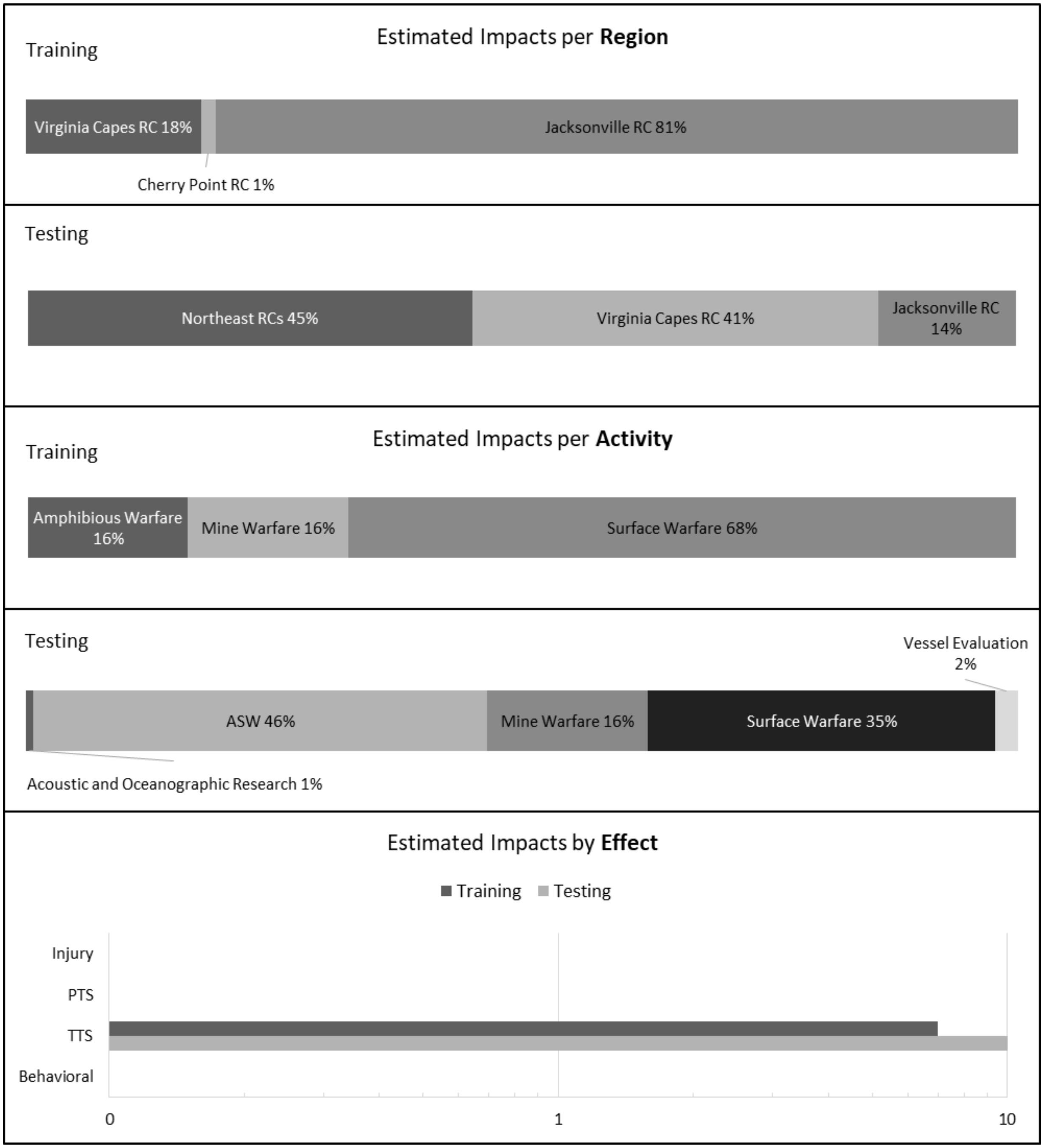
Impacts from Explosives Under Alternative 2 for Testing Activities

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. The primary distinction is that explosive use under Alternative 2 for testing does increase slightly in some locations per year as compared to Alternative 1. Also, annual numbers of activities using explosives would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the number of impacts for this species from testing under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities). Estimated impacts apply to the western North Atlantic stock.

Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of North Atlantic right 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 North Atlantic right whales and will have no effect on North Atlantic right whale critical habitat.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No behavioral responses, PTS, or injury (non-auditory) are estimated for this species. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-99: North Atlantic Right Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 2

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, although the quantitative analysis estimates that no blue whales would be impacted. Long-term consequences for individuals, 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 not result in the unintentional taking of blue whale incidental to those activities.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 1 may affect ESA-listed blue whales. The Navy has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.

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, although the quantitative analysis estimates that no blue whales would be impacted except for estimated TTS for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97).

As described for other mysticetes 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 will 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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 1 may affect ESA-listed blue whales. The Navy has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Explosives Under Alternative 2 for Training Activities

Blue whales may be exposed to sound or energy from explosions associated with training activities throughout the year, although the quantitative analysis estimates that no blue whales would be impacted. Long-term consequences for individuals, 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 not result in the unintentional taking of blue whale incidental to those activities.

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

Blue whales may be exposed to sound or energy from explosions associated with testing activities throughout the year, although the quantitative analysis estimates that no blue whales would be impacted except for impacts due to Ship Shock Trials. Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

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.

Bryde's Whales

For the purposes of this analysis, estimated impacts on Bryde's whales are broken out into two different groups: the ESA-listed northern Gulf of Mexico stock and a group with no stock designation. Estimated impacts on the northern Gulf of Mexico stock only occur in the Gulf of Mexico and surrounding Navy areas. Takes that occur in the Atlantic are considered to be part of the no stock designation group as it is not anticipated that whales from the Gulf of Mexico stock would occur on the east coast.

Impacts from Explosives Under Alternative 1 for Training Activities

Bryde's 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 TTS (see Figure 3.7-100 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple groups (see Table 3.7-77).

As described for other mysticetes 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

A small and resident population area for Bryde's whales identified by LaBrecque et al. (2015a, 2015b) overlaps the Gulf of Mexico Range Complex within the Study Area. Navy training activities that use explosives could occur year-round within the Gulf of Mexico Range Complex; however, the quantitative analysis indicates no impacts on Bryde's whales. Bryde's whales residing in this area could be exposed to sound or energy from explosives; however, impacts on natural behavior patterns or abandonment would not be anticipated within the identified Bryde's whale small and resident population area. In addition to procedural mitigation that is implemented whenever and wherever explosive activities occur, the Navy will not use explosives (except during mine warfare activities) within the newly developed Bryde's Whale Mitigation Area to further avoid or reduce potential impacts on this small and resident population (see Section 5.4.4, Mitigation Areas in the Gulf of Mexico).

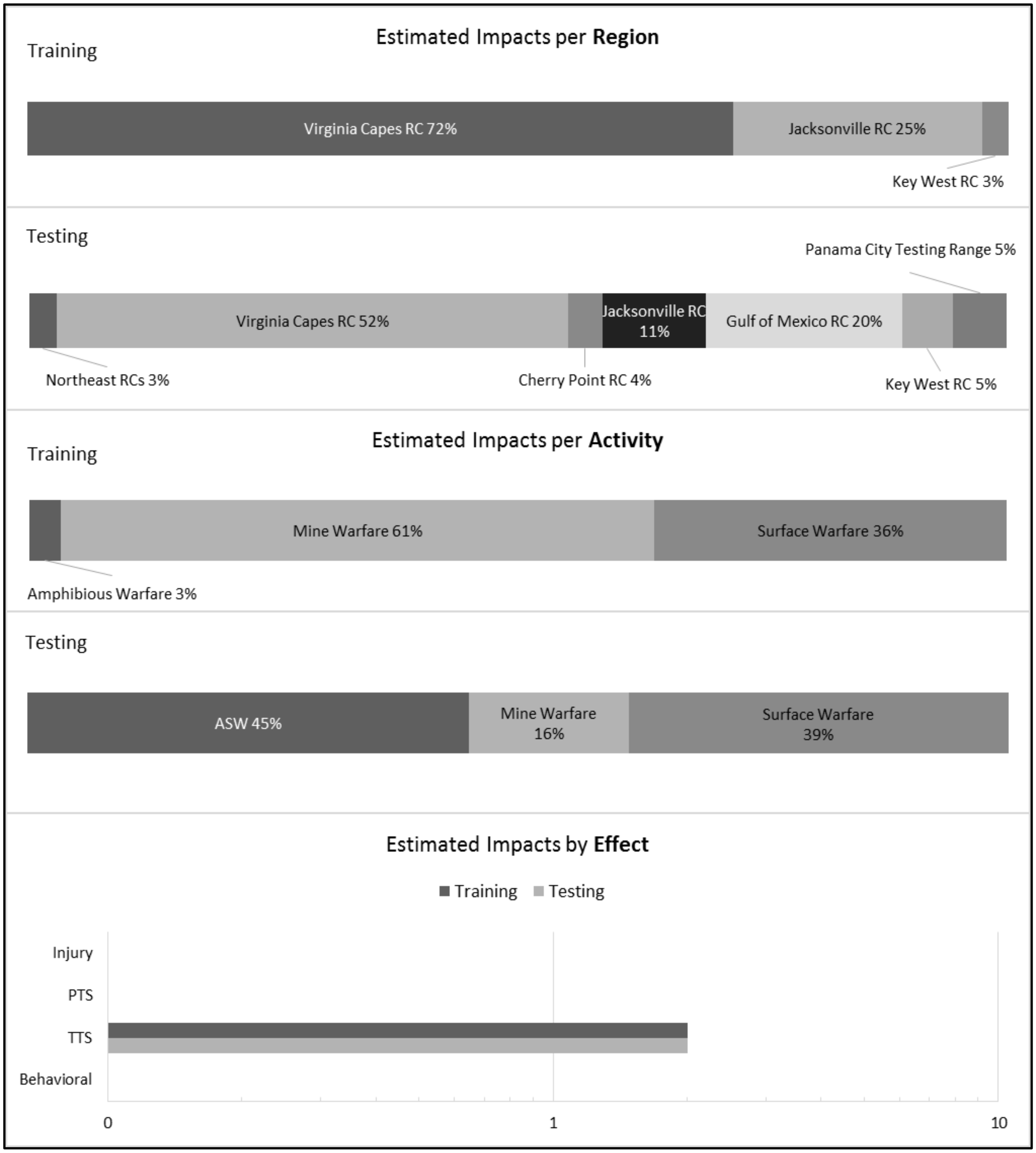
Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will result in the unintentional taking of Bryde's whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 1 may affect ESA-listed Bryde's whales. The Navy has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Explosives Under Alternative 1 for Testing Activities

Bryde's 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 TTS (see Figure 3.7-100 and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS and PTS for Ship Shock Trials (Figure 3.7-96 and Figure

3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple groups (see Table 3.7-77).



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No behavioral responses, PTS, or injury (non-auditory) are estimated for this species. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-100: Bryde's Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

Table 3.7-77: Estimated Impacts on Individual Bryde's Whale Groups Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts per **Species' Group**		
Group	***Training***	***Testing***
Northern Gulf of Mexico	3%	31%
NSD	97%	69%

As described for other mysticetes 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

A small and resident population area for Bryde's whales identified by LaBrecque et al. (2015b) overlaps the Gulf of Mexico Range Complex within the Study Area. Navy testing activities that use explosives could occur year-round within the Gulf of Mexico Range Complex; however, the quantitative analysis indicates impacts on Bryde's whales within the Bryde's whale small and resident population area identified by LaBrecque et al. (2015b) are so low as to be unlikely in any given year. Significant impacts on natural behaviors or abandonment of the area by Bryde's whales in the small and resident population area identified by LaBrecque et al. (2015b) are unlikely due to Navy testing activities that use explosives. In addition to procedural mitigation that is implemented whenever and wherever explosive activities occur, the Navy will not use explosives (except during mine warfare activities) within the newly developed Bryde's Whale Mitigation Area to further avoid or reduce potential impacts on this small and resident population (see Section 5.4.4, Mitigation Areas in the Gulf of Mexico).

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 will result in the unintentional taking of Bryde's whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 1 may affect ESA-listed Bryde's whales. The Navy has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.

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 number of impacts from training under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of Bryde's 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 Bryde's whales.

Impacts from Explosives Under Alternative 2 for Testing Activities

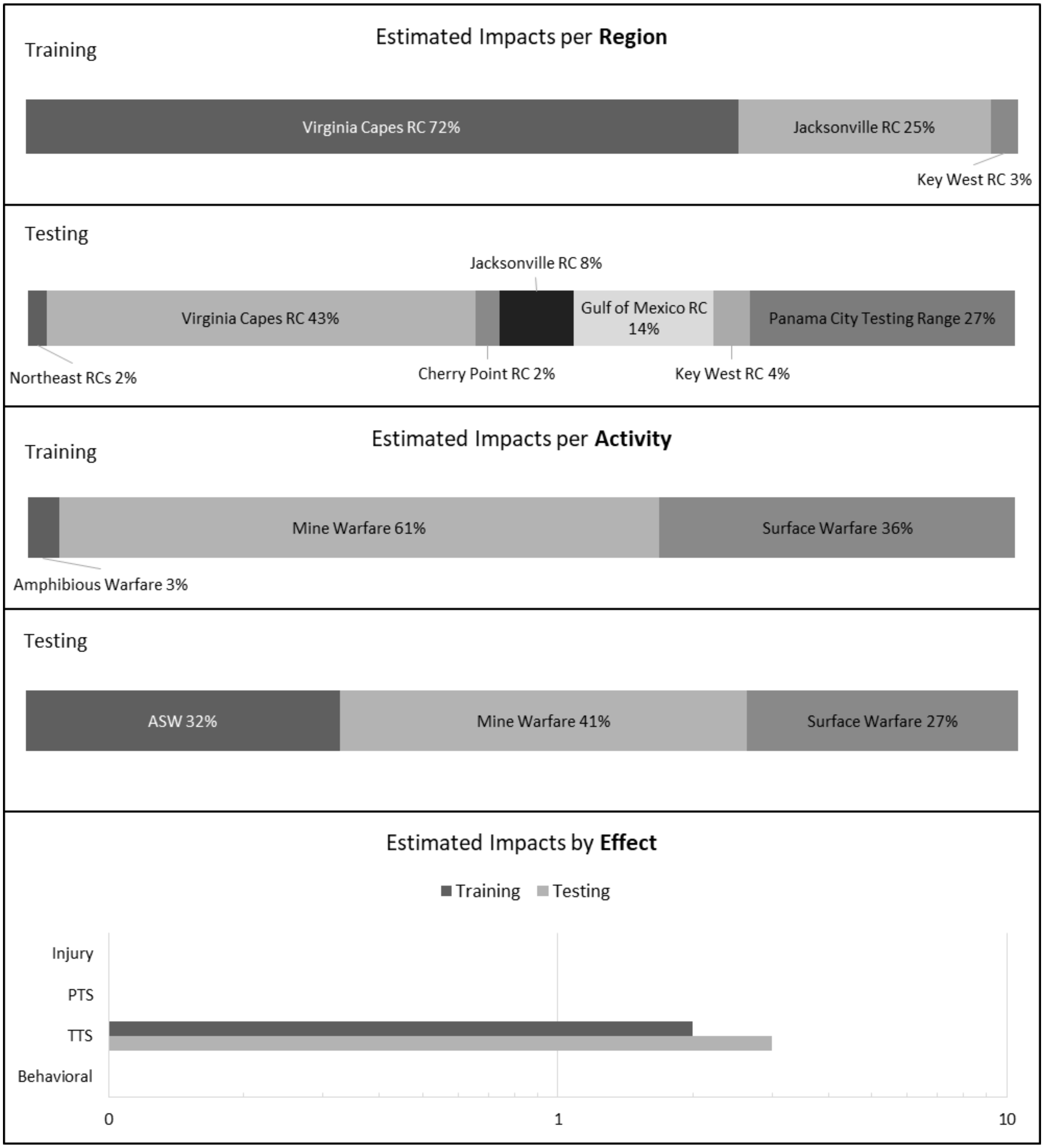
Bryde's whales may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 2, estimates behavioral reactions and TTS (see Figure 3.7-101 and tabular results in Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities). The quantitative analysis also estimates TTS and PTS for Ship Shock Trials (Figure 3.7-96and Figure 3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple groups (see Table 3.7-78).

Potential impacts under Alternative 2 from Explosive use would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in explosives use associated with testing activities under Alternative 2 versus Alternative 1.

Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of Bryde's 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 Bryde's whales.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No behavioral responses, PTS, or injury (non-auditory) are estimated for this species. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-101: Bryde's Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 2

Table 3.7-78: Estimated Impacts on Individual Bryde's Whale Groups Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 2

Estimated Impacts per **Species' Group**		
Group	***Training***	***Testing***
Northern Gulf of Mexico	3%	45%
NSD	97%	55%

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 TTS and PTS (see Figure 3.7-102 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the western North Atlantic stock.

As described for other mysticetes 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Feeding areas for fin whales identified by LaBrecque et al. (2015a) overlap the Northeast Range Complexes within the Study Area. Navy training activities that use explosives could occur year-round within the Northeast Range Complexes; however, within the Northeast Range Complexes training with explosives typically occurs only within Narragansett Bay, which is outside two of the fin whale feeding areas identified by LaBrecque et al. (2015a). In addition to procedural mitigation that is implemented whenever and wherever explosive activities occur, the Navy will implement mitigation to not conduct certain explosive activities within the Northeast North Atlantic Right Whale Mitigation Area year-round. This will further avoid or reduce potential impacts on fin whale feeding behavior within two of the feeding areas identified by LaBrecque et al. (2015a) (see Section 5.4.2, Mitigation Areas off the Northeastern United States). Fin whales within the identified feeding areas would not be exposed to sound or energy from explosives; therefore, impacts on feeding behaviors would not be anticipated within the identified fin whale feeding areas from training with explosives.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will result in the unintentional taking of fin whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 1 may affect ESA-listed fin whales. The Navy has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.

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 TTS and PTS (see Figure 3.7-102 and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS and PTS for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the western North Atlantic stock.

As described for other mysticetes 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

The feeding areas for fin whales identified by LaBrecque et al. (2015a) overlap the Northeast Range Complexes within the Study Area. Navy testing activities that use explosives could occur year-round within the Northeast Range Complexes. A small number of behavioral reactions or TTS could occur within the fin whale feeding areas identified by LaBrecque et al. (2015a). Few impacts overall are predicted within the entire Study Area due to explosive testing activities; therefore significant impacts on feeding behaviors within the fin whale feeding area identified by LaBrecque et al. (2015a) are not anticipated. In addition to procedural mitigation that is implemented whenever and wherever explosive activities occur, the Navy will implement mitigation to not conduct certain explosive activities within the Northeast North Atlantic Right Whale Mitigation Area year-round. This will further avoid or reduce potential impacts on fin whale feeding behavior within two of the feeding areas identified by LaBrecque et al. (2015a) (see Section 5.4.2, Mitigation Areas off the Northeastern United States).

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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 1 may affect ESA-listed fin whales. The Navy has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No behavioral responses or injury (non-auditory) are estimated for this species. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-102: Fin Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

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 number of impacts from training under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Pursuant to the MMPA, the use of explosives 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 explosives during training activities as described under Alternative 2 may affect ESA-listed fin whales.

Impacts from Explosives Under Alternative 2 for Testing Activities

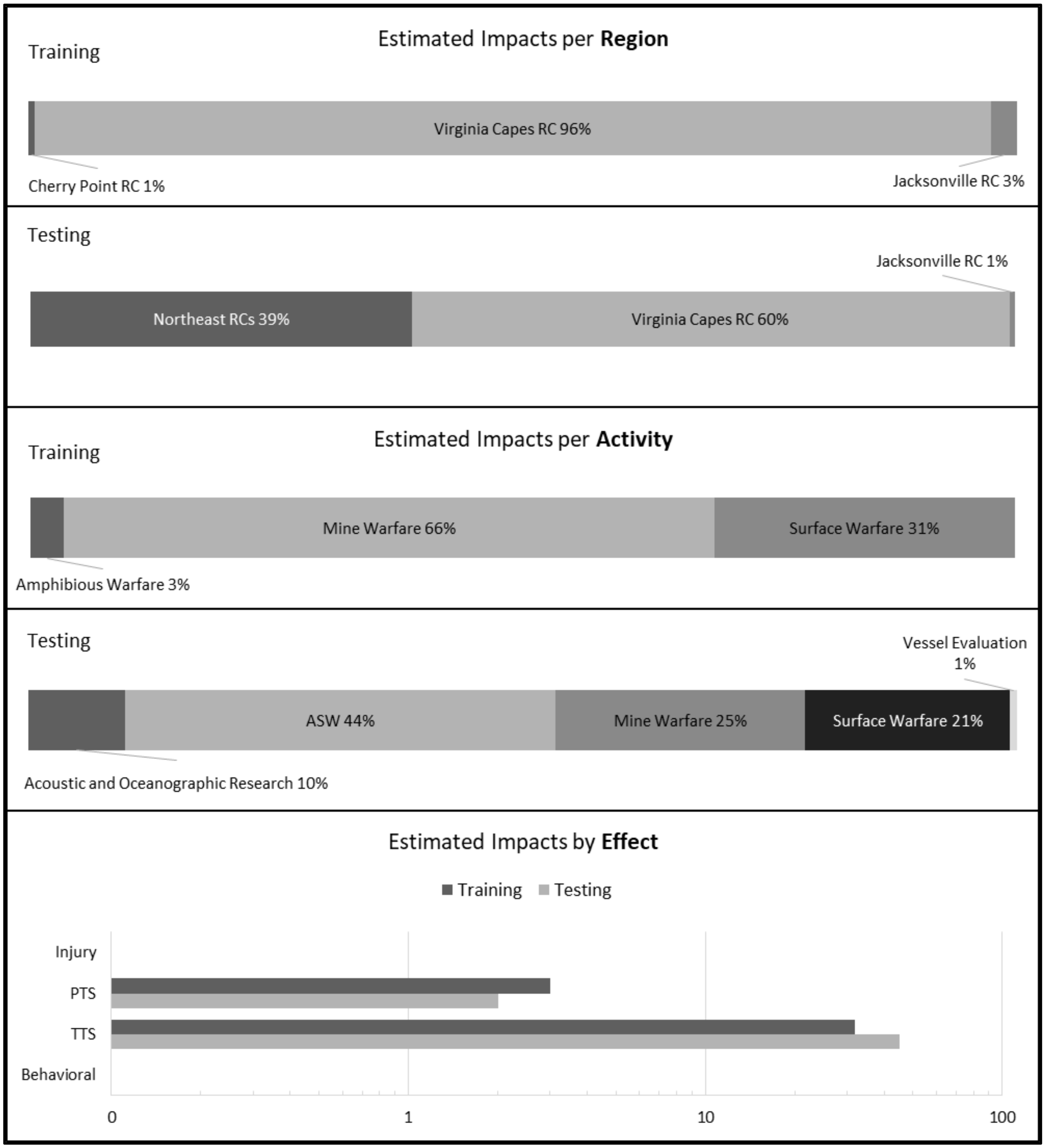
Fin whales may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosives per year under Alternative 2, estimates TTS and PTS (see Figure 3.7-103 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the western North Atlantic stock.

Potential impacts under Alternative 2 from Explosive use would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in explosives use associated with testing activities under Alternative 2 versus Alternative 1.

Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

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.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No behavioral responses or injury (non-auditory) are estimated for this species. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-103: Fin Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 2

Humpback Whales

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 TTS and PTS (see Figure 3.7-104 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the Gulf of Maine stock.

As described for other mysticetes 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

The feeding area for humpback whales identified by LaBrecque et al. (2015a) overlaps the Northeast Range Complexes within the Study Area. Navy training activities that use explosives could occur year-round within the Northeast Range Complexes; however, within the Northeast Range Complexes training with explosives typically occurs only within Narragansett Bay, which is outside the humpback whale feeding area identified LaBrecque et al. (2015a). In addition to procedural mitigation that is implemented whenever and wherever explosive activities occur, the Navy will implement mitigation to not conduct certain explosive activities within the Northeast North Atlantic Right Whale Mitigation Area year-round. This will further avoid or reduce potential impacts on humpback whale feeding behavior within the feeding area identified by LaBrecque et al. (2015a) (see Section 5.4.2, Mitigation Areas off the Northeastern United States). Humpback whales within the identified feeding area would not be exposed to sound or energy; therefore, impacts on feeding behaviors would not be anticipated within the identified humpback whale feeding area from training with explosives.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will result in the unintentional taking of humpback whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

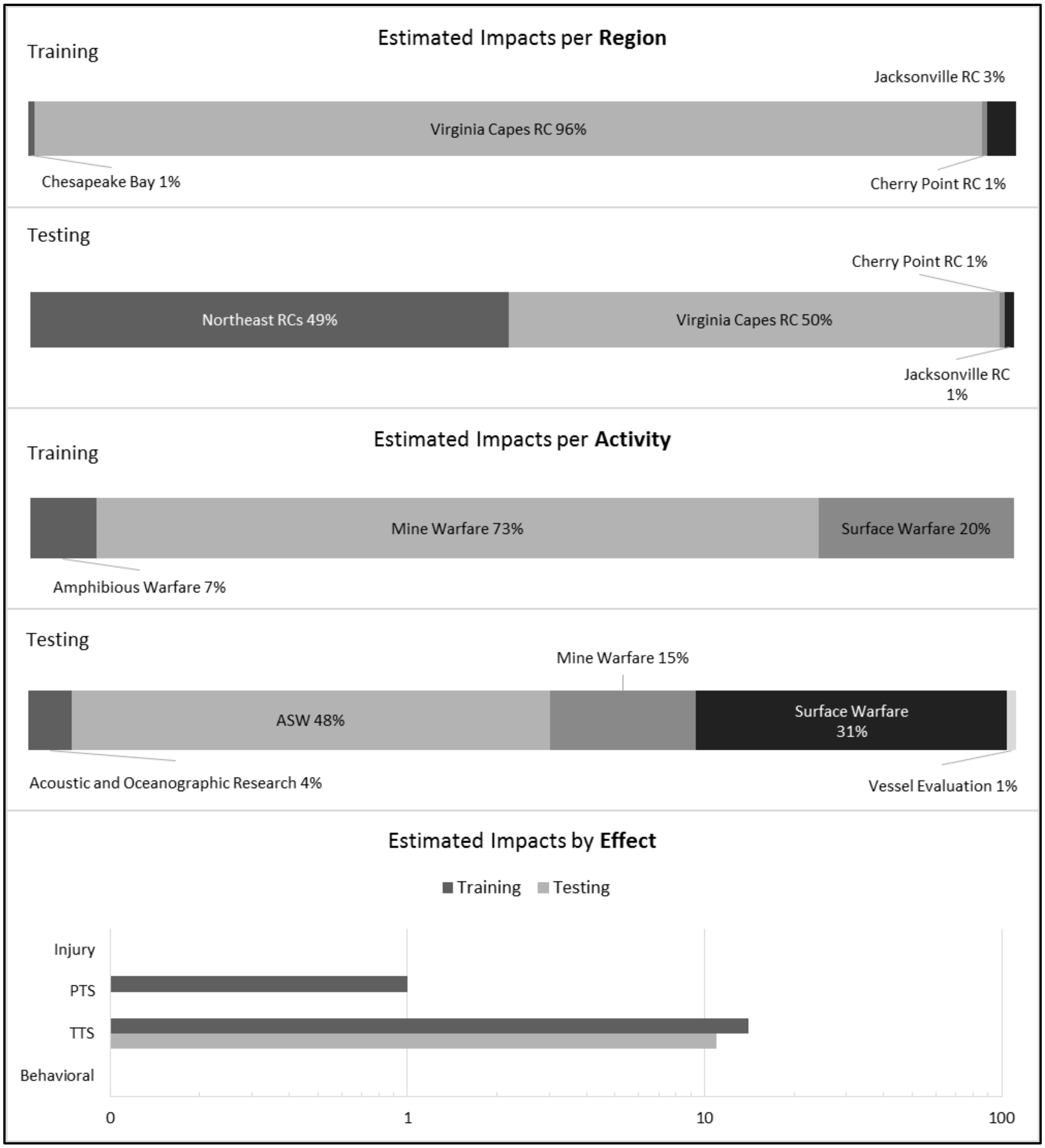
Impacts from Explosives Under Alternative 1 for Testing Activities

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 TTS (see Figure 3.7-104 and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS and PTS for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the Gulf of Maine stock.

As described for other mysticetes 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

The feeding area for humpback whales identified by LaBrecque et al. (2015a) overlaps the Northeast Range Complexes within the Study Area. Navy testing activities that use explosives could occur year-round within the Northeast Range Complexes. A small number of behavioral reactions or TTS could occur within the humpback whale feeding area identified by LaBrecque et al. (2015a). Few impacts overall are predicted within the entire Study Area due to explosive testing activities; therefore significant impacts on feeding behaviors within the humpback whale feeding area identified by LaBrecque et al. (2015a) are not anticipated. In addition to procedural mitigation that is implemented whenever and wherever explosive activities occur, the Navy will implement mitigation to not conduct certain explosive activities within the Northeast North Atlantic Right Whale Mitigation Area year-round. This will further avoid or reduce potential impacts on humpback whale feeding behavior within the feeding area identified by LaBrecque et al. (2015a) (see Section 5.4.2, Mitigation Areas off the Northeastern United States).

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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No behavioral responses or injury (non-auditory) are estimated for this species. 100 percent Gulf of Maine stock. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-104: Humpback Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

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 number of impacts from training under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of humpback whales incidental to those activities.

Impacts from Explosives Under Alternative 2 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 2, estimates behavioral reactions and TTS (see Figure 3.7-105 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the Gulf of Maine stock.

Potential impacts under Alternative 2 from Explosive use would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in explosives use associated with testing activities under Alternative 2 versus Alternative 1.

Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

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.

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No behavioral responses or injury (non-auditory) are estimated for this species. 100 percent Gulf of Maine stock. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-105: Humpback Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 2

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 TTS (see Figure 3.7-106 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the Canadian East Coast stock.

As described for other mysticetes 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Feeding areas for minke whales identified by LaBrecque et al. (2015a) overlap the Northeast Range Complexes within the Study Area. Navy training activities that use explosives could occur year-round within the Northeast Range Complexes; however, within the Northeast Range Complexes training with explosives typically occurs only within Narragansett Bay, which is outside the significant majority of minke whale feeding areas identified by LaBrecque et al. (2015a). In addition to procedural mitigation that is implemented whenever and wherever explosive activities occur, the Navy will implement mitigation to not conduct certain explosive activities within the Northeast North Atlantic Right Whale Mitigation Area year-round. This will further avoid or reduce potential impacts on minke whale feeding behavior within the feeding areas identified by LaBrecque et al. (2015a) (see Section 5.4.2, Mitigation Areas off the Northeastern United States). Minke whales in the identified feeding area would not be exposed to sound or energy from explosives; therefore, impacts on feeding behaviors would not be anticipated within the identified minke whale feeding area from training with explosives.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will result in the unintentional taking of minke whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

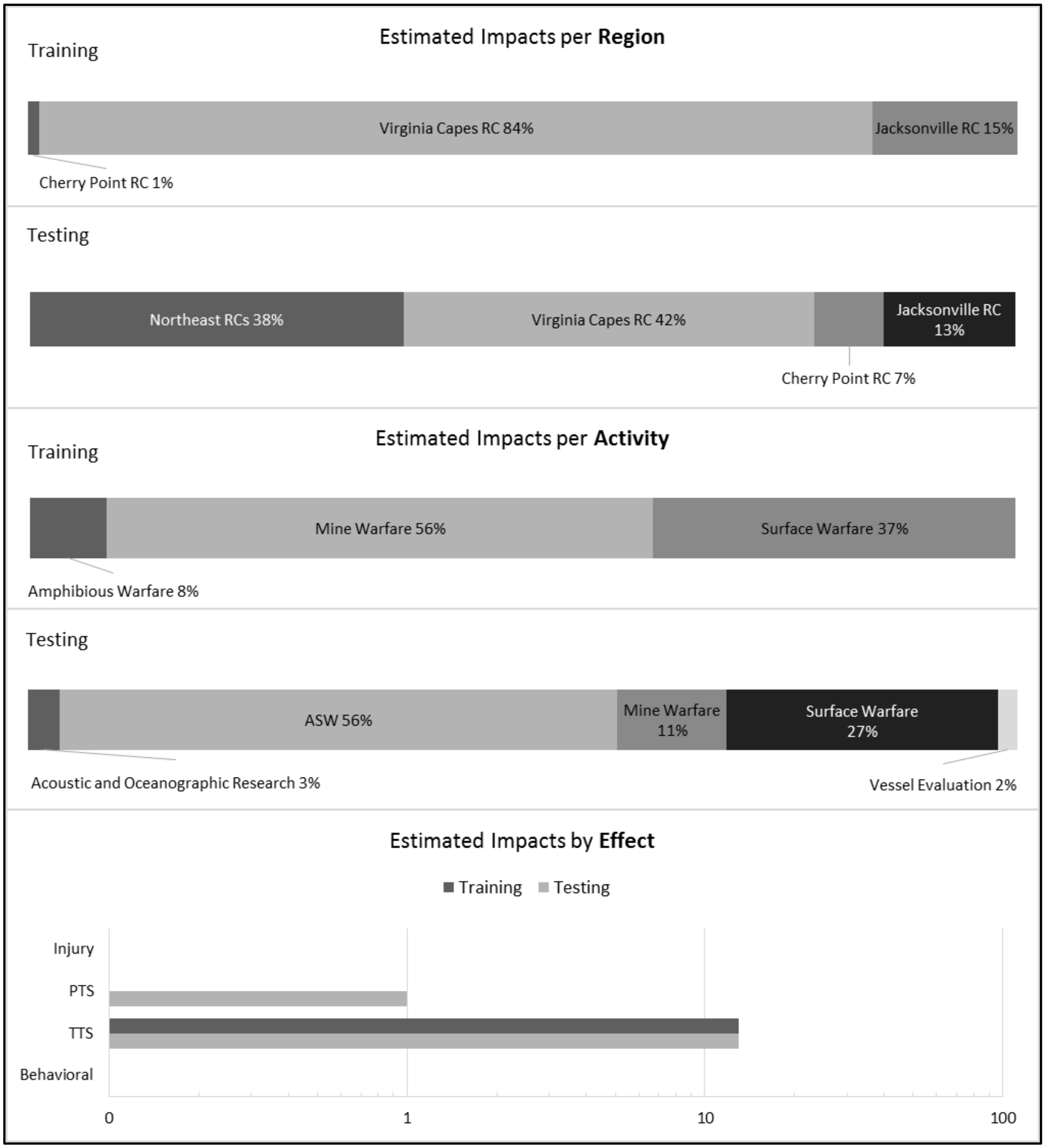
Impacts from Explosives Under Alternative 1 for Testing Activities

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 TTS and PTS (see Figure 3.7-106 and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS and PTS for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the Canadian East Coast stock.

As described for other mysticetes 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

The feeding areas for minke whales identified by LaBrecque et al. (2015a) overlap the Northeast Range Complexes within the Study Area. Navy testing activities that use explosives could occur year-round within the Northeast Range Complexes. A small number of behavioral reactions or TTS could occur within the minke whale feeding areas identified by LaBrecque et al. (2015a). Few impacts overall are predicted within the entire Study Area due to explosive testing activities; therefore significant impacts on feeding behaviors within the minke whale feeding areas identified by LaBrecque et al. (2015a) are not anticipated. In addition to procedural mitigation that is implemented whenever and wherever explosive activities occur, the Navy will implement mitigation to not conduct certain explosive activities within the Northeast North Atlantic Right Whale Mitigation Area year-round. This will further avoid or reduce potential impacts on minke whale feeding behavior within the feeding areas identified by LaBrecque et al. (2015a) (see Section 5.4.2, Mitigation Areas off the Northeastern United States).

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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No behavioral responses or injury (non-auditory) are estimated for this species. 100 percent Canadian East Coast stock. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-106: Minke Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

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 number of impacts from training under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of minke whales incidental to those activities.

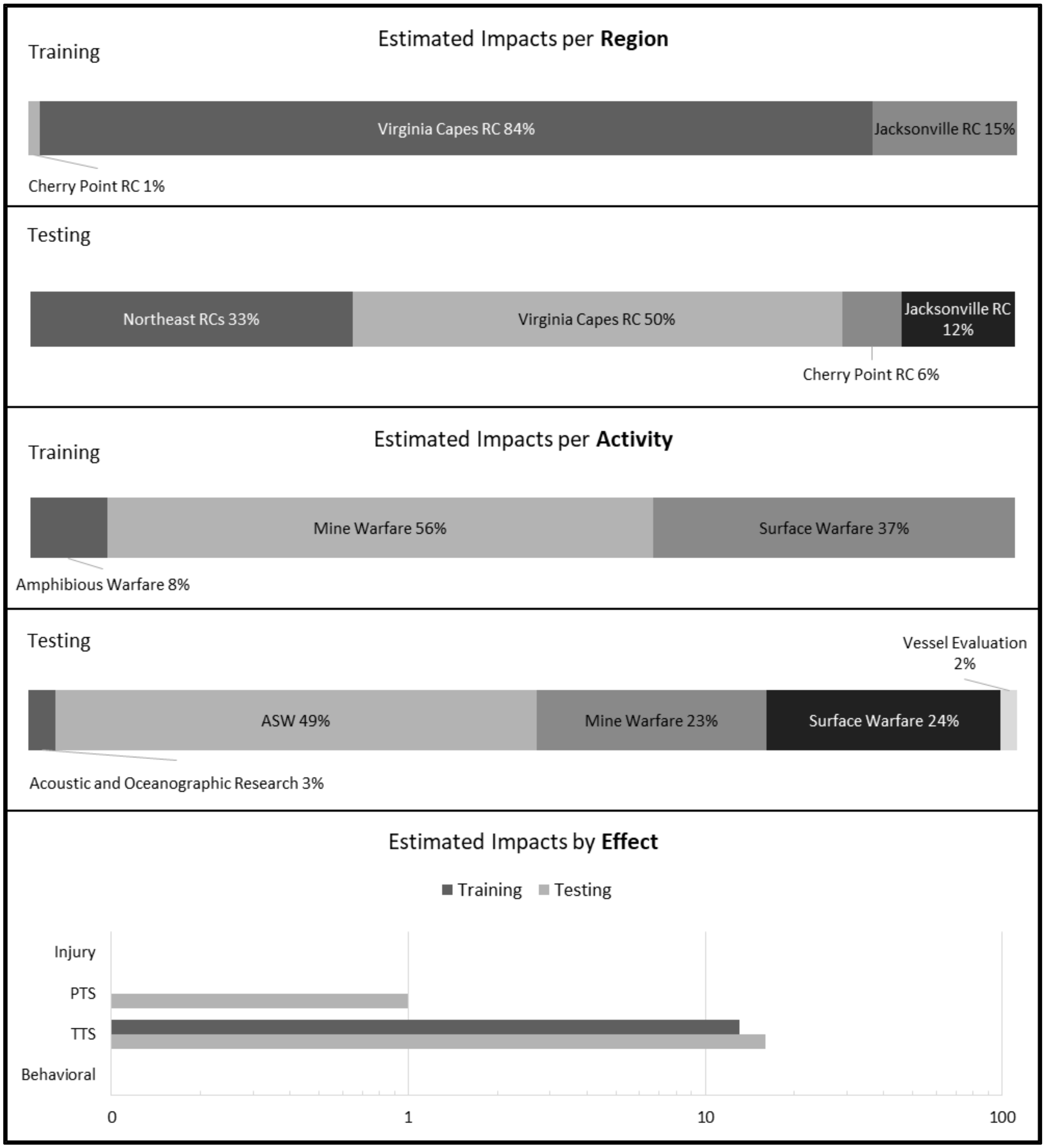
Impacts from Explosives Under Alternative 2 for Testing Activities

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 2, estimates TTS and PTS (see Figure 3.7-107 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the Canadian East Coast stock.

Potential impacts under Alternative 2 from Explosive use would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in explosives use associated with testing activities under Alternative 2 versus Alternative 1.

Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

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.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No behavioral responses or injury (non-auditory) are estimated for this species. 100 percent Canadian East Coast stock. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-107: Minke Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 2

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 TTS (see Figure 3.7-108 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the Nova Scotia stock.

As described for other mysticetes 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

A feeding area for sei whales identified by LaBrecque et al. (2015a) overlaps the Northeast Range Complexes within the Study Area. Navy training activities that use explosives could occur year-round within the Northeast Range Complexes; however, within the Northeast Range Complexes, training with explosives typically occurs only within Narragansett Bay, which is outside the sei whale feeding area identified LaBrecque et al. (2015a). In addition to procedural mitigation that is implemented whenever and wherever explosive activities occur, the Navy will implement mitigation to not conduct certain explosive activities within the Northeast North Atlantic Right Whale Mitigation Area year-round. This will further avoid or reduce potential impacts on sei whale feeding behavior within the feeding area identified by LaBrecque et al. (2015a) (see Section 5.4.2, Mitigation Areas off the Northeastern United States). Sei whales within the identified feeding area would not be exposed to sound or energy from explosives; therefore, impacts on feeding behaviors would not be anticipated within the identified sei whale feeding area from training with explosives.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will result in the unintentional taking of sei whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 1 may affect ESA-listed sei whales. The Navy has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.

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 explosives per year under Alternative 1, estimates TTS (see Figure 3.7-108 and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS and PTS for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the Nova Scotia stock.

As described for other 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. 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

The feeding area for sei whales identified by LaBrecque et al. (2015a) overlaps the Northeast Range Complexes within the Study Area. Navy testing activities that use explosives could occur year-round within the Northeast Range Complexes. A small number of behavioral reactions or TTS could occur within the sei whale feeding area identified by LaBrecque et al. (2015a). Few impacts overall are predicted within the entire Study Area due to explosive testing activities; therefore significant impacts on feeding behaviors within the sei whale feeding area identified by LaBrecque et al. (2015a) are not anticipated. In addition to procedural mitigation that is implemented whenever and wherever explosive activities occur, the Navy will implement mitigation to not conduct certain explosive activities within the Northeast North Atlantic Right Whale Mitigation Area year-round. This will further avoid or reduce potential impacts on sei whale feeding behavior within the feeding area identified by LaBrecque et al. (2015a) (see Section 5.4.2, Mitigation Areas off the Northeastern United States).

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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 1 may affect ESA-listed sei whales. The Navy has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No behavioral responses, PTS, or injury (non-auditory) are estimated for this species. 100 percent Nova Scotia stock. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-108: Sei Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

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 number of impacts from training under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Pursuant to the MMPA, the use of explosives 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 explosives during training activities as described under Alternative 2 may affect ESA-listed sei whales.

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. The primary distinction is that explosive use under Alternative 2 for testing does increase slightly in some locations per year as compared to Alternative 1. Also, annual numbers of activities using explosives would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the number of impacts for this species from testing under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

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.

Odontocetes

Odontocetes may be exposed to sound and energy from explosives associated with training activities throughout the year. Explosions produce sounds that are within the hearing range of odontocetes (see Section 3.7.2.1.4, Hearing and Vocalization). Potential impacts from explosive energy and sound include non-auditory injury, hearing loss, physiological stress, masking, and behavioral reactions. Impact ranges for odontocetes exposed to explosive sound and energy are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives) under mid-frequency cetaceans for most species, and under high-frequency cetaceans for Kogia whales and harbor 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 most 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 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 odontocetes' ability to locate prey or rate of feeding.

Research and observations (see Section 3.7.3.2.1.5, 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 3.7.3.2.1.3 (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.

Research and observations of auditory masking in marine mammals due to impulsive sounds are discussed in Section 3.7.3.2.1.4 (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 activities 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.

Sperm Whales (Endangered Species Act-Listed)

Impacts from Explosives Under Alternative 1 for Training Activities

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 behavioral reactions and TTS (see Figure 3.7-109 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-79).

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 will 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 sperm whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 1 may affect ESA-listed sperm whales. The Navy has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.

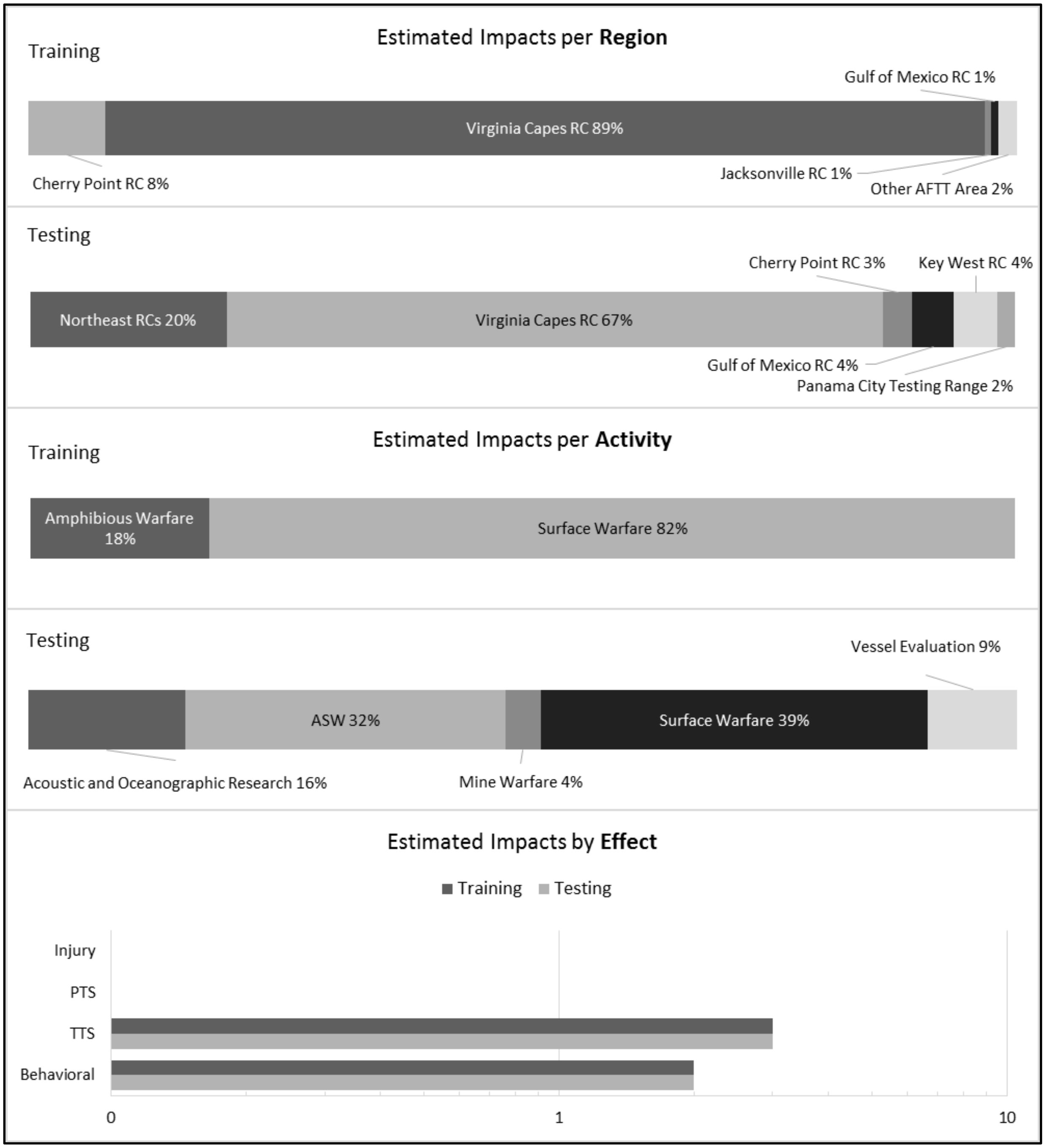
Impacts from Explosives Under Alternative 1 for Testing Activities

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 behavioral reactions and TTS (see Figure 3.7-109 and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS, PTS, and non-auditory injury for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-79).

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. Non-auditory injury includes low severity injuries; following recovery, any long-term consequences to an individual are expected to be minor. Considering these factors and the mitigation measures that will 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 sperm whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 1 may affect ESA-listed sperm whales. The Navy has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No PTS or injury (non-auditory) are estimated for this species. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift.

Figure 3.7-109: Sperm Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

Table 3.7-79: Estimated Impacts on Individual Sperm Whale Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Gulf of Mexico Oceanic	1%	7%
North Atlantic	99%	93%

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 number of impacts from training under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Pursuant to the MMPA, the use of explosives 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 explosives during training activities as described under Alternative 2 may affect ESA-listed sperm whales.

Impacts from Explosives Under Alternative 2 for Testing Activities

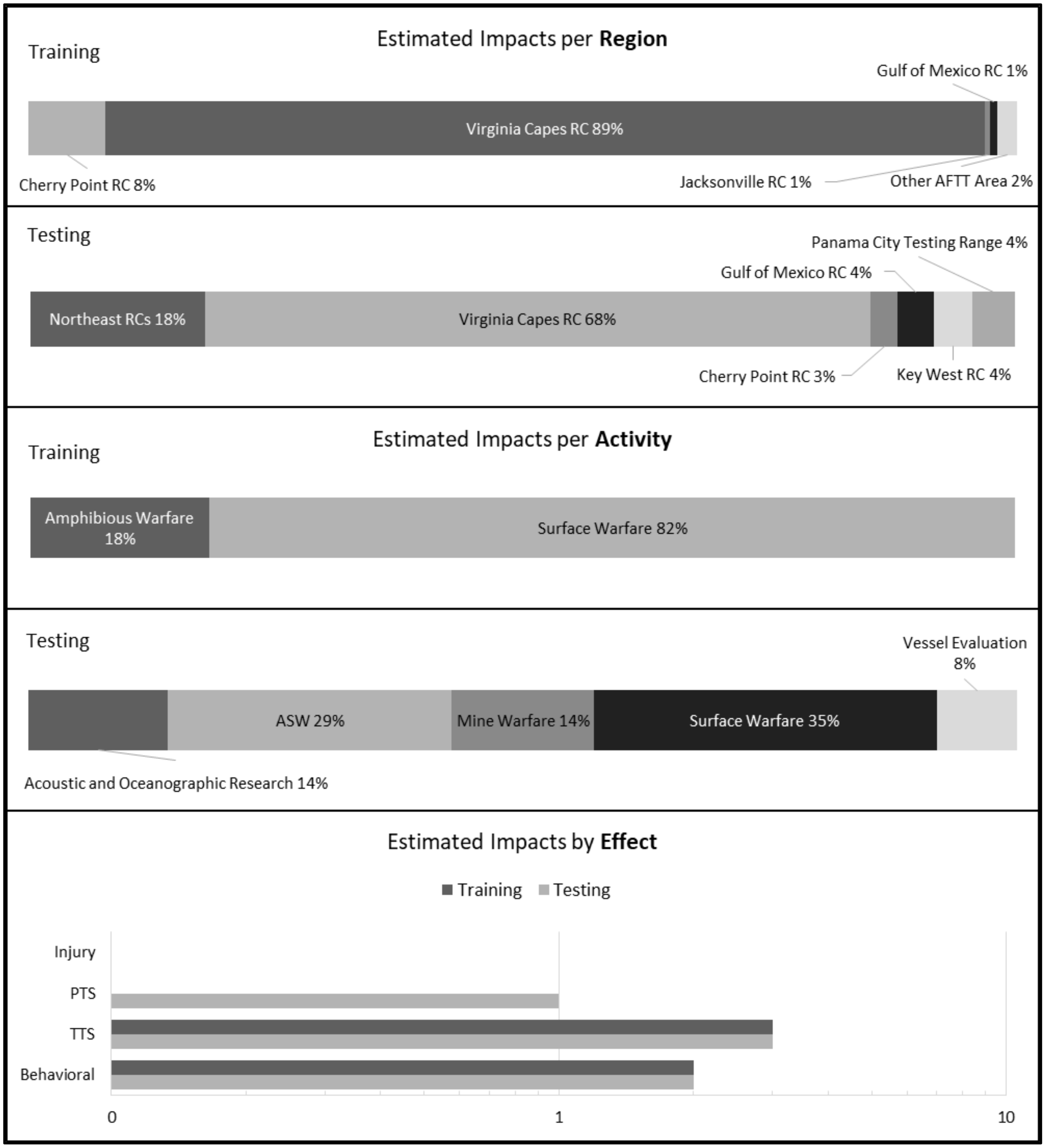
Sperm whales may be exposed to sound or energy from explosions associated with testing activities throughout the year. The quantitative analysis, using the maximum number of explosions per year under Alternative 2, estimates behavioral reactions, TTS, and PTS (see Figure 3.7-110 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-80).

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. Non-auditory injury includes low severity injuries; following recovery, any long-term consequences to an individual are expected to be minor. Considering these factors and the mitigation measures that will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

Pursuant to the MMPA, the use of explosives 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 explosives during testing activities as described under Alternative 2 may affect ESA-listed sperm whales.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injury (non-auditory) is estimated for this species. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-110: Sperm Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 2

Table 3.7-80: Estimated Impacts on Individual 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 per **Species' Stock**		
Stock	***Training***	***Testing***
Gulf of Mexico Oceanic	1%	9%
North Atlantic	99%	91%

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 behavioral reactions, TTS, and PTS (see Figure 3.7-111 and Figure 3.7-112, and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-81 and Table 3.7-82).

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 will 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 dwarf and pygmy sperm whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

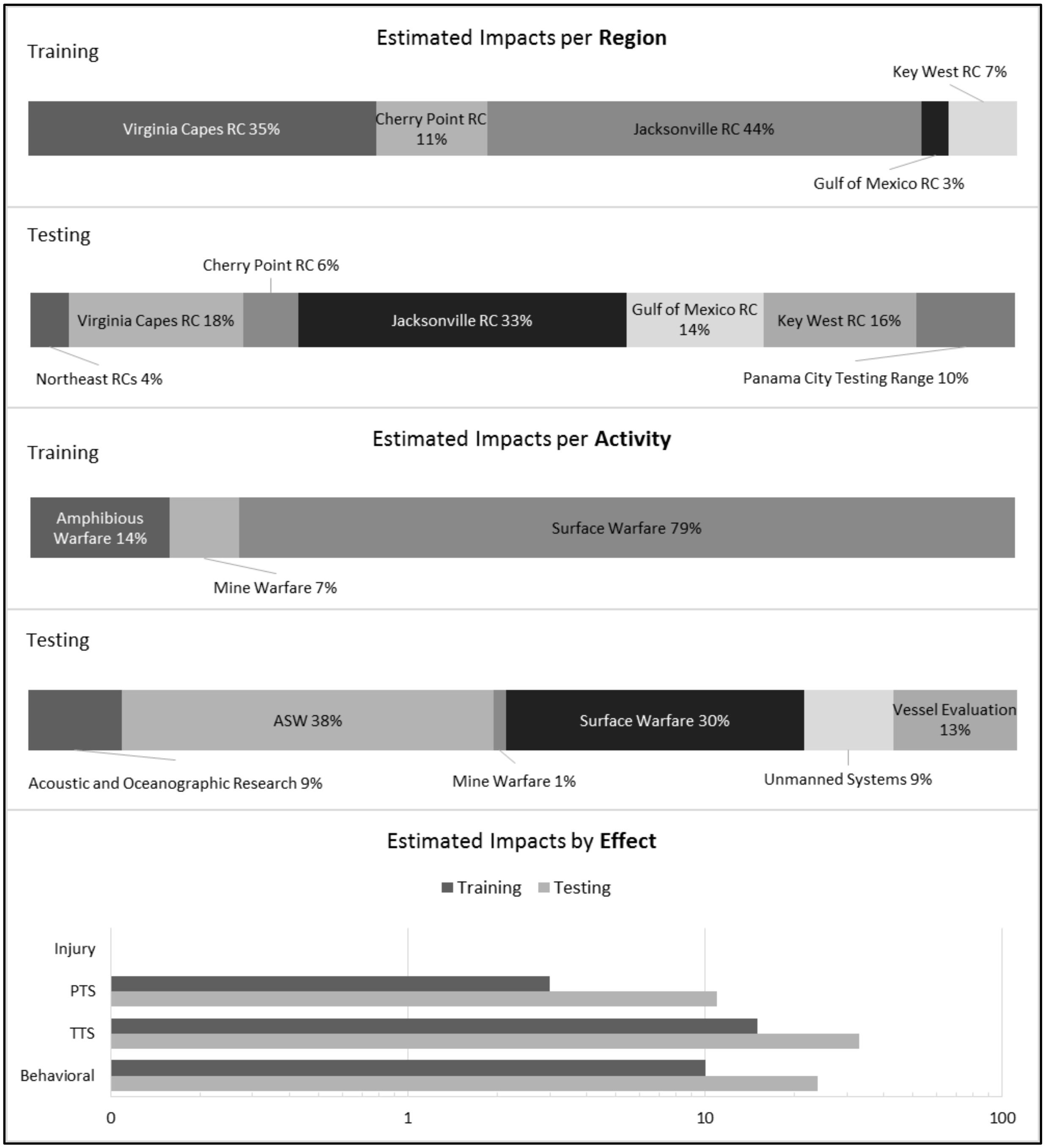
Impacts from Explosives Under Alternative 1 for Testing Activities

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 explosives per year under Alternative 1, estimates behavioral reactions, TTS, and PTS (see Figure 3.7-111 and Figure 3.7-112, and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS and PTS for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for these species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-81 and Table 3.7-82).

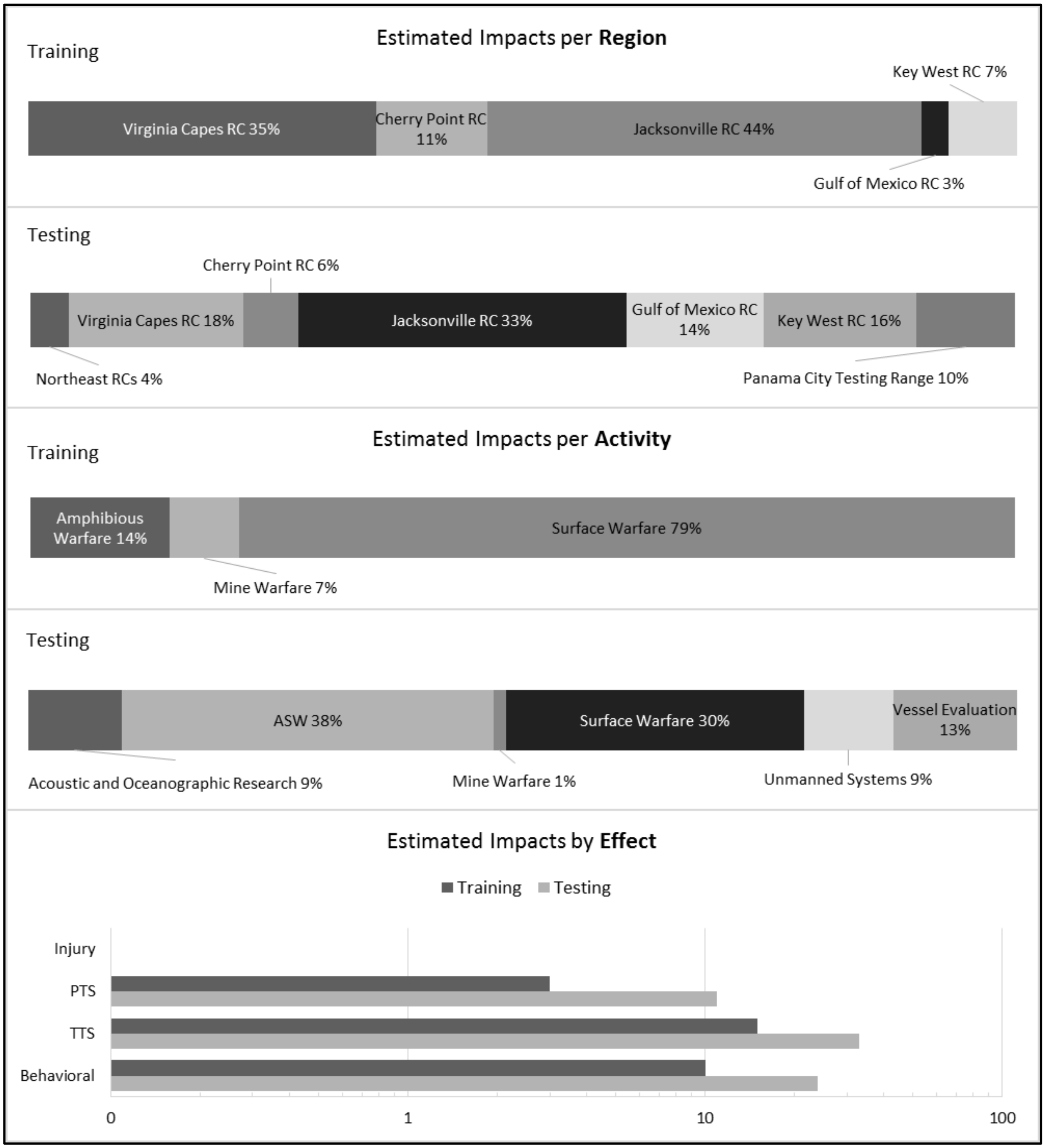
As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. PTS in an individual could have no to minor long-term consequences for individuals 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 will 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 dwarf and pygmy sperm whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injury (non-auditory) is estimated for this species. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-111: Dwarf Sperm Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injury (non-auditory) is estimated for this species. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-112: Pygmy Sperm Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

Table 3.7-81: Estimated Impacts on Individual Dwarf Sperm Whale Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Gulf of Mexico Oceanic	5%	28%
Western North Atlantic	95%	72%

Table 3.7-82: 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.

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	5%	28%
Western North Atlantic	95%	72%

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 number of impacts from training under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of dwarf and pygmy sperm whales incidental to those activities.

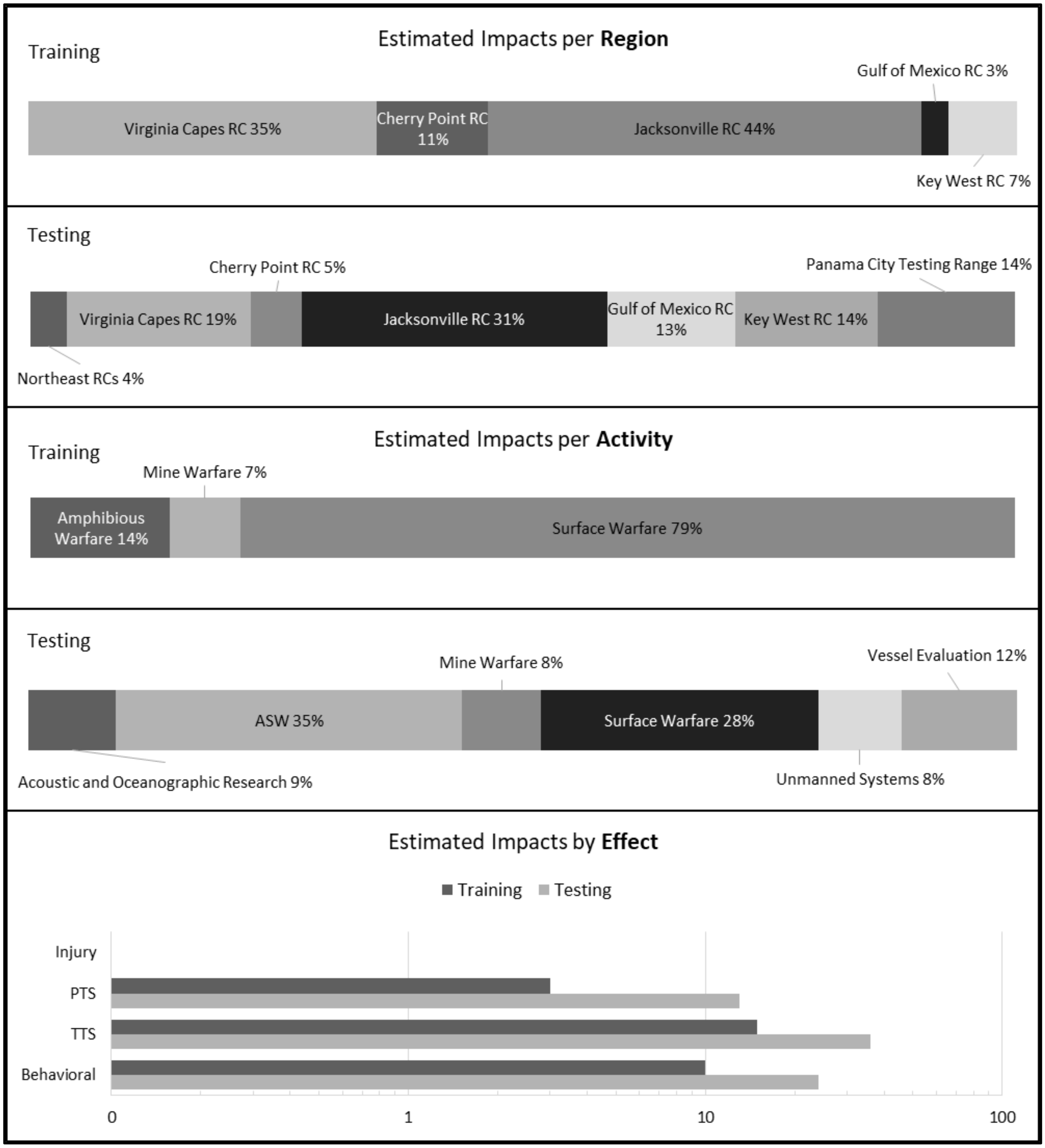
Impacts from Explosives Under Alternative 2 for Testing Activities

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 explosives per year under Alternative 2, estimates behavioral reactions, TTS, and PTS (see Figure 3.7-113 and Figure 3.7-114, and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-83 and Table 3.7-84).

Potential impacts under Alternative 2 from Explosive use would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in explosives use associated with testing activities under Alternative 2 versus Alternative 2.

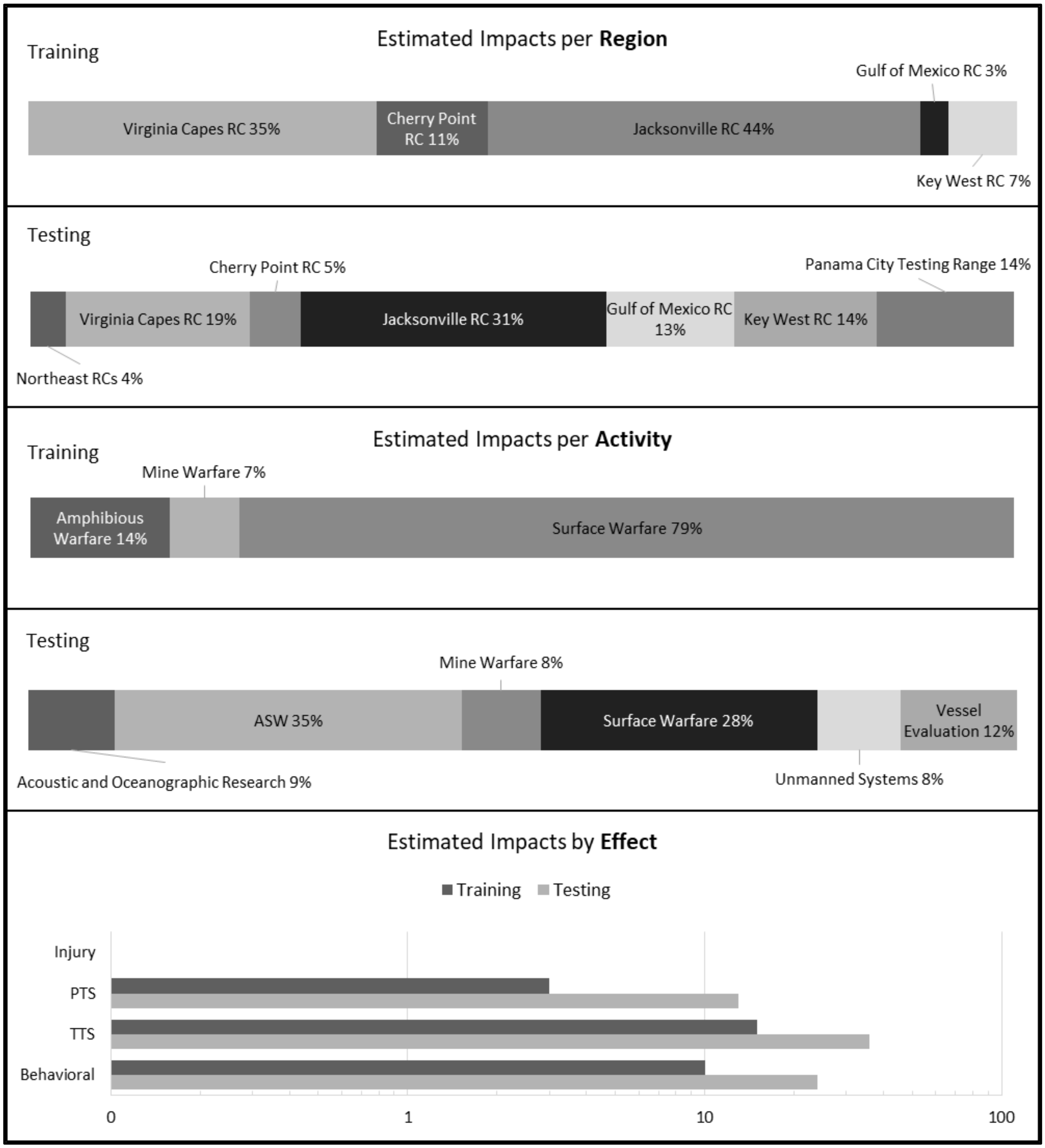
Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of dwarf and pygmy sperm whales incidental to those activities.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injury (non-auditory) is estimated for this species. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-113: Dwarf Sperm Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 2



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injury (non-auditory) is estimated for this species. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-114: Pygmy Sperm Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 2

Table 3.7-83: Estimated Impacts on Individual Dwarf 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 per **Species' Stock**		
Stock	***Training***	***Testing***
Gulf of Mexico Oceanic	5%	31%
Western North Atlantic	95%	69%

Table 3.7-84: 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 per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	5%	31%
Western North Atlantic	95%	69%

Beaked Whales

Beaked whales are a group of species which within the AFTT Study Area includes: Blainville's beaked whales, Cuvier's beaked whales, Gervais' beaked whales, Sowerby's beaked whales, True's beaked whales, and Northern bottlenose whales.

Northern bottlenose whales may be exposed to sound or energy from explosions associated with training or testing activities throughout the year, although the quantitative analysis estimates that no northern bottlenose whales would be impacted. Long-term consequences for individuals, the species, or stock would not be expected.

The use of explosives during training or testing activities under the Proposed Action may not result in the unintentional taking of northern bottlenose whales incidental to those activities.

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 behavioral reactions and TTS (see Figure 3.7-115 through Figure 3.7-119, and tabular results in Appendix E, Estimated Marine Mammals 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. No impacts are estimated for the northern bottlenose whale. Impact ranges for these species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks for Blainville's, Cuvier's, and Gervais' beaked whales (see Table 3.7-85 and Table 3.7-87) and for the western North Atlantic stock of the Sowerby's and True's beaked whale.

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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

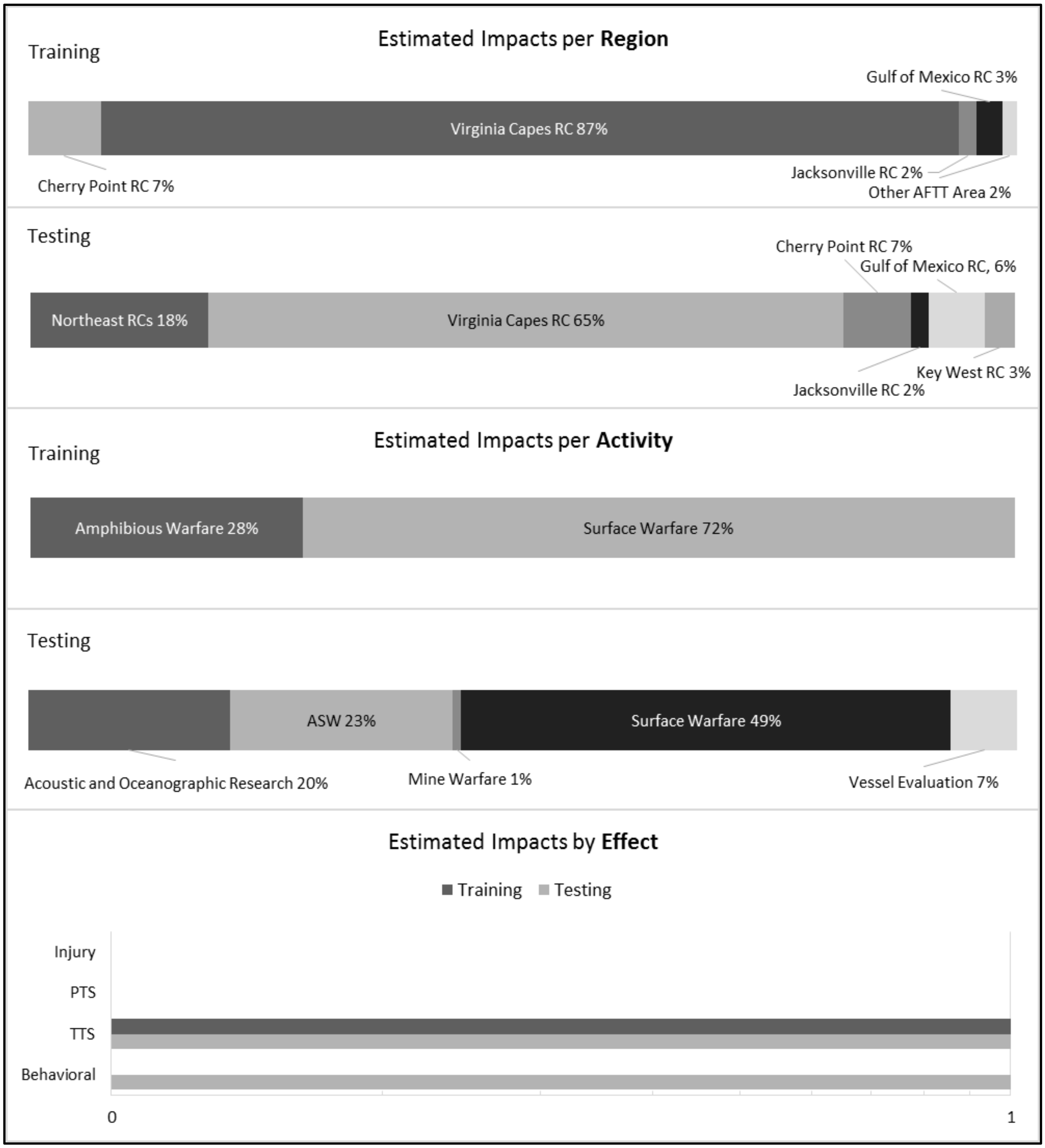
Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will result in the unintentional taking of Blainville's, Cuvier's, Gervais', Sowerby's, and True's beaked whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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 behavioral reactions and TTS (see Figure 3.7-115 through Figure 3.7-119, and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS and PTS for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for these species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks for Blainville's, Cuvier's, and Gervais' beaked whales (see Table 3.7-85 and Table 3.7-87) and for the western North Atlantic stock of the Sowerby's and True's beaked whale.

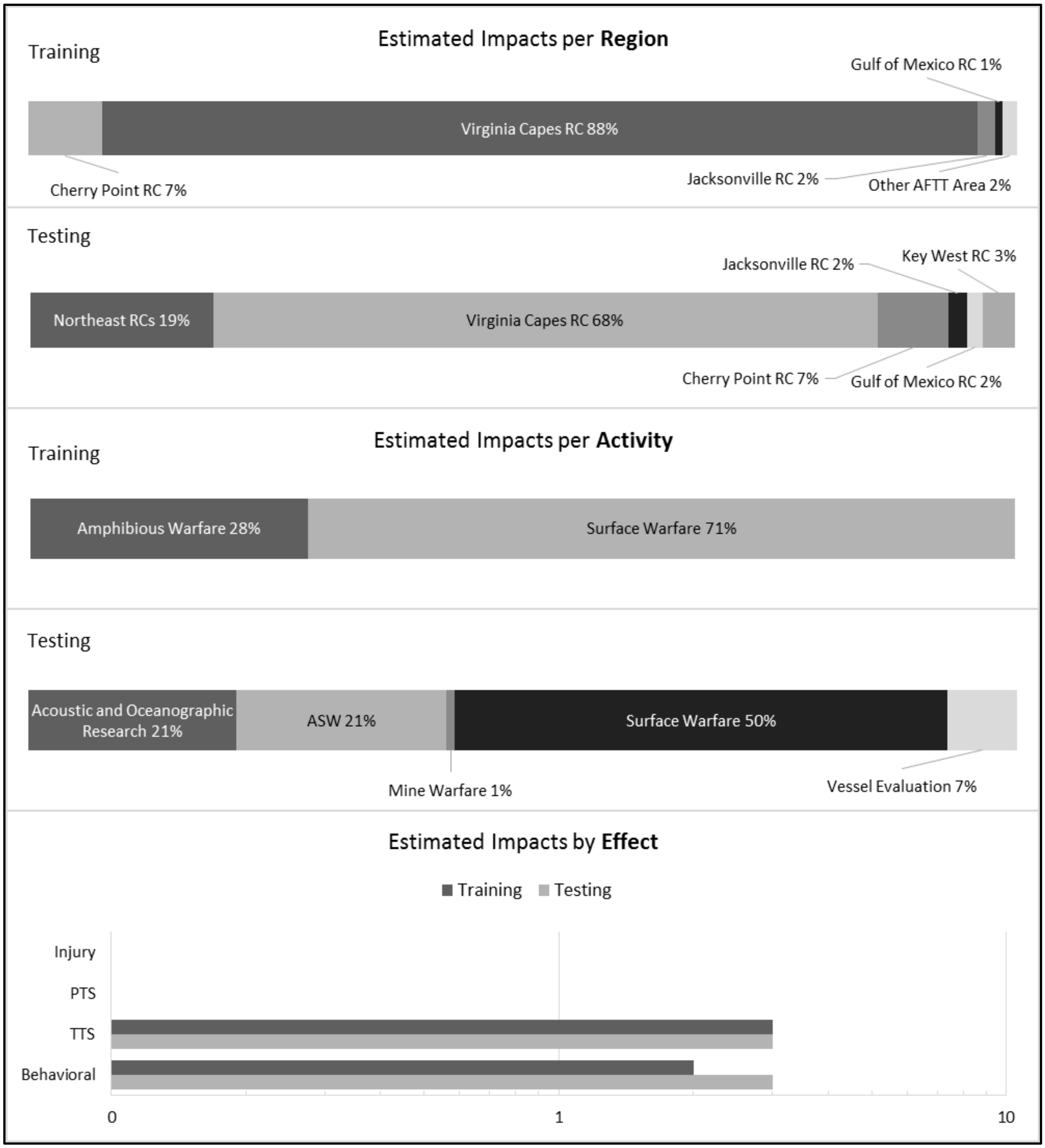
As described above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. PTS in an individual could have no to minor long-term consequences for individuals although 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 will 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 Blainville's, Cuvier's, Gervais', Sowerby's, and True's beaked whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No PTS or injury (non-auditory) are estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-115: Blainville's Beaked Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No PTS or injury (non-auditory) are estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-116: Cuvier's Beaked Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No PTS or injury (non-auditory) are estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-117: Gervais' Beaked Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

Table 3.7-85: Estimated Impacts on Individual Blainesville's Beaked Whale Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	3%	6%
Western North Atlantic	97%	94%

Table 3.7-86: Estimated Impacts on Individual Cuvier's Beaked Whale Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	1%	2%
Western North Atlantic	99%	98%

Table 3.7-87: Estimated Impacts on Individual Gervais' Beaked Whale Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	3%	6%
Western North Atlantic	97%	94%

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No PTS or injury (non-auditory) are estimated for this species. 100 percent western North Atlantic stock. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-118: Sowerby's Beaked Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No behavioral responses, PTS, or injury (non-auditory) are estimated for this species. 100 percent western North Atlantic stock. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-119: True's Beaked Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

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 number of impacts from training under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of Blainville's, Cuvier's, Gervais', Sowerby's, and True's beaked whales incidental to those activities.

Impacts from Explosives Under Alternative 2 for Testing Activities

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. The primary distinction is that explosive use under Alternative 2 for testing does increase slightly in some locations per year as compared to Alternative 1. Also, annual numbers of activities using explosives would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the number of impacts for these species from testing under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

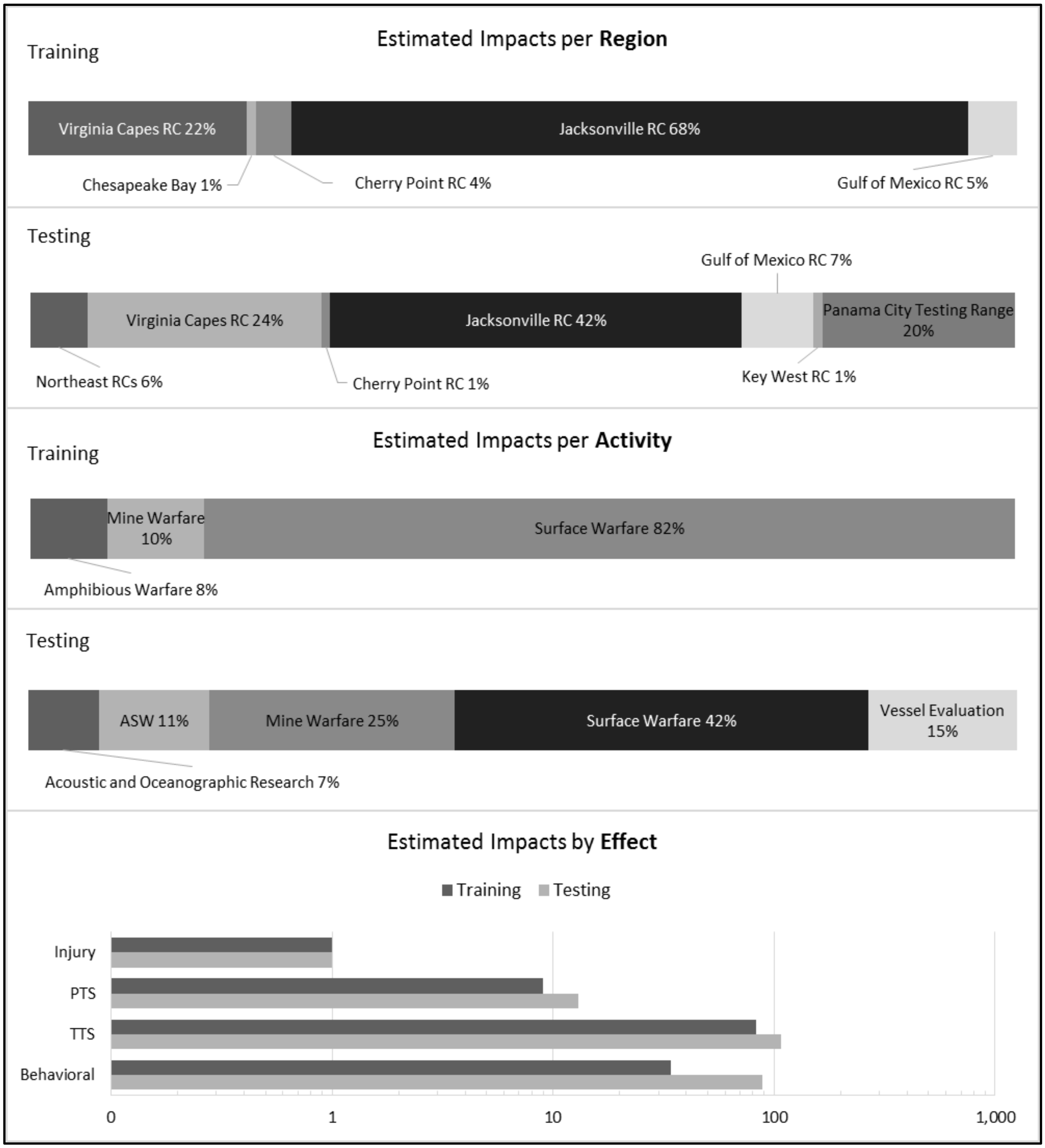
Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of Blainville's, Cuvier's, Gervais', Sowerby's, and True's beaked whales incidental to those activities.

Atlantic Spotted Dolphins

Impacts from Explosives Under Alternative 1 for Training Activities

Atlantic spotted 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 behavioral reactions, TTS, PTS, and (non-auditory) injury (see Figure 3.7-120 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-88).

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. Non-auditory injury includes low severity injuries; following recovery, any long-term consequences to an individual are expected to be minor. Long-term consequences for the population are unlikely to occur even if an injury created long-term consequences for that individual.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-120: Atlantic Spotted Dolphin Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

Table 3.7-88: Estimated Impacts on Individual Atlantic Spotted Dolphin Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	1%	2%
Western North Atlantic	99%	98%

Considering these factors and the mitigation measures that will 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 Atlantic spotted dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Impacts from Explosives Under Alternative 1 for Testing Activities

Atlantic spotted 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, TTS, PTS, and (non-auditory) injury (see Figure 3.7-120 and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS, PTS, and injury (non-auditory) for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-88).

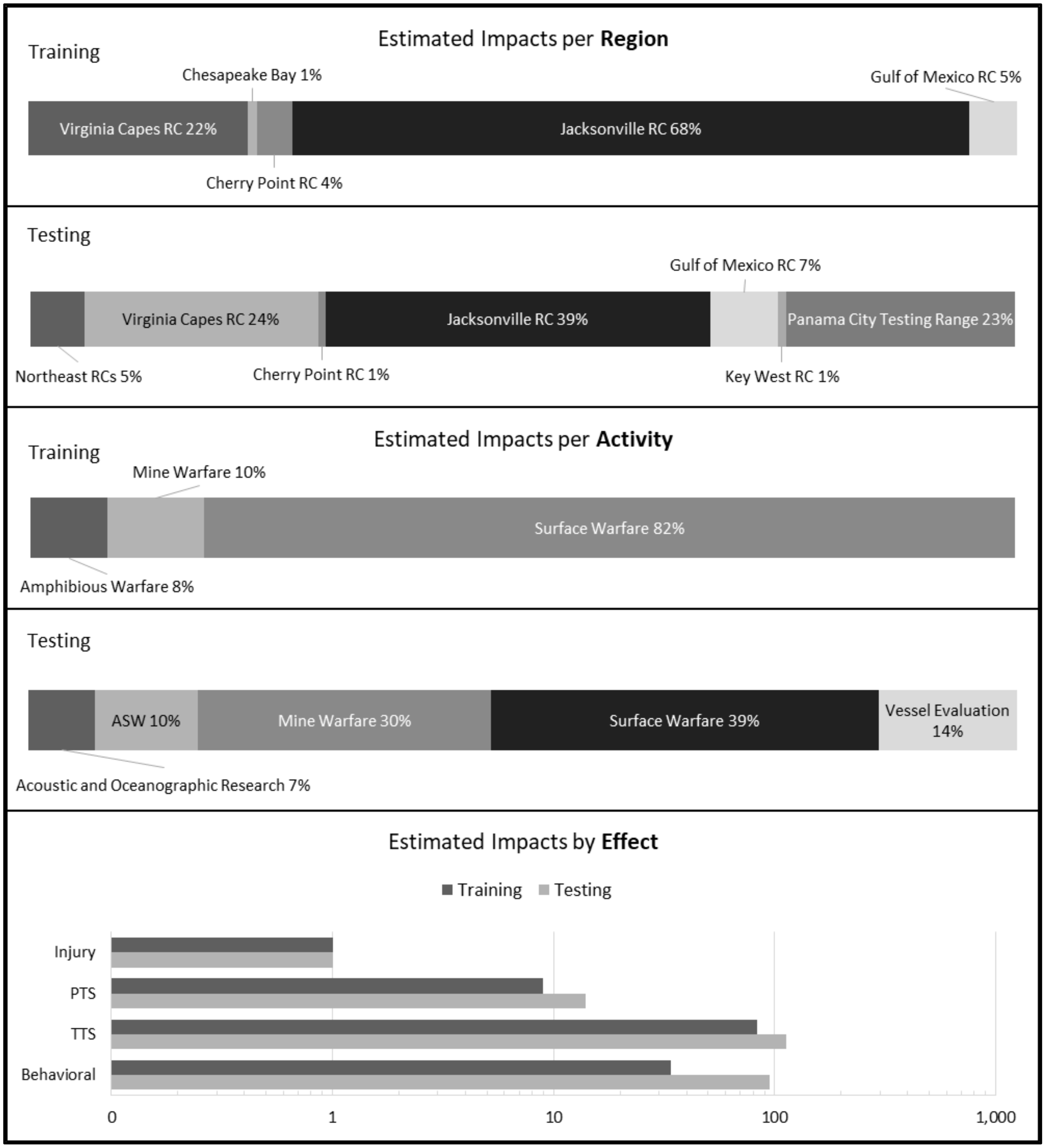
As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. PTS in an individual could have no to minor long-term consequences for individuals although a single minor long-term consequence for an individual is unlikely to lead to long-term consequences for a population. Non-auditory injury includes low severity injuries; following recovery, any long-term consequences to an individual are expected to be minor. Long-term consequences for the population are unlikely to occur even if an injury created long-term consequences for that individual. Considering these factors and the mitigation measures that will 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 Atlantic spotted dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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 number of impacts from training under Alternative 2 may be greater than under

Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-121: Atlantic Spotted Dolphin Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 2

Table 3.7-89: Estimated Impacts on Individual Atlantic Spotted Dolphin Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 2

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	5%	30%
Western North Atlantic	95%	70%

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of Atlantic spotted dolphins incidental to those activities.

Impacts from Explosives Under Alternative 2 for Testing Activities

Atlantic spotted 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 2, estimates behavioral reactions TTS, PTS, and (non-auditory) injury (see Figure 3.7-121 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-89).

Potential impacts under Alternative 2 from Explosive use would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in explosives use associated with testing activities under Alternative 2 versus Alternative 1.

Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of Atlantic spotted dolphins incidental to those activities.

Atlantic White-Sided Dolphins

Impacts from Explosives Under Alternative 1 for Training Activities

Atlantic 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 behavioral reactions, TTS, and PTS (see Figure 3.7-122 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the western North Atlantic stock.

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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injury (non-auditory) is estimated for this species. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-122: Atlantic White-Sided Dolphin Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will result in the unintentional taking of Atlantic white-sided dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Impacts from Explosives Under Alternative 1 for Testing Activities

Atlantic 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, TTS, and PTS (see Figure 3.7-122 and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS, PTS, injury (non-auditory), and a single mortality for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the western North Atlantic stock.

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. Non-auditory injury includes low severity injuries; following recovery, any long-term consequences to an individual are expected to be minor. Long-term consequences for the population are unlikely to occur even if an injury created long-term consequences for that individual or lead to mortality. Considering these factors and the mitigation measures that will 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 Atlantic white-sided dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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 number of impacts from training under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Pursuant to the MMPA, the use of explosives during training Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of Atlantic white-sided dolphins incidental to those activities.

Impacts from Explosives Under Alternative 2 for Testing Activities

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. 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 number of impacts from training under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Pursuant to the MMPA, the use of explosives during testing Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of Atlantic white-sided dolphins incidental to those activities.

Bottlenose Dolphins

Impacts from Explosives Under Alternative 1 for Training Activities

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 behavioral reactions, TTS, PTS, and (non-auditory) injury (see Figure 3.7-123 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-90).

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. Non-auditory injury includes low severity injuries; following recovery, any long-term consequences to an individual are expected to be minor. Long-term consequences for the population are unlikely to occur even if an injury created long-term consequences for that individual. Considering these factors and the mitigation measures that will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

There are 21 small and resident population areas for common bottlenose dolphins identified by LaBrecque et al. (2015a, 2015b) that overlap or are directly adjacent to the AFTT Study Area. These identified areas are within bays and estuaries where the Navy does not train with explosives. Bottlenose dolphins in the identified small and resident population areas identified by LaBrecque et al. (2015a, 2015b) would not be exposed to sound or energy from explosives; therefore, impacts would not be anticipated within the identified bottlenose dolphin small and resident population areas from training with explosives.

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will result in the unintentional taking of bottlenose dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

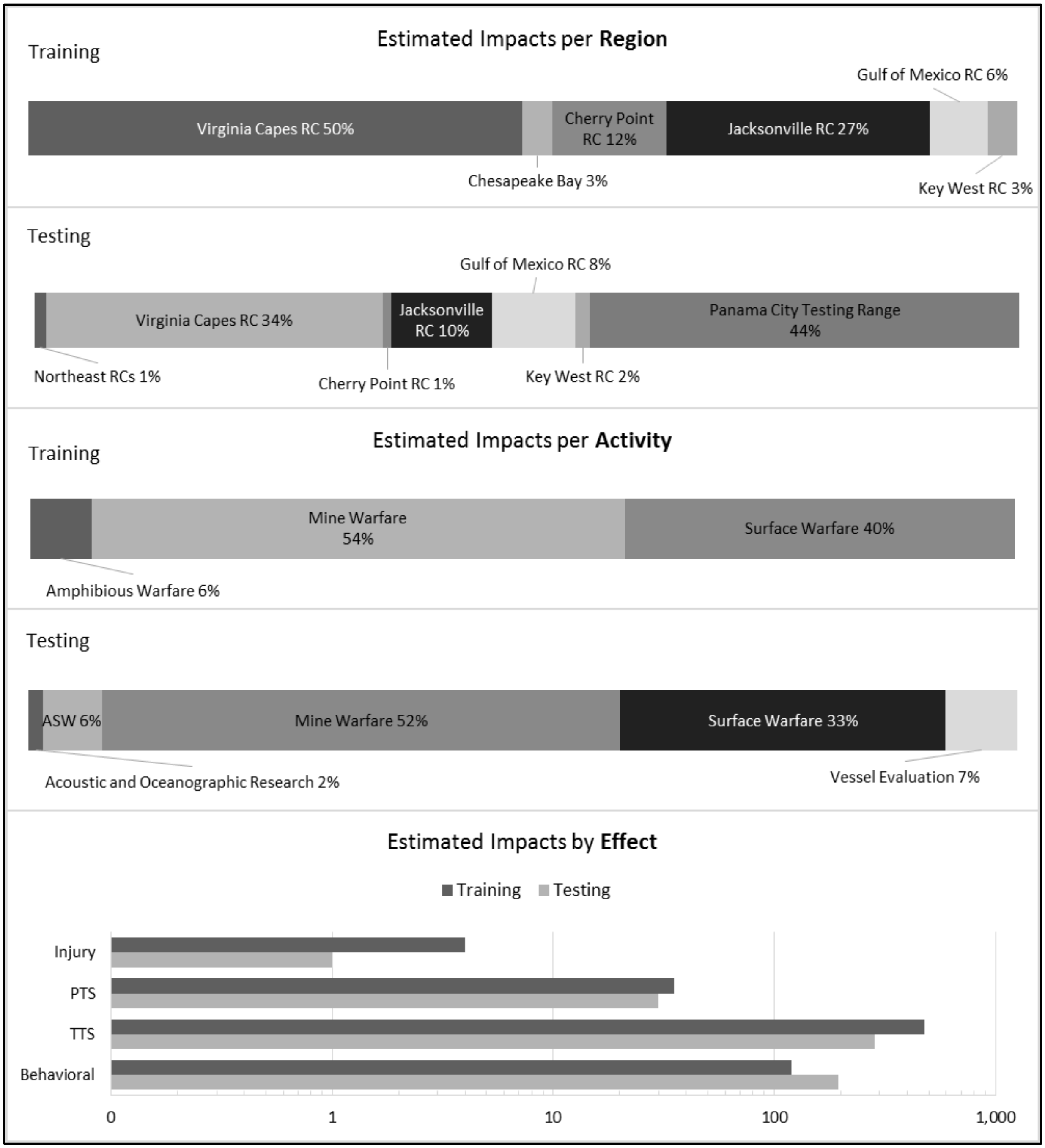
Impacts from Explosives Under Alternative 1 for Testing Activities

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 behavioral reactions, TTS, PTS, and (non-auditory) injury (see Figure 3.7-123 and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS, PTS, and injury (non-auditory) for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-90).

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. Non-auditory injury includes low severity injuries; following recovery, any long-term consequences to an individual are expected to be minor. Long-term consequences for the population are unlikely to occur even if an injury created long-term consequences for that individual. Considering these factors and the mitigation measures that will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

There are 21 small and resident population areas for common bottlenose dolphins identified by LaBrecque et al. (2015a, 2015b) that overlap or are directly adjacent to the AFTT Study Area. These identified areas are within bays and estuaries where the Navy does not test with explosives. Bottlenose dolphins in the identified small and resident population areas identified by LaBrecque et al. (2015a, 2015b) would not be exposed to sound or energy from explosives; therefore, impacts would not be anticipated within the identified bottlenose dolphin small and resident population areas from testing with explosives.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 1 will result in the unintentional taking of bottlenose dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-123: Bottlenose Dolphin Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

Table 3.7-90: Estimated Impacts on Individual Bottlenose Dolphin Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Gulf of Mexico Northern Coastal	1%	6%
Gulf of Mexico Western Coastal	0%	1%
Northern Gulf of Mexico Continental Shelf	4%	40%
Northern Gulf of Mexico Oceanic	1%	5%
Western North Atlantic Central Florida Coastal	1%	1%
Western North Atlantic Northern Migratory Coastal	9%	5%
Western North Atlantic Offshore	76%	41%
Western North Atlantic South Carolina/ Georgia Coastal	1%	1%
Western North Atlantic Southern Migratory Coastal	5%	1%

Impacts from Explosives Under Alternative 2 for Training Activities

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 2, estimates behavioral reactions, TTS, PTS, and (non-auditory) injury (see Figure 3.7-124 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-91).

Potential impacts under Alternative 2 from Explosive use would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in explosives use associated with testing activities under Alternative 2 versus 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 bottlenose dolphins incidental to those activities.

Impacts from Explosives Under Alternative 2 for Testing Activities

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 2, estimates behavioral reactions, TTS, PTS, and (non-auditory) injury (see Figure 3.7-124 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-91).

Potential impacts under Alternative 2 from Explosive use would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in explosives use associated with testing activities under Alternative 2 versus Alternative 1.

Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of bottlenose dolphins incidental to those activities.

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-124: Bottlenose Dolphin Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 2

Table 3.7-91: Estimated Impacts on Individual Bottlenose Dolphin Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 2

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Gulf of Mexico Northern Coastal	1%	6%
Gulf of Mexico Western Coastal	0%	1%
Northern Gulf of Mexico Continental Shelf	4%	41%
Northern Gulf of Mexico Oceanic	1%	5%
Western North Atlantic Central Florida Coastal	1%	0%
Western North Atlantic Northern Migratory Coastal	10%	5%
Western North Atlantic Offshore	77%	40%
Western North Atlantic South Carolina/ Georgia Coastal	1%	0%
Western North Atlantic Southern Migratory Coastal	5%	1%

Clymene Dolphins

Impacts from Explosives Under Alternative 1 for Training Activities

Clymene 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 behavioral reactions, TTS, and PTS (see Figure 3.7-125 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the western North Atlantic stock.

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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

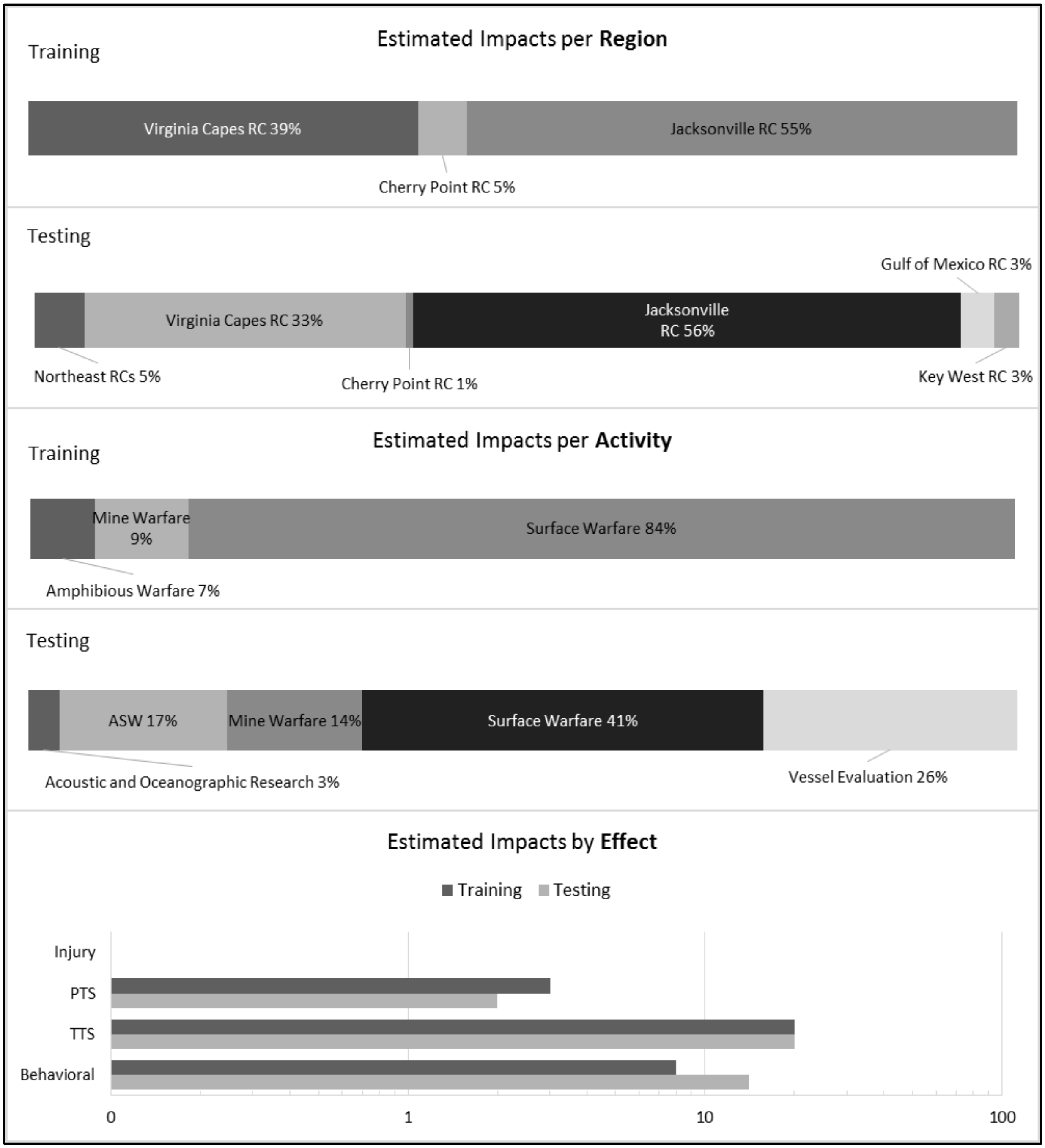
Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will result in the unintentional taking of Clymene dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Impacts from Explosives Under Alternative 1 for Testing Activities

Clymene 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, TTS, and PTS (see Figure 3.7-125 and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS, PTS, and injury (non-auditory) for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-92).

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. 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. Non-auditory injury includes low severity injuries; following recovery, any long-term consequences to an individual are expected to be minor. Long-term consequences for the population are unlikely to occur even if an injury created long-term consequences for that individual. Considering these factors and the mitigation measures that will 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 Clymene dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injury (non-auditory) is estimated for this species. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-125: Clymene Dolphin Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

Table 3.7-92: Estimated Impacts on Individual Clymene Dolphin Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	0%	4%
Western North Atlantic	100%	96%

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 number of impacts from training under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of Clymene dolphins incidental to those activities.

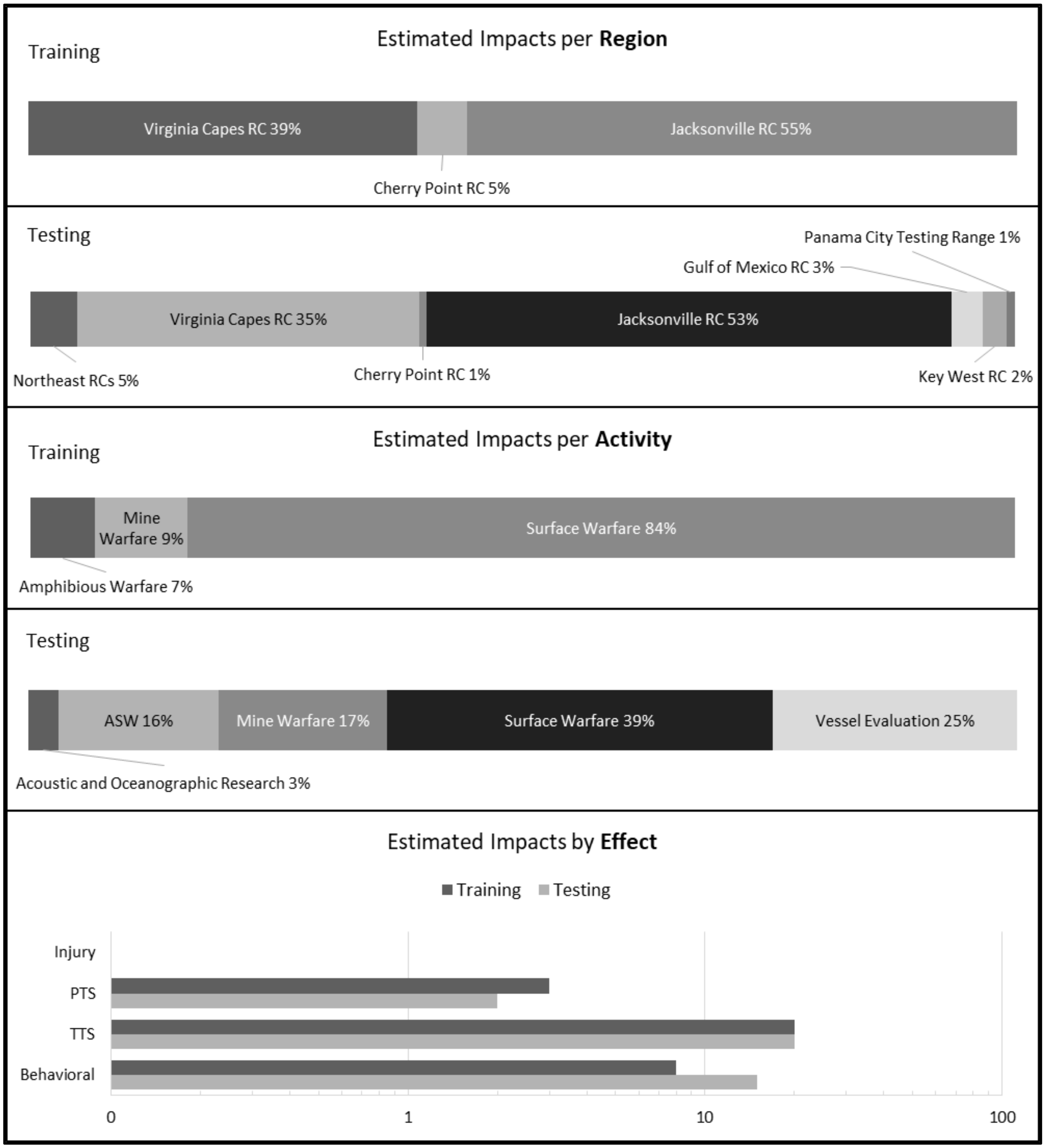
Impacts from Explosives Under Alternative 2 for Testing Activities

Clymene 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 2, estimates behavioral reactions, TTS, and PTS (see Figure 3.7-125 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-93).

Potential impacts under Alternative 2 from explosives use would be similar in type as for Alternative 1, although the number of impacts would increase slightly based on the slight increase in explosives use associated with testing activities under Alternative 2 versus Alternative 1.

Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of Clymene dolphins incidental to those activities.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injury (non-auditory) is estimated for this species. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-126: Clymene Dolphin Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 2

Table 3.7-93: Estimated Impacts on Individual Clymene Dolphin Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 2

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	0%	5%
Western North Atlantic	100%	95%

False Killer Whales

Impacts from Explosives Under Alternative 1 for Training Activities

False 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 behavioral reactions and TTS (see Figure 3.7-127 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-94).

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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

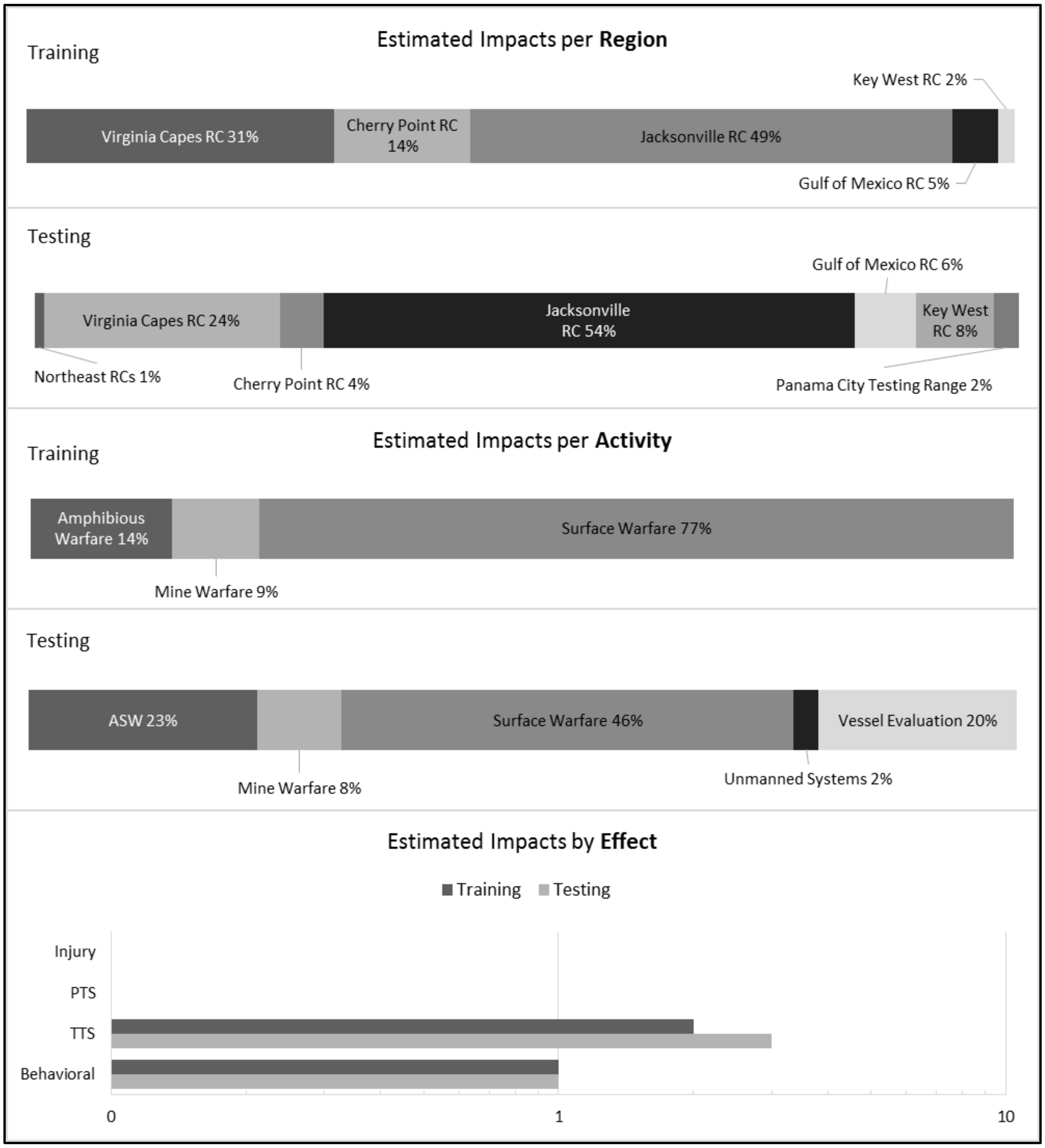
Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will result in the unintentional taking of false killer whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Impacts from Explosives Under Alternative 1 for Testing Activities

False 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 behavioral reactions and TTS (see Figure 3.7-127 and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS and PTS for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-94).

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. 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 will 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 false killer whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No PTS or injury (non-auditory) are estimated for this species. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-127: False Killer Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

Table 3.7-94: Estimated Impacts on Individual False Killer Whale Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	5%	11%
Western North Atlantic	95%	89%

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 number of impacts from training under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of false killer whales 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. The primary distinction is that explosive use under Alternative 2 for testing does increase slightly in some locations per year as compared to Alternative 1. Also, annual numbers of activities using explosives would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the number of impacts for this species from testing under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of false killer whales incidental to those activities.

Fraser's Dolphins

Impacts from Explosives Under Alternative 1 for Training Activities

Fraser's dolphin may be exposed to sound or energy from explosions associated with training activities under Alternative 1 throughout the year, although the quantitative analysis estimates that no Fraser's dolphin would be impacted. Long-term consequences for individuals, the species, or stock would not be expected.

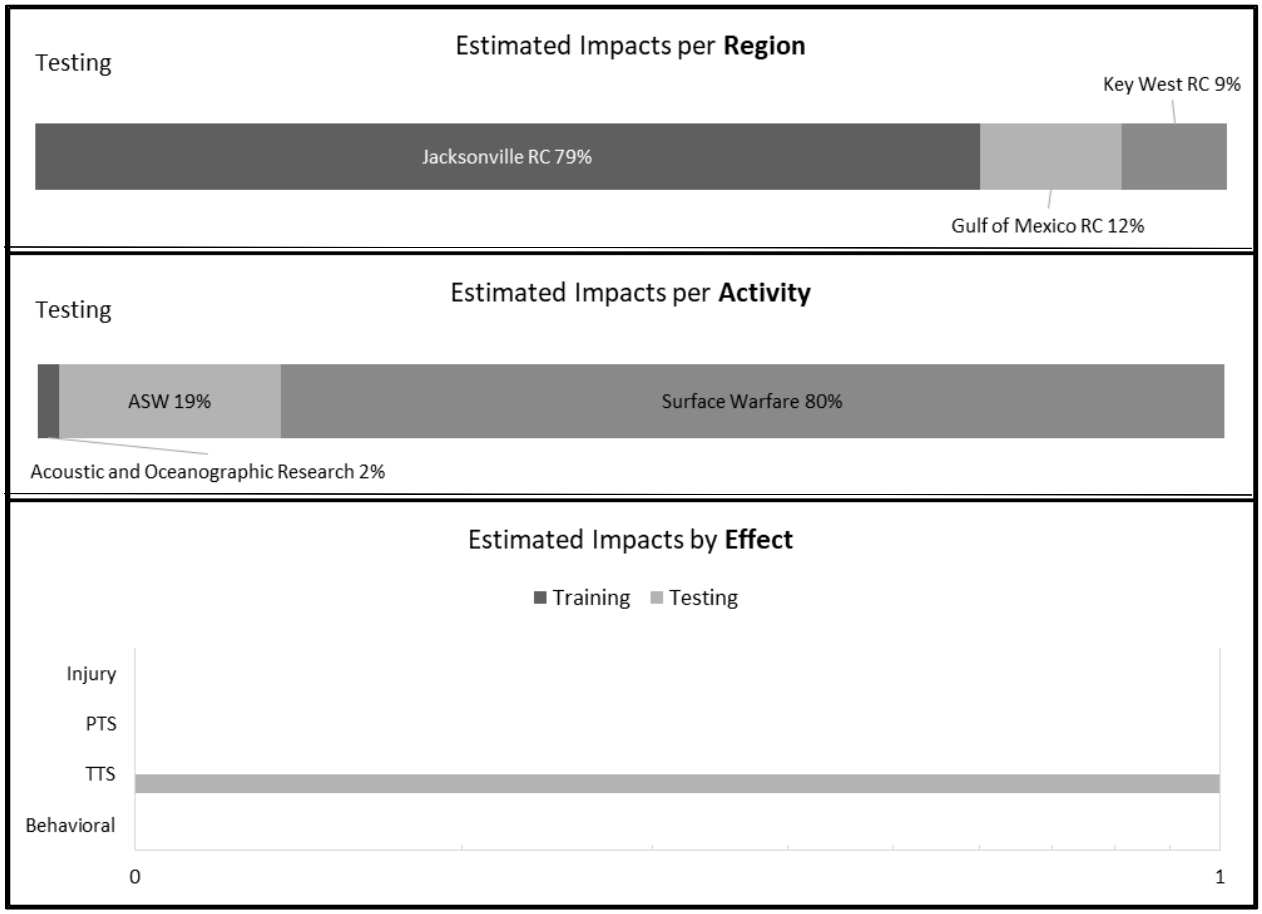
Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will not result in the unintentional taking of Fraser's dolphin incidental to those activities.

Impacts from Explosives Under Alternative 1 for Testing Activities

Fraser'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 TTS (see Figure 3.7-128 and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS, PTS, and injury (non-auditory) for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-95).

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. Non-auditory injury includes low severity injuries; following recovery, any long-term consequences to an individual are expected to be minor. Long-term consequences for the population are unlikely to occur even if an injury created long-term consequences for that individual. Considering these factors and the mitigation measures that will 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 Fraser's dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No behavioral response, PTS, injury (non-auditory) are estimated for this species. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-128: Fraser's Dolphin Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

Table 3.7-95: Estimated Impacts on Individual Fraser's Dolphin Stocks Within the Study Area per Year from Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	16%	14%
Western North Atlantic	84%	86%

Impacts from Explosives Under Alternative 2 for Training Activities

Fraser's dolphin may be exposed to sound or energy from explosions associated with training activities under Alternative 2 throughout the year, although the quantitative analysis estimates that no Fraser's dolphin would be impacted. Long-term consequences for individuals, 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 not result in the unintentional taking of Fraser's dolphin 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. The primary distinction is that explosive use under Alternative 2 for testing does increase slightly in some locations per year as compared to Alternative 1. Also, annual numbers of activities using explosives would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the number of impacts for this species from testing under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of Fraser's dolphins incidental to those activities.

Killer Whales

Killer whales may be exposed to sound or energy from explosions associated with training or testing activities throughout the year, although the quantitative analysis estimates that no killer whales would be impacted. Long-term consequences for individuals, 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 or 2 will not result in the unintentional taking of killer whales incidental to those activities.

Melon-Headed Whales

Impacts from Explosives Under Alternative 1 for Training Activities

Melon-headed 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 behavioral reactions, TTS, and PTS (see Figure 3.7-129 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the western North Atlantic stock for training (see Table 3.7-96).

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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

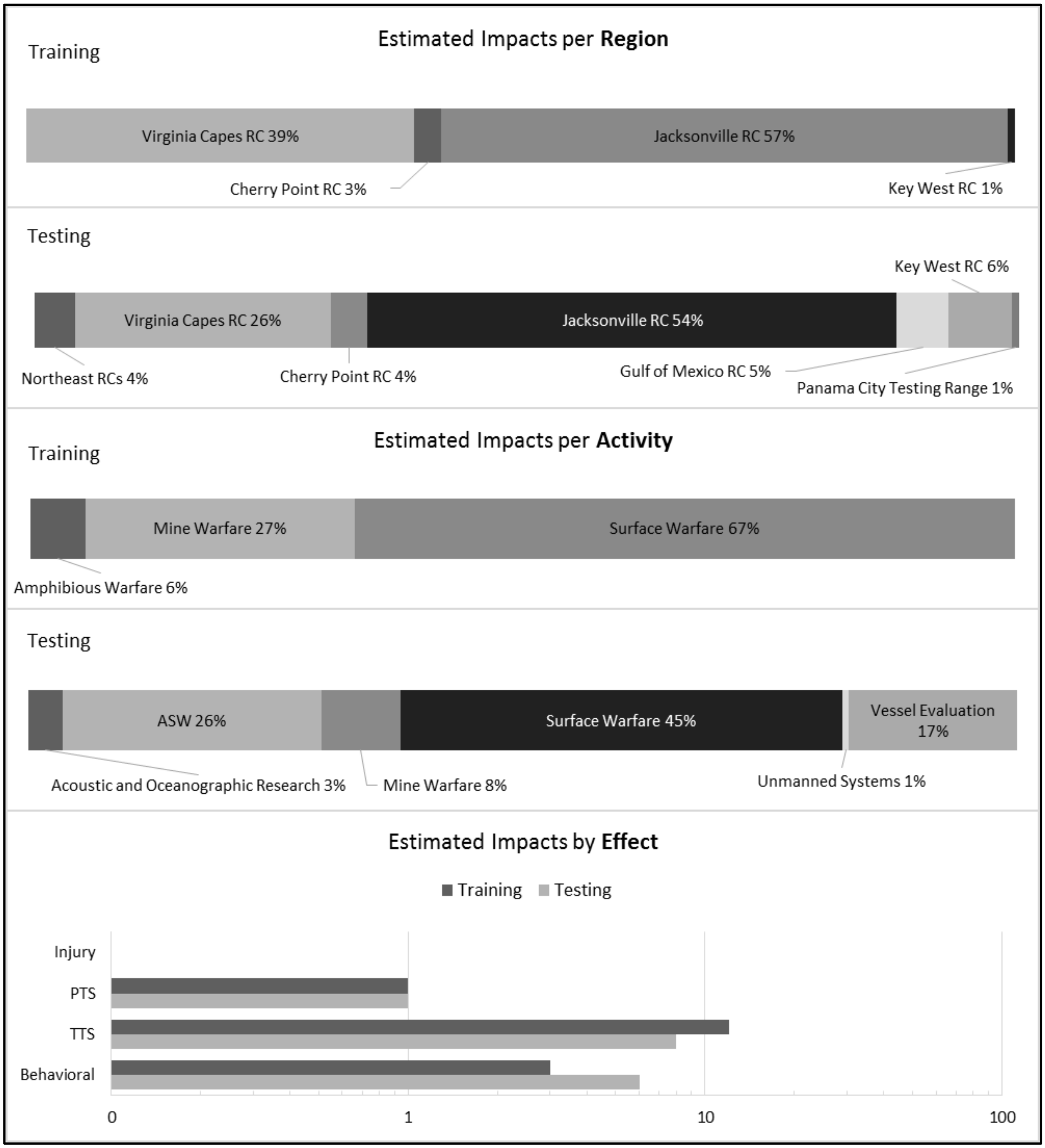
Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will result in the unintentional taking of melon-headed whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Impacts from Explosives Under Alternative 1 for Testing Activities

Melon-headed 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, TTS, and PTS (see Figure 3.7-129 and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS, PTS, and injury (non-auditory) for Ship Shock Trials (Figure 3.7-96and Figure 3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-96).

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. Non-auditory injury includes low severity injuries; following recovery, any long-term consequences to an individual are expected to be minor. Long-term consequences for the population are unlikely to occur even if an injury created long-term consequences for that individual. Considering these factors and the mitigation measures that will 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 melon-headed whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injury (non-auditory) is estimated for this species. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-129: Melon-Headed Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

Table 3.7-96: Estimated Impacts on Individual Melon-Headed Whale Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	0%	8%
Western North Atlantic	100%	92%

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 number of impacts from training under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of melon-headed whales 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. The primary distinction is that explosive use under Alternative 2 for testing does increase slightly in some locations per year as compared to Alternative 1. Also, annual numbers of activities using explosives would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the number of impacts for this species from testing under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of melon-headed whales incidental to those activities.

Pantropical Spotted Dolphins

Impacts from Explosives Under Alternative 1 for Training Activities

Pantropical spotted 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 behavioral reactions, TTS, and PTS (see Figure 3.7-130 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-97).

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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

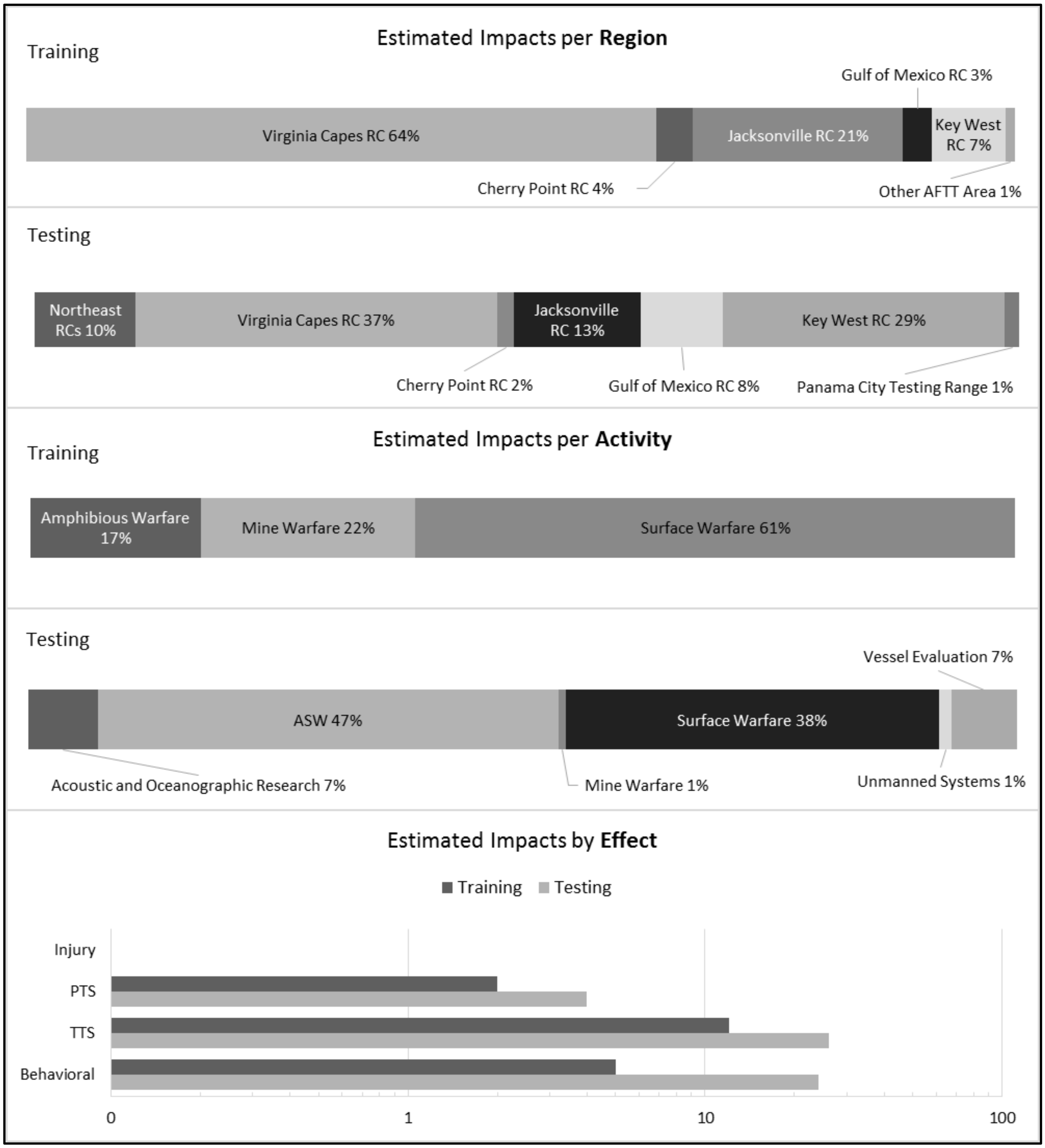
Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will result in the unintentional taking of pantropical spotted dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Impacts from Explosives Under Alternative 1 for Testing Activities

Pantropical spotted 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, TTS, and PTS (see Figure 3.7-130 and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS, PTS, injury (non-auditory), and a single mortality for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-97).

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. Non-auditory injury includes low severity injuries; following recovery, any long-term consequences to an individual are expected to be minor. Long-term consequences for the population are unlikely to occur even if an injury created long-term consequences for that individual or lead to mortality. Considering these factors and the mitigation measures that will 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 pantropical spotted dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injury (non-auditory) is estimated for this species. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-130: Pantropical Spotted Dolphin Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

Table 3.7-97: Estimated Impacts on Individual Pantropical Spotted Dolphin Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	5%	17%
Western North Atlantic	95%	83%

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 number of impacts from training under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of pantropical spotted dolphins incidental to those activities.

Impacts from Explosives Under Alternative 2 for Testing Activities

Pantropical spotted 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 2, estimates behavioral reactions, TTS, PTS, and non-auditory injury (see Figure 3.7-131 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-98).

Potential impacts under Alternative 2 from Explosive use would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in explosives use associated with testing activities under Alternative 2 versus Alternative 1.

Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of pantropical spotted dolphins incidental to those activities.

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-131: Pantropical Spotted Dolphin Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 2

Table 3.7-98: Estimated Impacts on Individual Pantropical Spotted Dolphin Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 2

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	5%	19%
Western North Atlantic	95%	81%

Pilot Whales

Pilot whales include two species that are often difficult to distinguish from one another: long-finned pilot whales and short-finned pilot whales.

Impacts from Explosives Under Alternative 1 for Training Activities

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 behavioral reactions and TTS (see Figure 3.7-132 and Figure 3.7-133, and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the western North Atlantic stocks of long-finned and to multiple stocks for short-finned pilot whales (see Table 3.7-99).

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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

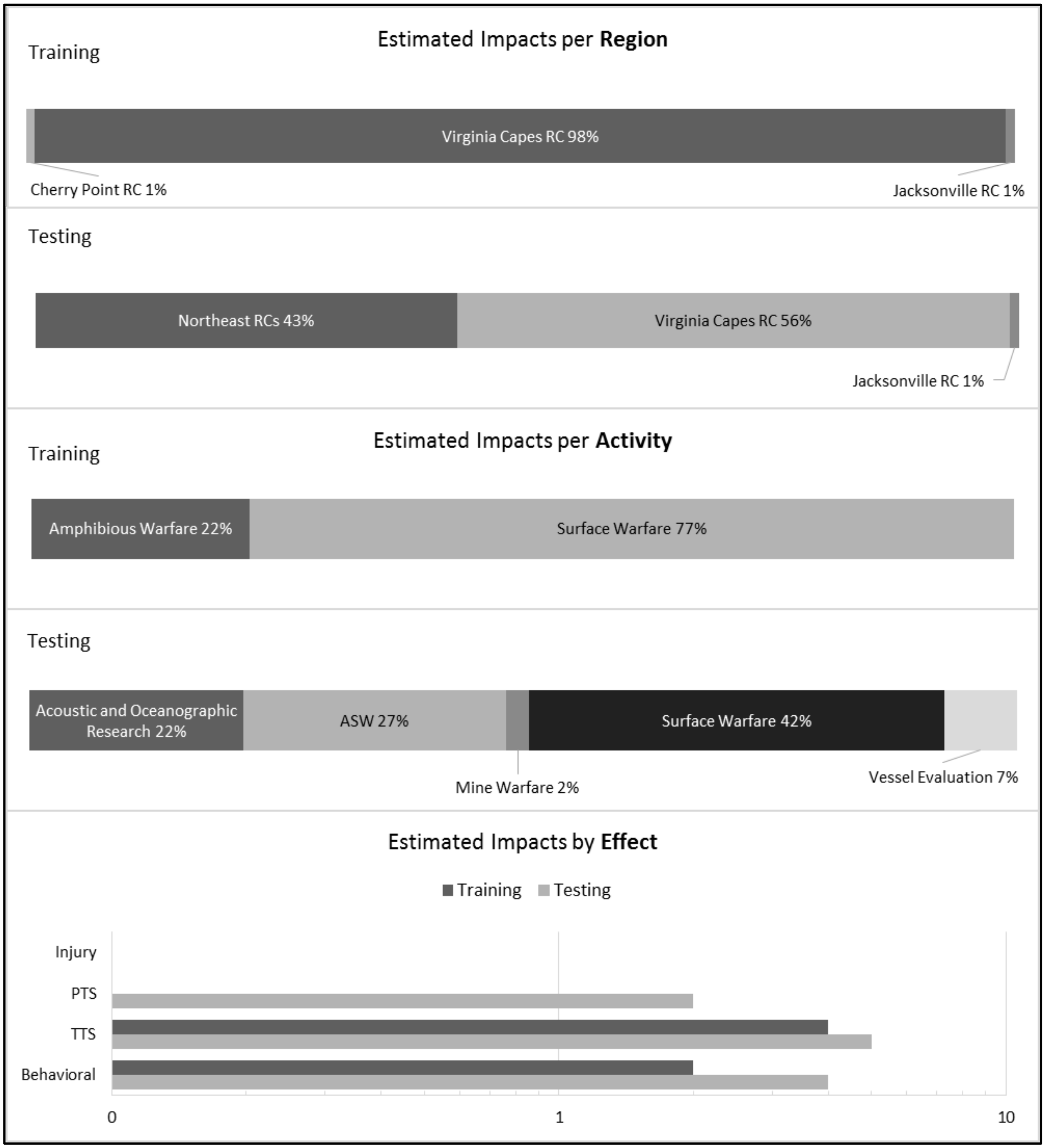
Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will result in the unintentional taking of long-finned and short-finned pilot whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Impacts from Explosives Under Alternative 1 for Testing Activities

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 behavioral reactions, TTS, and PTS (see Figure 3.7-132 and Figure 3.7-133, and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS, PTS, and injury (non-auditory) for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for these species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the western North Atlantic stocks of long-finned and to multiple stocks for short-finned pilot whales (see Table 3.7-99).

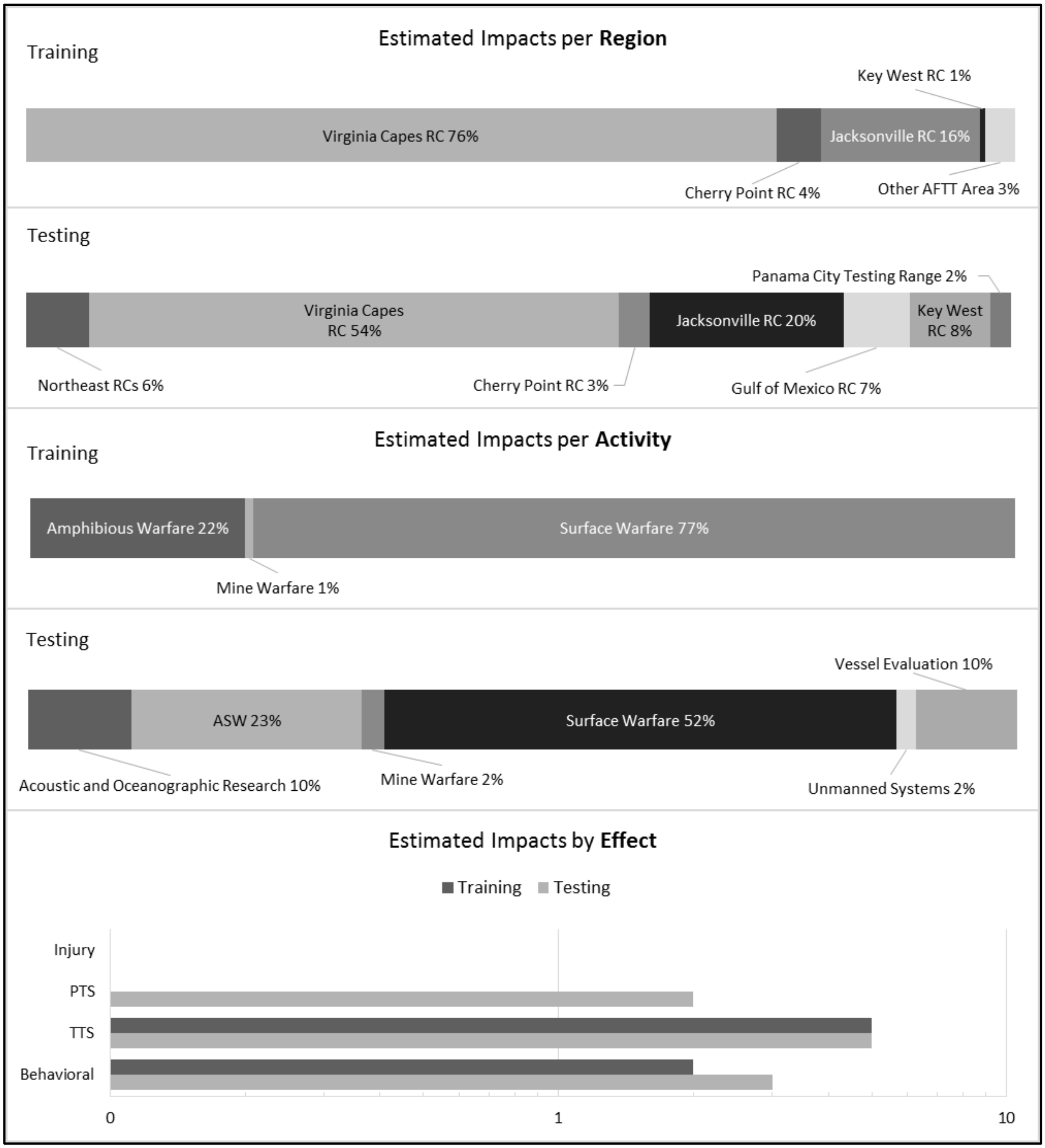
As described for odontocetes above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. PTS in an individual could have no to minor long-term consequences for individuals although a single minor long-term consequence for an individual is unlikely to lead to long-term consequences for a population. Non-auditory injury includes low severity injuries; following recovery, any long-term consequences to an individual are expected to be minor. Long-term consequences for the population are unlikely to occur even if an injury created long-term consequences for that individual. Considering these factors and the mitigation measures that will 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 long-finned and short-finned pilot whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injury (non-auditory) is estimated for this species. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-132: Long-Finned Pilot Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injury (non-auditory) is estimated for this species. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-133: Short-Finned Pilot Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

Table 3.7-99: Estimated Impacts on Individual Short-Finned Pilot Whale Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	0%	11%
Western North Atlantic	100%	89%

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 number of impacts from training under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of long-finned and short-finned pilot whales incidental to those activities.

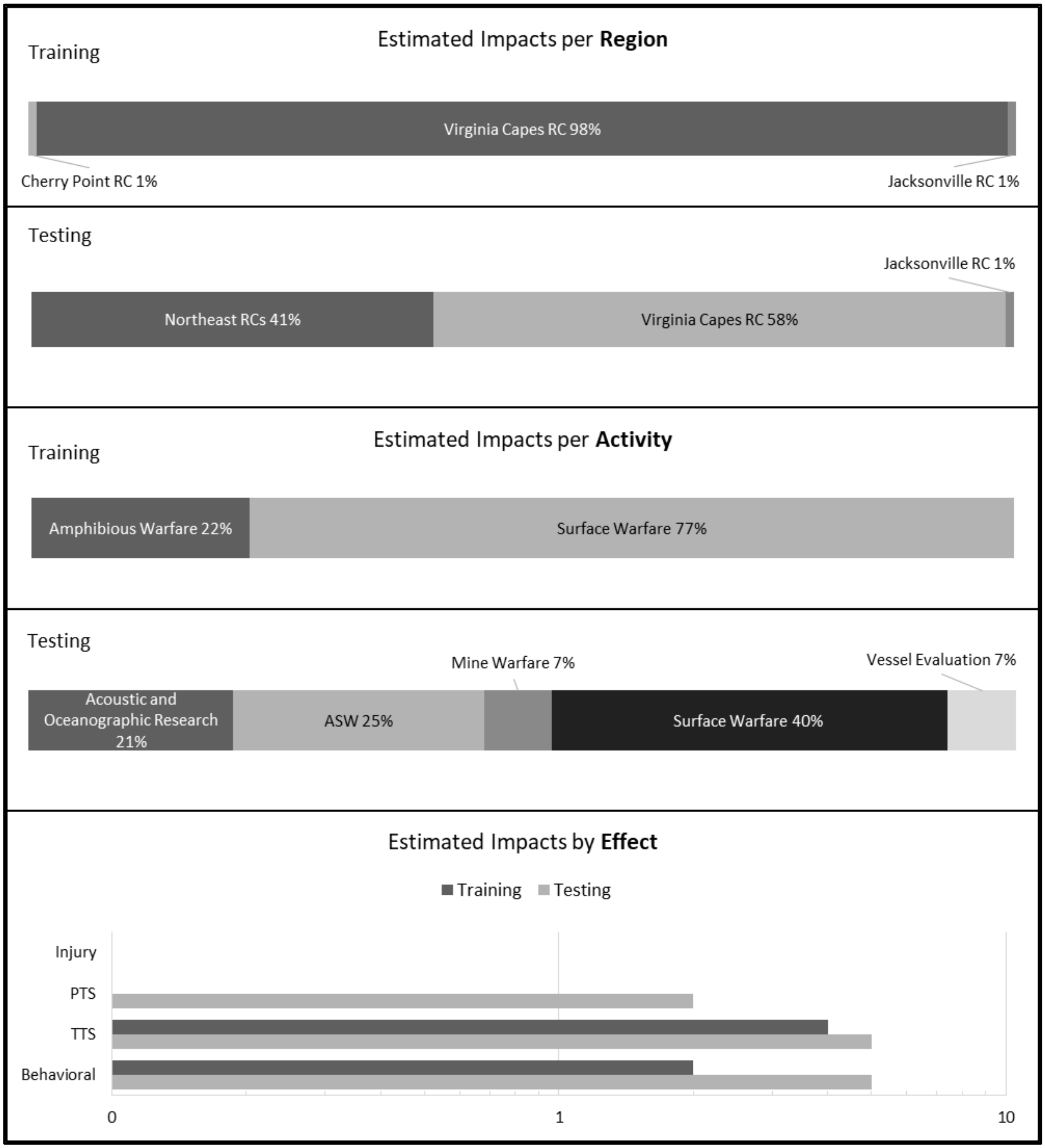
Impacts from Explosives Under Alternative 2 for Testing Activities

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 2, estimates behavioral reactions, TTS, and PTS (see Figure 3.7-134 and Figure 3.7-135, and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the western North Atlantic stocks of long-finned and to multiple stocks for short-finned pilot whales (see Table 3.7-100).

Potential impacts under Alternative 2 from Explosive use would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in explosives use associated with testing activities under Alternative 2 versus Alternative 1.

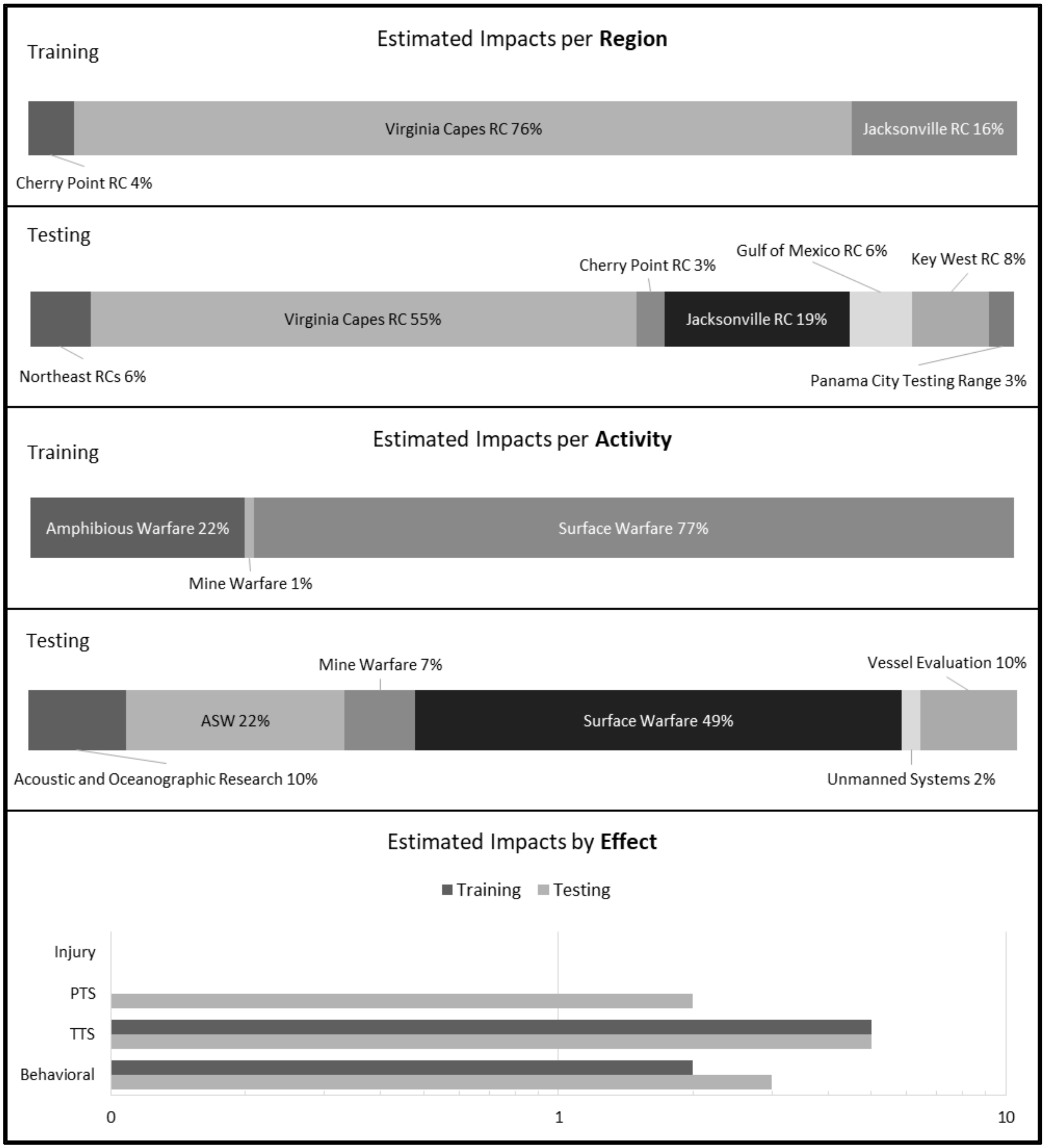
Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of long-finned and short-finned pilot whales incidental to those activities.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injury (non-auditory) is estimated for this species. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-134: Long-Finned Pilot Whale Impacts Estimated per Year the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 2



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injury (non-auditory) is estimated for this species. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-135: Short-Finned Pilot Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 2

Table 3.7-100: Estimated Impacts on Individual Short-Finned Pilot Whale Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 2

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	0%	11%
Western North Atlantic	100%	89%

Pygmy Killer Whales

Impacts from Explosives Under Alternative 1 for Training Activities

Pygmy 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 behavioral reactions and TTS (see Figure 3.7-136 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-101).

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 will 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 pygmy killer whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Impacts from Explosives Under Alternative 1 for Testing Activities

Pygmy 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 behavioral reactions and TTS (see Figure 3.7-136 and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS and PTS for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-101).

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 will 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 pygmy killer whales incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No PTS or injury (non-auditory) are estimated for this species. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-136: Pygmy Killer Whale Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

Table 3.7-101: Estimated Impacts on Individual Pygmy Killer Whale Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	2%	7%
Western North Atlantic	98%	93%

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 number of impacts from training under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of pygmy killer whales 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. The primary distinction is that explosive use under Alternative 2 for testing does increase slightly in some locations per year as compared to Alternative 1. Also, annual numbers of activities using explosives would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the number of impacts for this species from testing under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of pygmy killer whales incidental to those activities.

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 behavioral reactions and TTS (see Figure 3.7-137 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-102).

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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

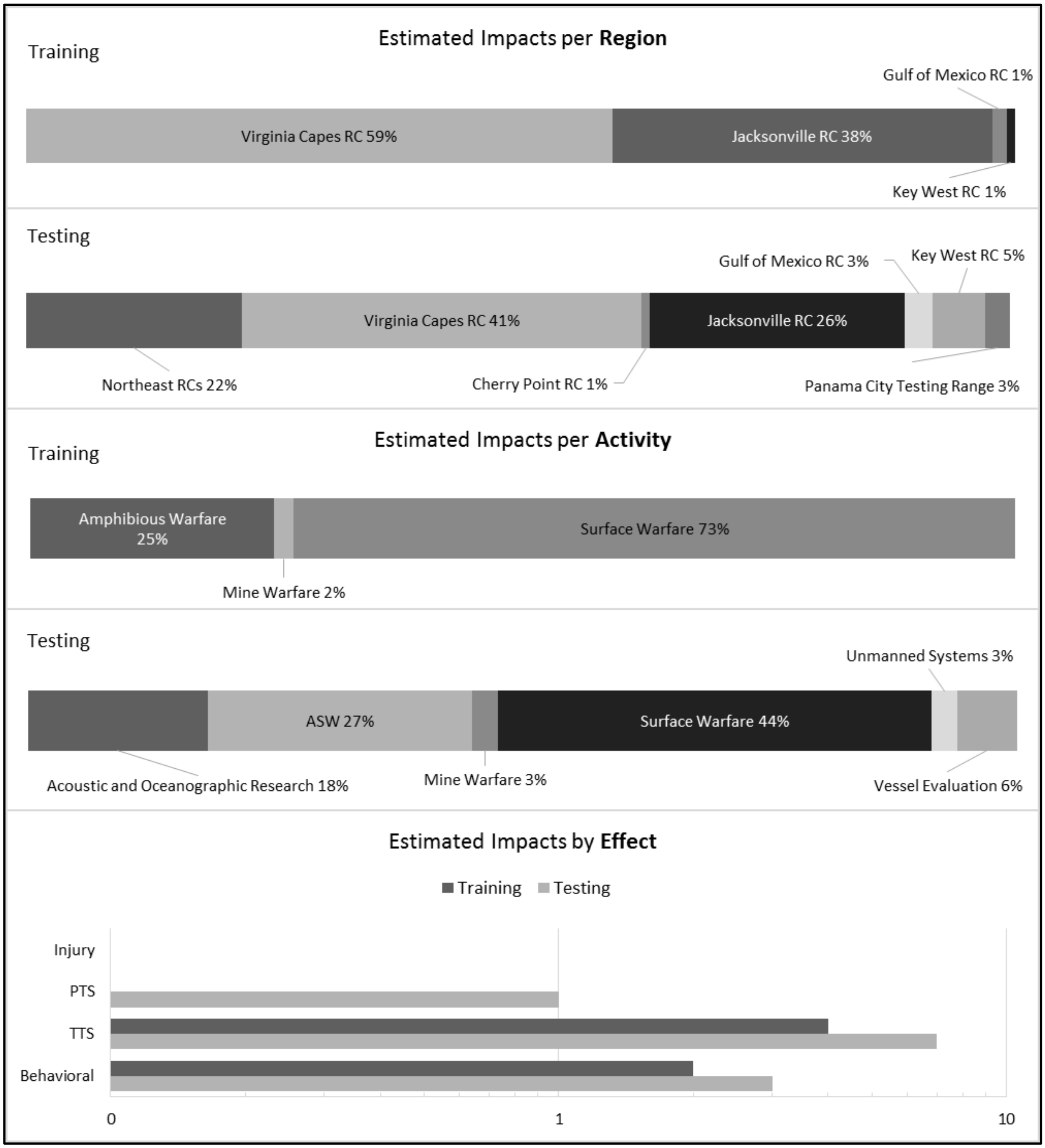
Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will result in the unintentional taking of Risso's dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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 behavioral reactions, TTS, and PTS (see Figure 3.7-137 and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS and PTS for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-102).

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 will 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 Risso's dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injury (non-auditory) is estimated for this species. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-137: Risso's Dolphin Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

Table 3.7-102: Estimated Impacts on Individual Risso's Dolphin Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	2%	7%
Western North Atlantic	98%	93%

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 number of impacts from training under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of Risso's dolphins incidental to those activities.

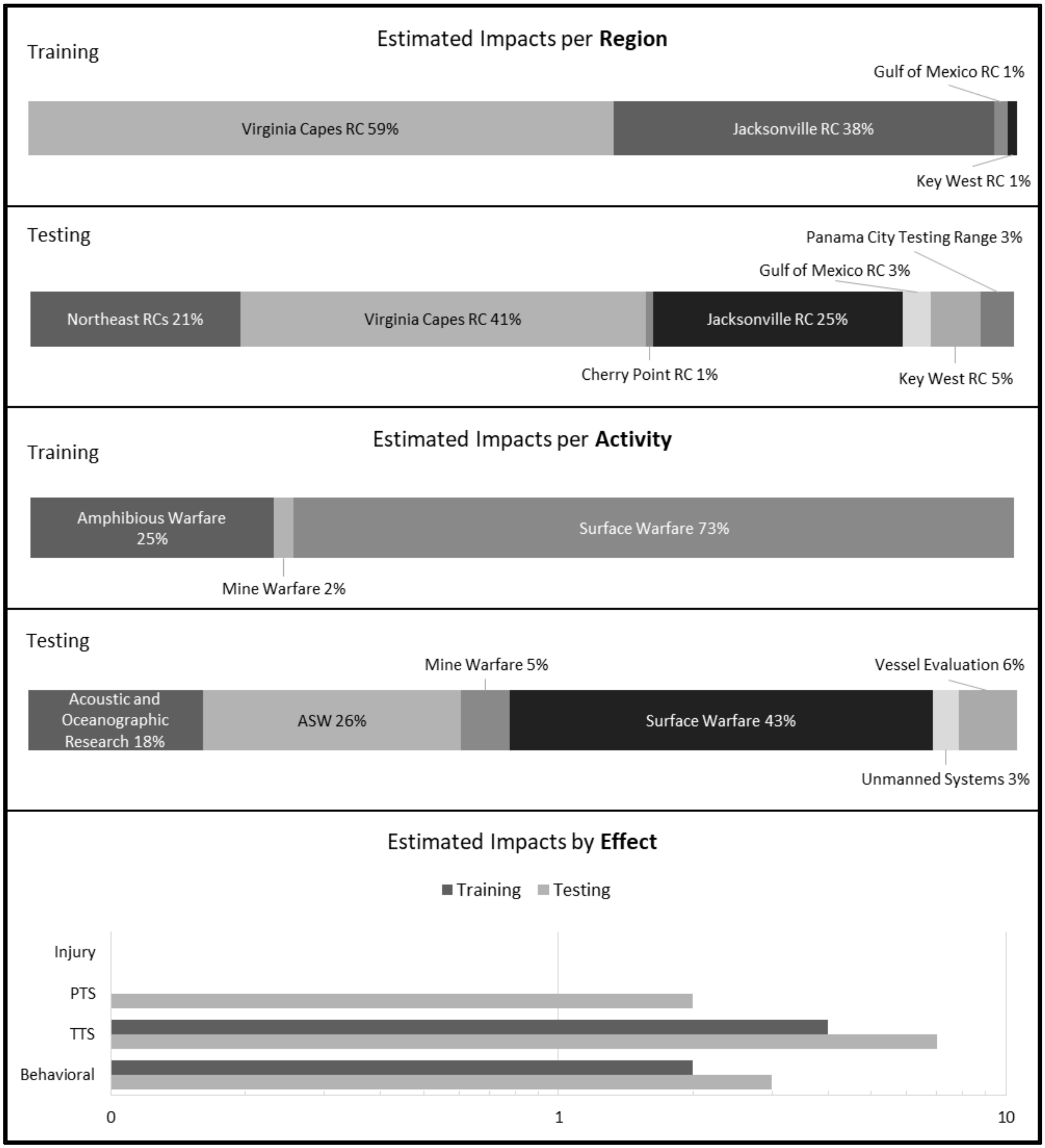
Impacts from Explosives Under Alternative 2 for Testing Activities

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 2, estimates behavioral reactions, TTS, and PTS (see Figure 3.7-138 and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS and PTS for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-103).

Potential impacts under Alternative 2 from Explosive use would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in explosives use associated with testing activities under Alternative 2 versus Alternative 1.

Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of Risso's dolphins incidental to those activities.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injury (non-auditory) is estimated for this species. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-138: Risso's Dolphin Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 2

Table 3.7-103: Estimated Impacts on Individual Risso's Dolphin Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 2

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	2%	7%
Western North Atlantic	98%	93%

Rough-Toothed Dolphins

Impacts from Explosives Under Alternative 1 for Training Activities

Rough-toothed 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 behavioral reactions and TTS (see Figure 3.7-139 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-104).

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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

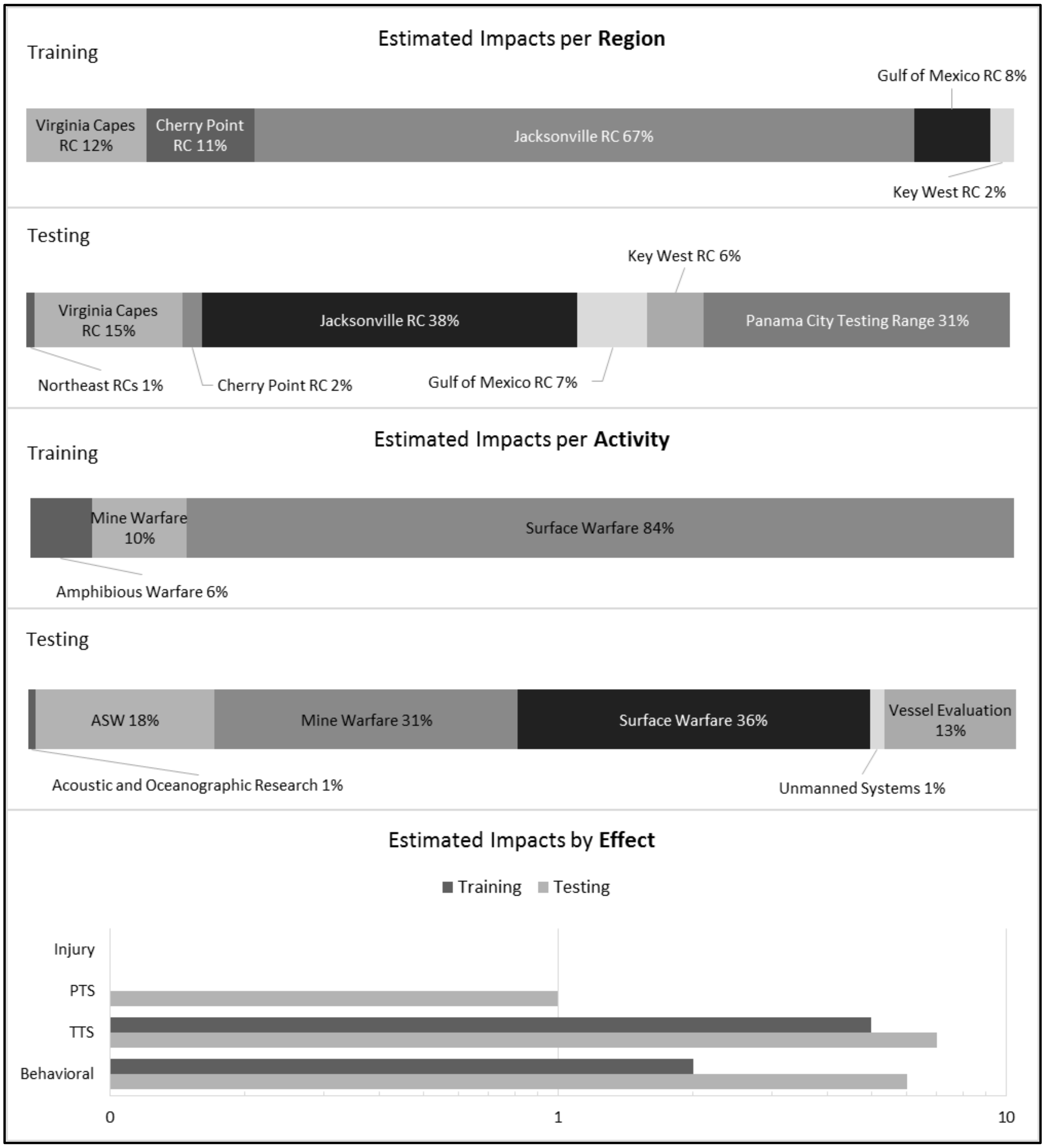
Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will result in the unintentional taking of rough-toothed dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Impacts from Explosives Under Alternative 1 for Testing Activities

Rough-toothed 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, TTS, and PTS (see Figure 3.7-139 and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS, PTS, and injury (non-auditory) for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-104).

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. Long-term consequences for the population are unlikely to occur even if an injury created long-term consequences for that individual. Considering these factors and the mitigation measures that will 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 rough-toothed dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injury (non-auditory) is estimated for this species. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-139: Rough-Toothed Dolphin Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

Table 3.7-104: Estimated Impacts on Individual Rough-Toothed Dolphin Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	8%	40%
Western North Atlantic	92%	60%

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 number of impacts from training under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of rough-toothed 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. The primary distinction is that explosive use under Alternative 2 for testing does increase slightly in some locations per year as compared to Alternative 1. Also, annual numbers of activities using explosives would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the number of impacts for this species from testing under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of rough-toothed dolphins incidental to those activities.

Short-Beaked Common Dolphins

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 behavioral reactions, TTS, PTS, and (non-auditory) injury (see Figure 3.7-140 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the western North Atlantic stock.

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. Non-auditory injury includes low severity injuries; following recovery, any long-term consequences to an individual are expected to be minor. Long-term consequences for the population are unlikely to occur even if an injury created long-term consequences for that individual. Considering these factors and the mitigation measures that will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

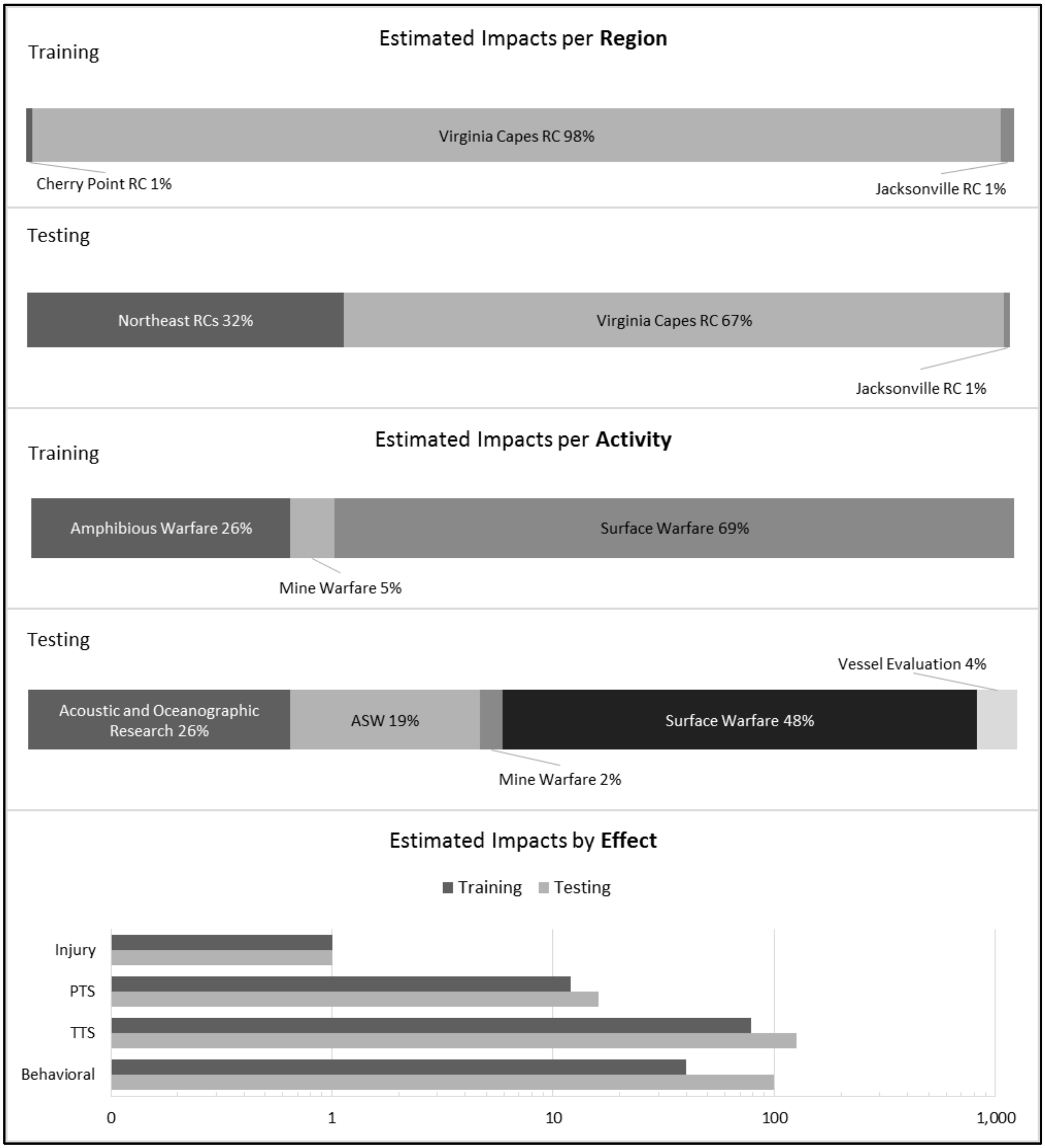
Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will result in the unintentional taking of short-beaked common dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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 behavioral reactions, TTS, PTS, and (non-auditory) injury (see Figure 3.7-140 and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS, PTS, injury (non-auditory), and mortality for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the western North Atlantic stock.

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. Non-auditory injury includes low severity injuries; following recovery, any long-term consequences to an individual are expected to be minor. Long-term consequences for the population are unlikely to occur even if an injury created long-term consequences for that individual or lead to mortality. Considering these factors and the mitigation measures that will 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 short-beaked common dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No behavioral response, PTS, or injury (non-auditory) are estimated for this species. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-140: Short-Beaked Common Dolphin Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

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 number of impacts from training under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of short-beaked common dolphins incidental to those activities.

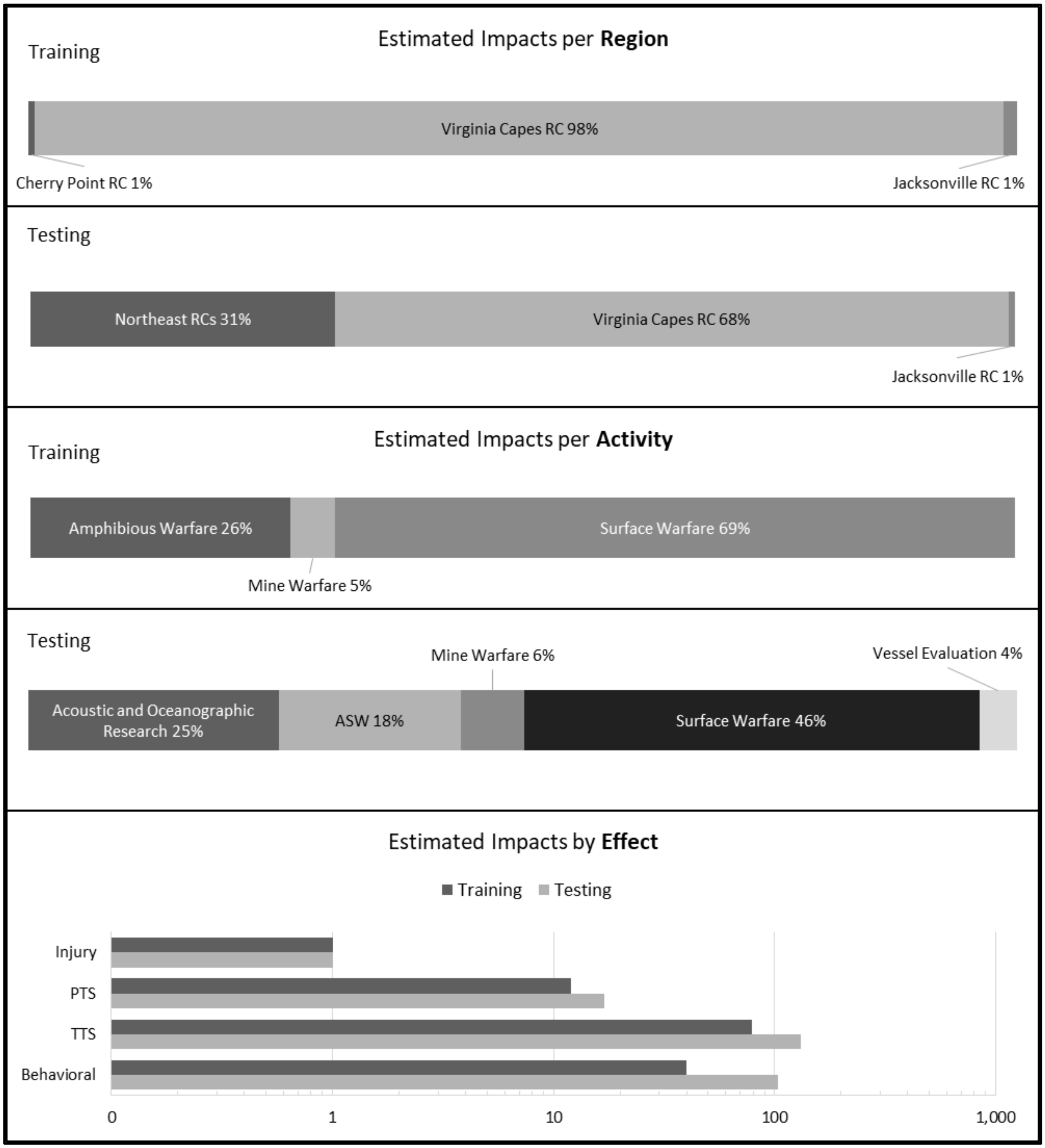
Impacts from Explosives Under Alternative 2 for Testing Activities

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 explosives per year under Alternative 2, estimates behavioral reactions, TTS, PTS, and (non-auditory) injury (see Figure 3.7-141 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives).

Potential impacts under Alternative 2 from Explosive use would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in explosives use associated with testing activities under Alternative 2 versus Alternative 1.

Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of short-beaked common dolphins incidental to those activities.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-141: Short-Beaked Common Dolphin Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 2

Spinner Dolphins

Impacts from Explosives Under Alternative 1 for Training Activities

Spinner 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 behavioral reactions, TTS, and PTS (see Figure 3.7-142 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-105).

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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

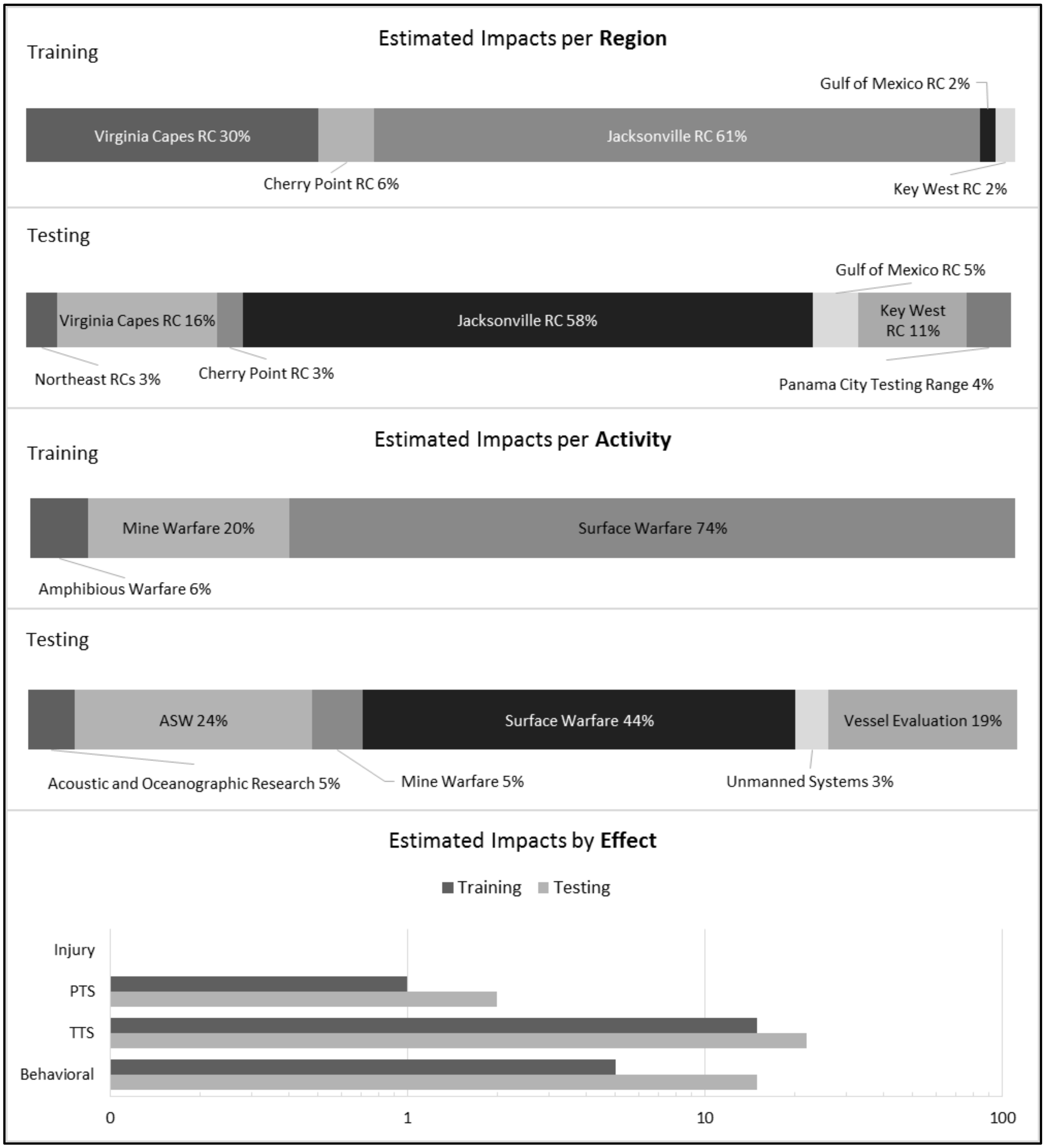
Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will result in the unintentional taking of spinner dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

Impacts from Explosives Under Alternative 1 for Testing Activities

Spinner 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, TTS, and PTS (see Figure 3.7-142 and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS, PTS, injury (non-auditory), and a single mortality for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-105).

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. Non-auditory injury includes low severity injuries; following recovery, any long-term consequences to an individual are expected to be minor. Long-term consequences for the population are unlikely to occur even if an injury created long-term consequences for that individual or lead to mortality. Considering these factors and the mitigation measures that will 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 spinner dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injury (non-auditory) is estimated for this species. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-142: Spinner Dolphin Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

Table 3.7-105: Estimated Impacts on Individual Spinner Dolphin Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	2%	12%
Western North Atlantic	98%	88%

Impacts from Explosives Under Alternative 2 for Training Activities

Spinner 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 2, estimates behavioral reactions, TTS, and PTS (see Figure 3.7-143 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-106).

Potential impacts under Alternative 2 from Explosive use would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in explosives use associated with testing activities under Alternative 2 versus 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 spinner dolphins incidental to those activities.

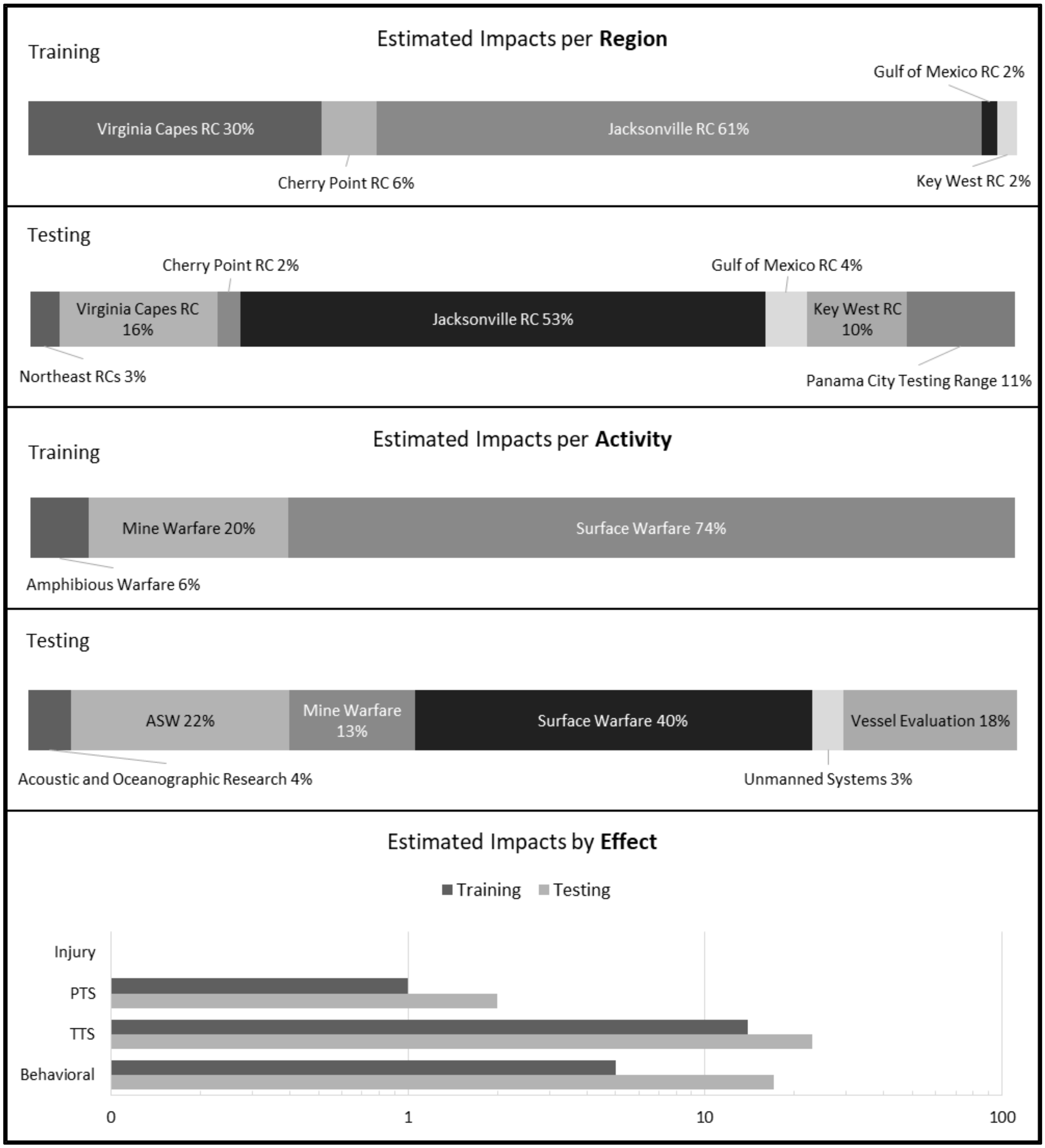
Impacts from Explosives Under Alternative 2 for Testing Activities

Spinner 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 2, estimates behavioral reactions, TTS, and PTS (see Figure 3.7-143 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-106).

Potential impacts under Alternative 2 from Explosive use would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in explosives use associated with testing activities under Alternative 2 versus Alternative 1.

Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of spinner dolphins incidental to those activities.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injury (non-auditory) is estimated for this species. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-143: Spinner Dolphin Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 2

Table 3.7-106: Estimated Impacts on Individual Spinner Dolphin Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 2

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	2%	18%
Western North Atlantic	98%	82%

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 behavioral reactions, TTS, and PTS (see Figure 3.7-144 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-107).

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. Non-auditory injury includes low severity injuries; following recovery, any long-term consequences to an individual are expected to be minor. Long-term consequences for the population are unlikely to occur even if an injury created long-term consequences for that individual. Considering these factors and the mitigation measures that will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

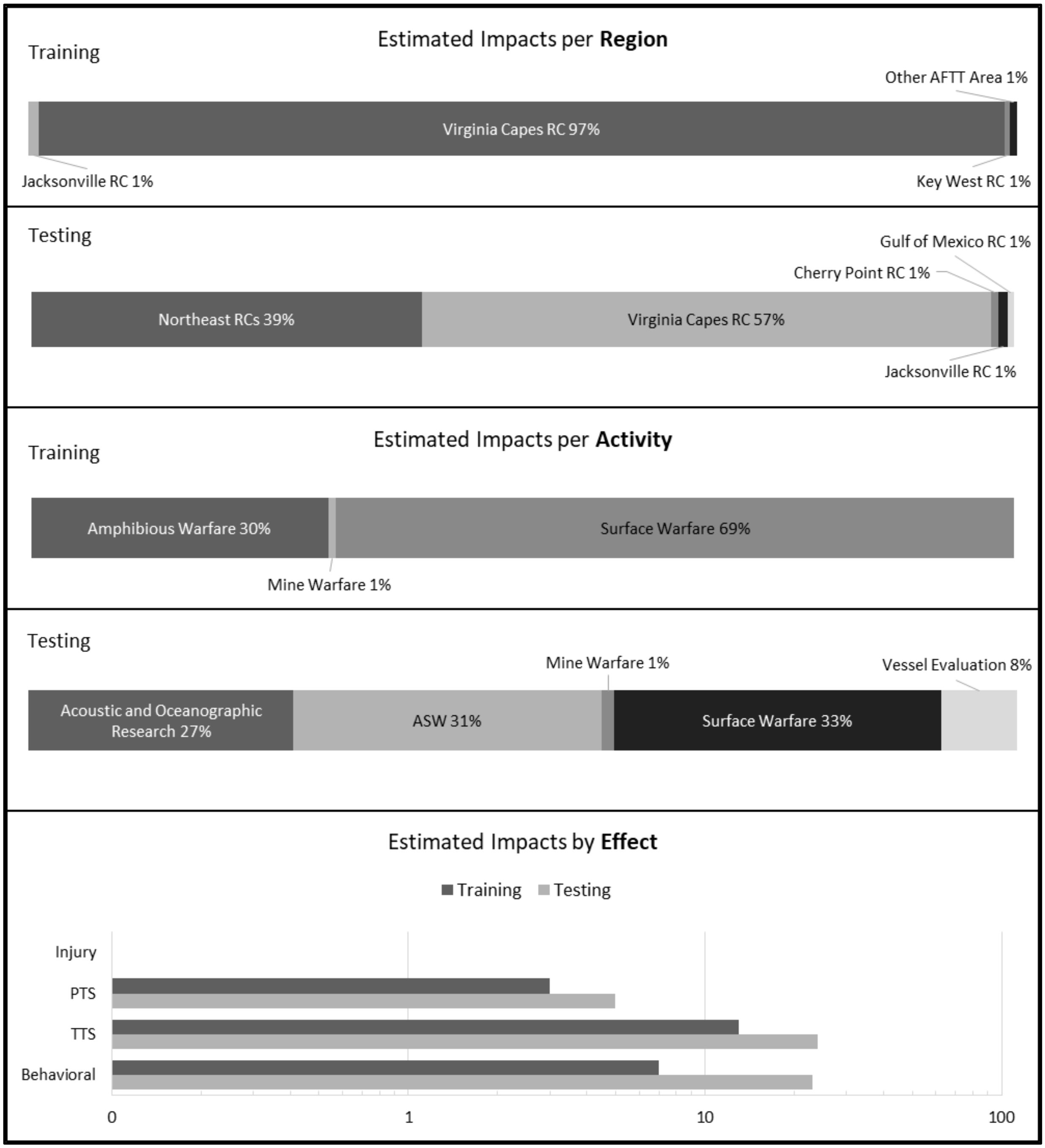
Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will result in the unintentional taking of striped dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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 behavioral reactions, TTS, and PTS (see Figure 3.7-144 and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS, PTS, and injury (non-auditory) for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-107).

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. Non-auditory injury includes low severity injuries; following recovery, any long-term consequences to an individual are expected to be minor. Long-term consequences for the population are unlikely to occur even if an injury created long-term consequences for that individual. Considering these factors and the mitigation measures that will 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 striped dolphins incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injury (non-auditory) is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-144: Striped Dolphin Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

Table 3.7-107: Estimated Impacts on Individual Striped Dolphin Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 1

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	0%	1%
Western North Atlantic	100%	99%

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 number of impacts from training under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

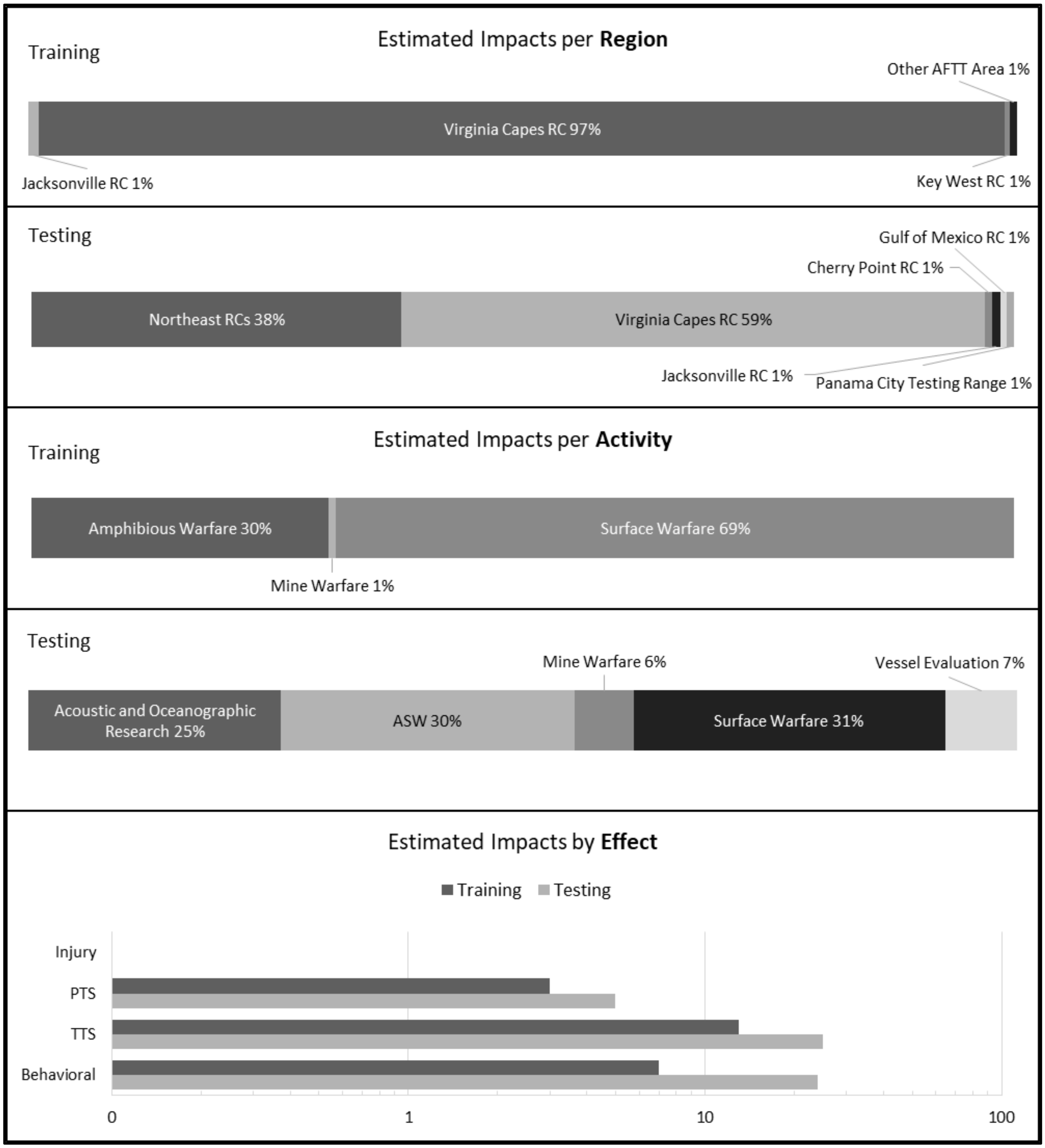
Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 2 will result in the unintentional taking of striped dolphins incidental to those activities.

Impacts from Explosives Under Alternative 2 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 2, estimates behavioral reactions, TTS, and PTS (see Figure 3.7-145 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to multiple stocks (see Table 3.7-108).

Potential impacts under Alternative 2 from Explosive use would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in explosives use associated with testing activities under Alternative 2 versus Alternative 1.

Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injury (non-auditory) is estimated for this species. AFTT: Atlantic Fleet Training and Testing; ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-145: Striped Dolphin Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 2

Table 3.7-108: Estimated Impacts on Individual Striped Dolphin Stocks Within the Study Area per Year from Training and Testing Explosions Using the Maximum Number of Explosions Under Alternative 2

Estimated Impacts per **Species' Stock**		
Stock	***Training***	***Testing***
Northern Gulf of Mexico	0%	1%
Western North Atlantic	100%	99%

Pursuant to the MMPA, the use of explosives during testing activities as described under Alternative 2 will result in the unintentional taking of striped dolphins incidental to those activities.

White-Beaked Dolphins

White-beaked dolphins may be exposed to sound or energy from explosions associated with training or testing activities throughout the year, although the quantitative analysis estimates that no white-beaked dolphins would be impacted. Long-term consequences for individuals, 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 or 2 will not result in the unintentional taking of white-beaked dolphins incidental to those activities.

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). During the period that a harbor porpoise had hearing loss, vocalizations from conspecifics could be more difficult to detect or interpret, however harbor porpoises vocalize at frequencies above 100 kHz which is likely to be well above the frequency of threshold shift induced by sound from an explosion. Odontocetes, including the harbor porpoise, use echolocation clicks to find and capture prey. These echolocation clicks and vocalizations are at frequencies above 100 kHz for harbor porpoises and are therefore unlikely to be affected by threshold shift at lower frequencies. This should not affect harbor porpoise's ability to locate prey or rate of feeding.

Research and observations (see Section 3.7.3.2.2.1, Methods for Analyzing Impacts from Explosives: Behavioral Responses from Explosives) show that harbor porpoises are sensitive to human disturbance including noise from impulsive sources. Observations of harbor porpoises near seismic surveys using air guns and pile driving operations show animals avoiding by 5 to 20 km, but returning quickly to the area after activities cease. Reactions could include alerting, startling, breaking off feeding dives and surfacing, diving or swimming away, change in vocalization, or showing no response at all. It is reasonable to expect that animals may leave an area of more intense explosive activity, but return within a few days, however most explosive use during Navy activities is short-duration consisting of only a single or few closely timed explosions 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 harbor porpoises are likely to be short term and moderate severity.

A few TTS or behavioral reactions in an individual animal within a given year are unlikely to result in any long-term consequences. PTS could reduce an animal's ability to detect biologically important sounds; however, as discussed above, a small threshold shift due to low-frequency sound from an explosion is unlikely to affect the hearing range that harbor porpoises 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 stocks. Considering these factors, and the low number of overall estimated impacts, long-term consequences for the population would not be expected.

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 behavioral reactions, TTS, and PTS (see Figure 3.7-146 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the Gulf of Maine/Bay of Fundy stock.

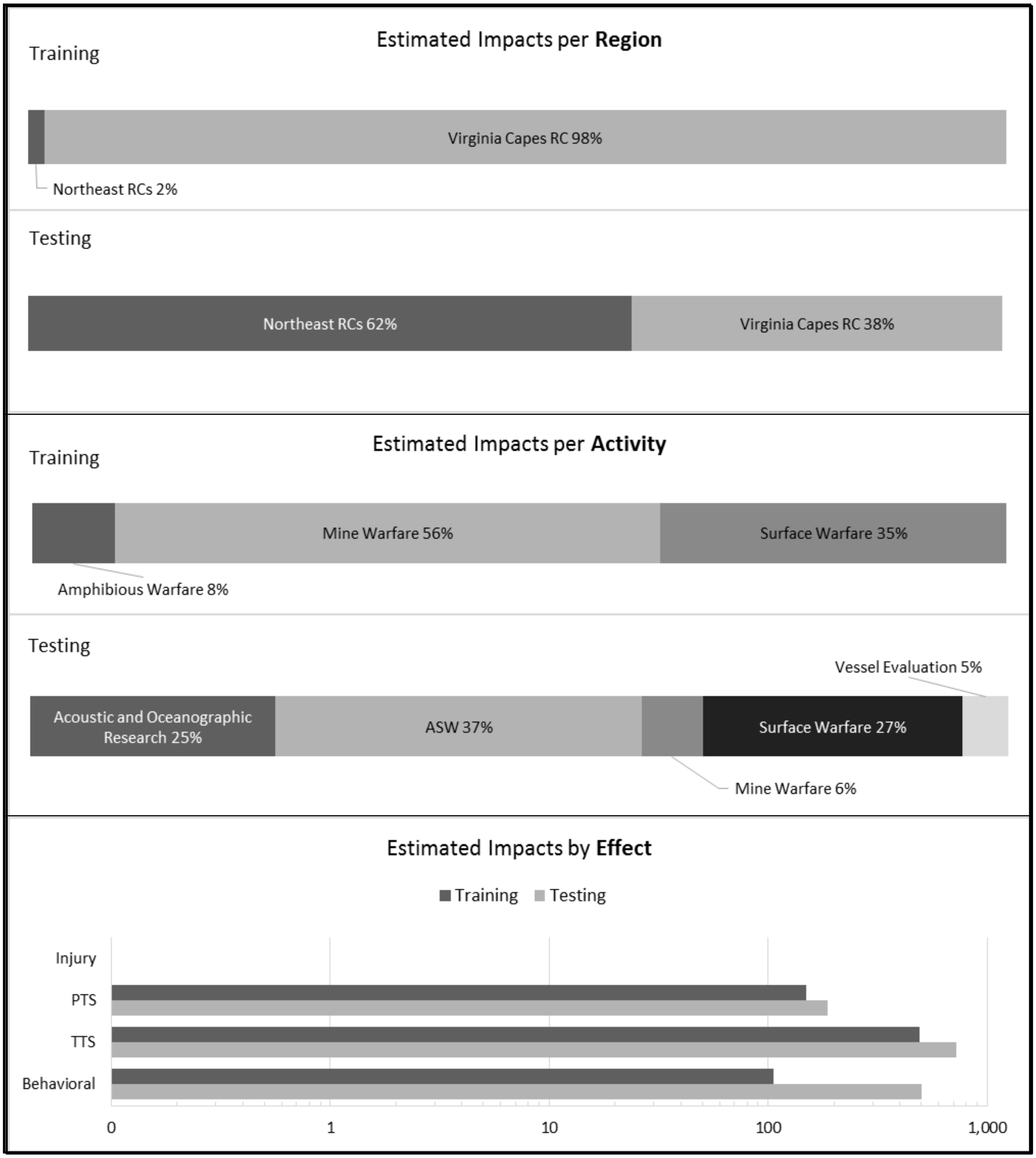
As described above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. PTS in an individual could have no to minor long-term consequences for individuals although 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

A small and resident population area for harbor porpoises identified by LaBrecque et al. (2015a) overlaps the Northeast Range Complexes within the Study Area. Navy training activities that involve the use of explosives could occur year-round within the Northeast Range Complexes; however, training with explosives typically occurs only within Narragansett Bay, which is outside the harbor porpoise small and resident population area identified by LaBrecque et al. (2015a). The identified harbor porpoise area would not be exposed to sound or energy from explosives; therefore, impacts would not be anticipated within the identified small and resident population area for harbor porpoises. In addition to procedural mitigation that is implemented whenever and wherever explosive activities occur, the Navy will implement mitigation to not conduct certain explosive activities within the Northeast North Atlantic Right Whale Mitigation Area year-round. This will further avoid or reduce potential impacts on the small and resident population of harbor porpoises identified by LaBrecque et al. (2015a) (see Section 5.4.2, Mitigation Areas off the Northeastern United States).

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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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 explosives per year under Alternative 1, estimates behavioral reactions, TTS, and PTS (see Figure 3.7-146 and tabular results in Appendix E, Estimated Marine Mammals 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. The quantitative analysis also estimates TTS and PTS for Ship Shock Trials (Figure 3.7-96 and Figure 3.7-97). Impact ranges for this species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the Gulf of Maine/Bay of Fundy stock.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injury (non-auditory) is estimated for this species. 100 percent Gulf of Maine/Bay of Fundy stock. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-146: Harbor Porpoise Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 1

As described for other 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. 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 will be implemented as described in Chapter 5 (Mitigation), long-term consequences for the species or stock would not be expected.

A small and resident population area for harbor porpoises identified by LaBrecque et al. (2015a) overlaps the Northeast Range Complexes within the Study Area. Navy testing activities that involve the use of explosives could occur year-round within the Northeast Range Complexes including the harbor porpoise small and resident population area identified by LaBrecque et al. (2015a). A small number of behavioral reactions, TTS, or PTS could occur within this identified area, although this area only overlaps a small portion of the Northeast Range Complexes. This leads to a lower likelihood that impacts estimated for harbor porpoises in the Northeast Range Complexes would occur within the small and resident population area for harbor porpoises identified by LaBrecque et al. (2015a). Due the low number of estimated impacts overall and the intermittent nature of explosive activities that could take place within the identified harbor porpoise area, significant impacts on natural behaviors within or abandonment of the small and resident population area for harbor porpoises identified by LaBrecque et al. (2015a) are not anticipated. In addition to procedural mitigation that is implemented whenever and wherever explosive activities occur, the Navy will implement mitigation to not conduct certain explosive activities within the Northeast North Atlantic Right Whale Mitigation Area year-round. This will further avoid or reduce potential impacts on the small and resident population of harbor porpoises identified by LaBrecque et al. (2015a) (see Section 5.4.2, Mitigation Areas off the Northeastern United States).

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 has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.

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 number of impacts from training under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities).

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.

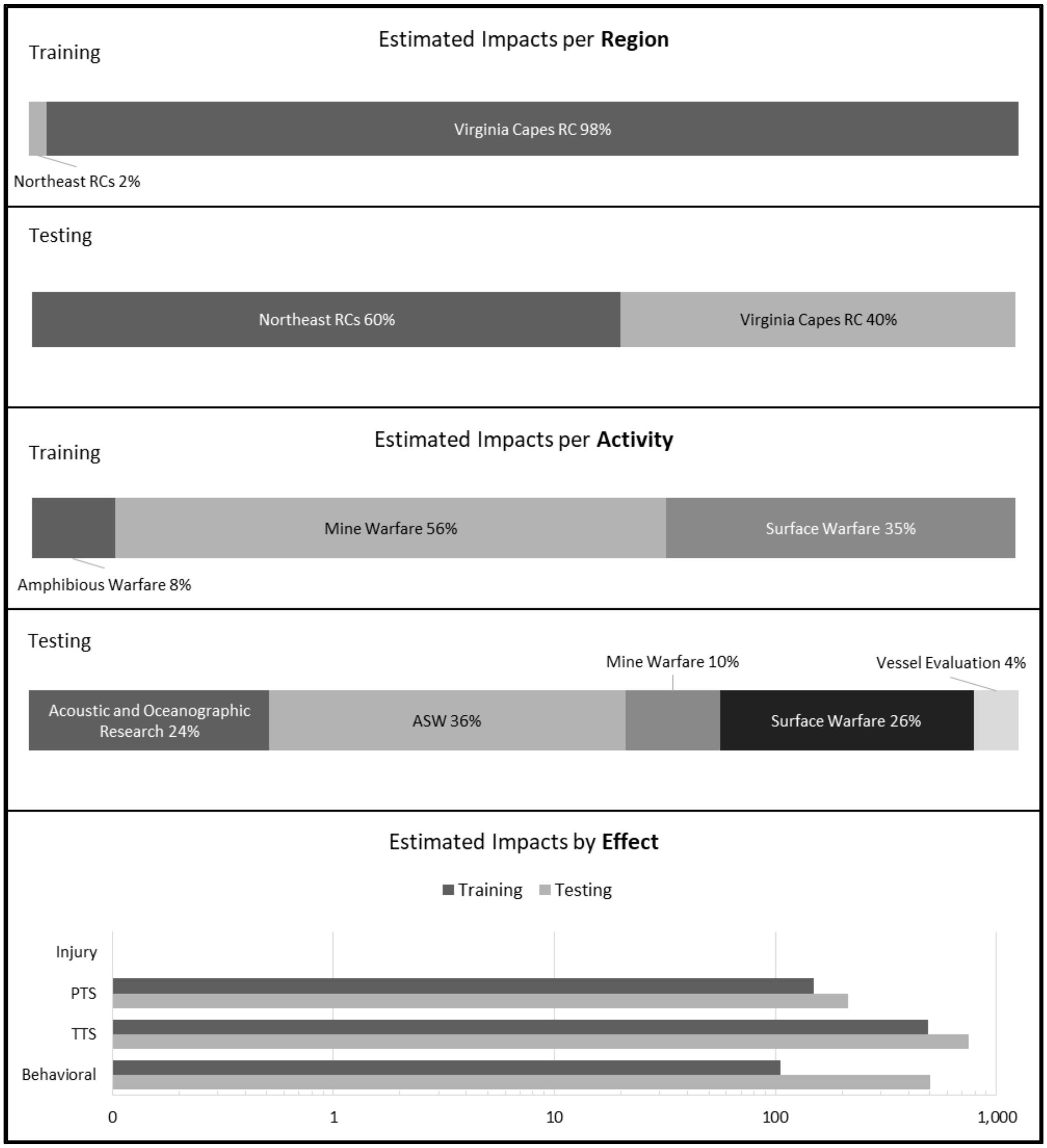
Impacts from Explosives Under Alternative 2 for Testing Activities

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 explosives per year under Alternative 2, estimates behavioral reactions, TTS, and PTS (see Figure 3.7-147 and tabular results in Appendix E, Estimated Marine Mammals 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 3.7.3.2.2.2 (Impact Ranges from Explosives).

Potential impacts under Alternative 2 from Explosive use would be similar in type as for Alternative 1, although the numbers of impacts would increase slightly based on the slight increase in explosives use associated with testing activities under Alternative 2 versus Alternative 1.

Potential impacts from Ship Shock Trials are identical for Alternatives 1 and 2.

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.



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injury (non-auditory) is estimated for this species. 100 percent Gulf of Maine/Bay of Fundy stock. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-147: Harbor Porpoise Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing (Excluding Full Ship Shock Trials) Under Alternative 2

Phocid Seals

Phocid seals in AFTT Study Area include harbor seals, gray seals, harp seals, hooded seals, bearded seals and ringed seals. Most of these species primary ranges are north of the AFTT Study Area.

Phocid seals that do experience TTS from explosive sounds 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 phocid seal had TTS, social calls from conspecifics could be more difficult to detect or interpret, however most phocid vocalizations may be above the frequency of TTS induced by an explosion. Killer whales are one of the phocid seals 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 phocid seals due to sound from explosions is unlikely to reduce detection of killer whale calls. Phocid seals probably 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 3.7.3.1.1.4 (Auditory Masking). Explosions introduce low-frequency, broadband sounds into the environment, which could mask hearing thresholds in phocid seals 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 seals in the area over the short duration of the event. Potential costs to seals 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 in Section 3.7.3.2.2.1, Methods for Analyzing Impacts from Explosives) show that pinnipeds (including phocid seals) 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 3.7.3.2.1.3 (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.

Impacts from Explosives Under Alternative 1 for Training Activities

Phocid seals may be exposed to sound or energy from explosions associated with training activities under Alternative 1 throughout the year, although the quantitative analysis estimates that no phocid seals would be impacted. Long-term consequences for individuals, the species, or stock would not be expected.

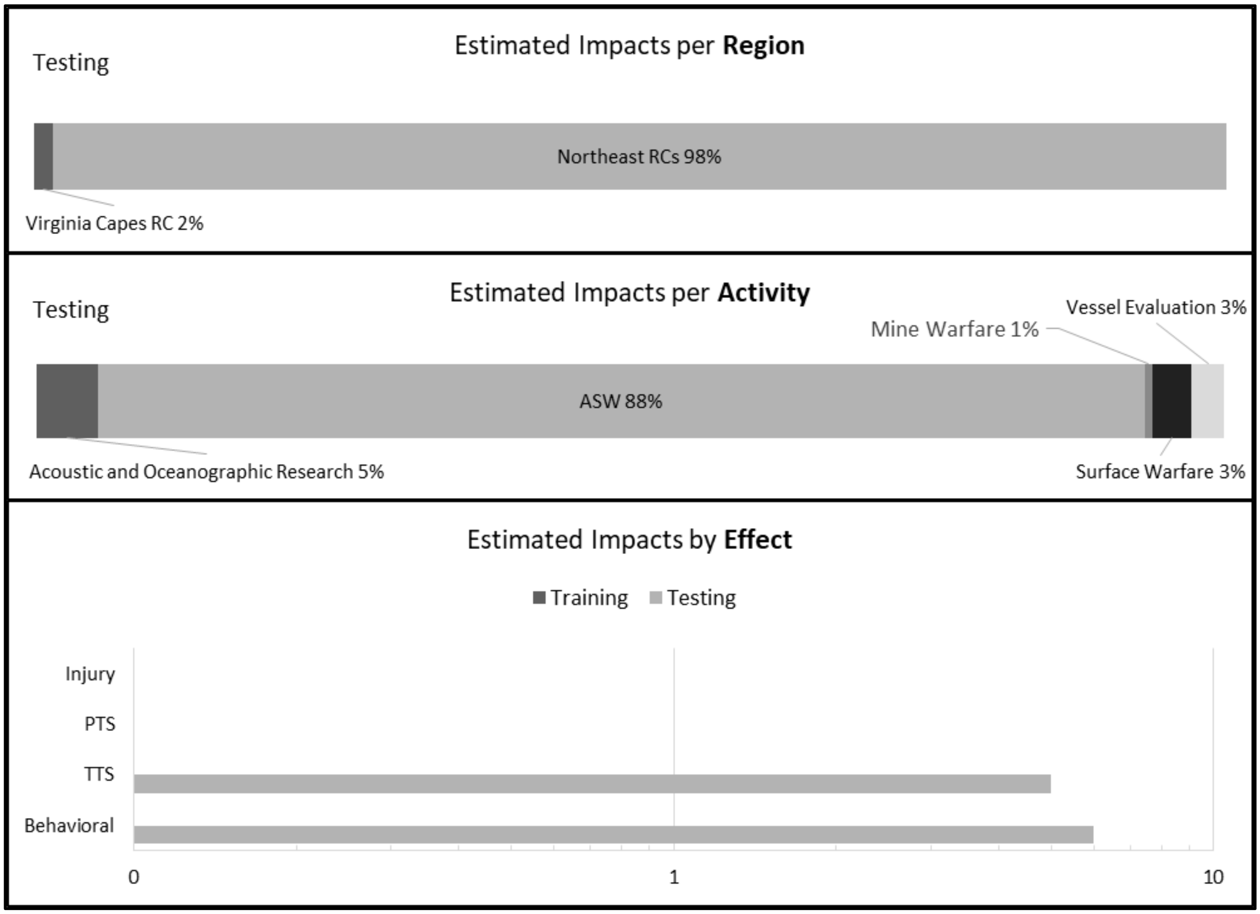
Pursuant to the MMPA, the use of explosives during training activities as described under Alternative 1 will not result in the unintentional taking of phocid seals incidental to those activities.

Impacts from Explosives Under Alternative 1 for Testing Activities

Phocid 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 and TTS for gray and hooded seals and behavioral reactions, TTS, and PTS for harbor and harp seals (see Figure 3.7-148 through Figure 3.7-151, and tabular results in Appendix E, Estimated Marine Mammals 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. No impacts are estimated for ringed or bearded seals. No impacts are estimated from Ship Shock Trials. Impact ranges for these species are discussed in Section 3.7.3.2.2.2 (Impact Ranges from Explosives). Estimated impacts apply to the western North Atlantic stocks of gray, harbor, harp, and hooded seals.

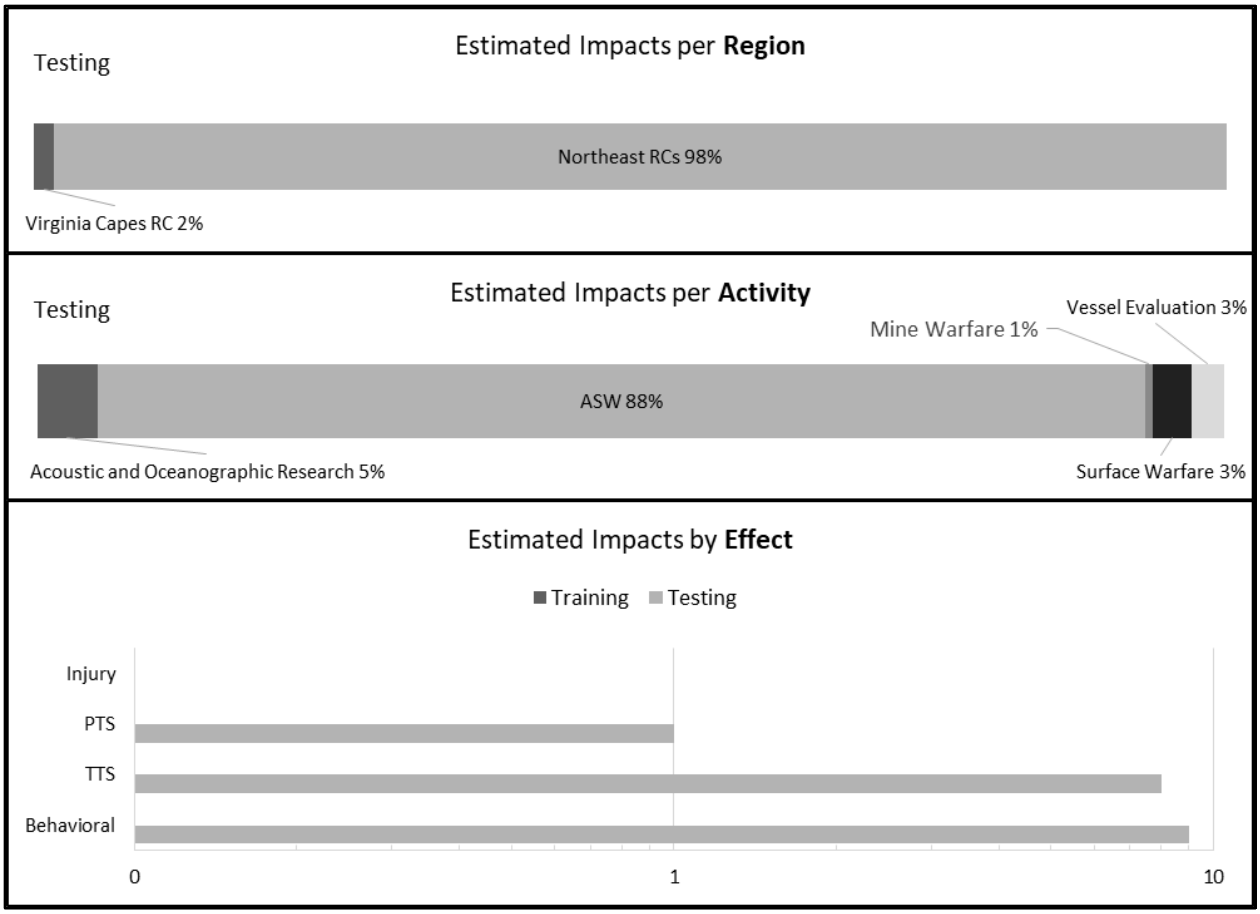
As described above, even a few minor to moderate TTS or behavioral reactions to an individual over the course of a year are unlikely to have any significant costs or long-term consequences for that individual. PTS in an individual could have no to minor long-term consequences for individuals although 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 will 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, harbor, harp and hooded seals incidental to those activities. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard.



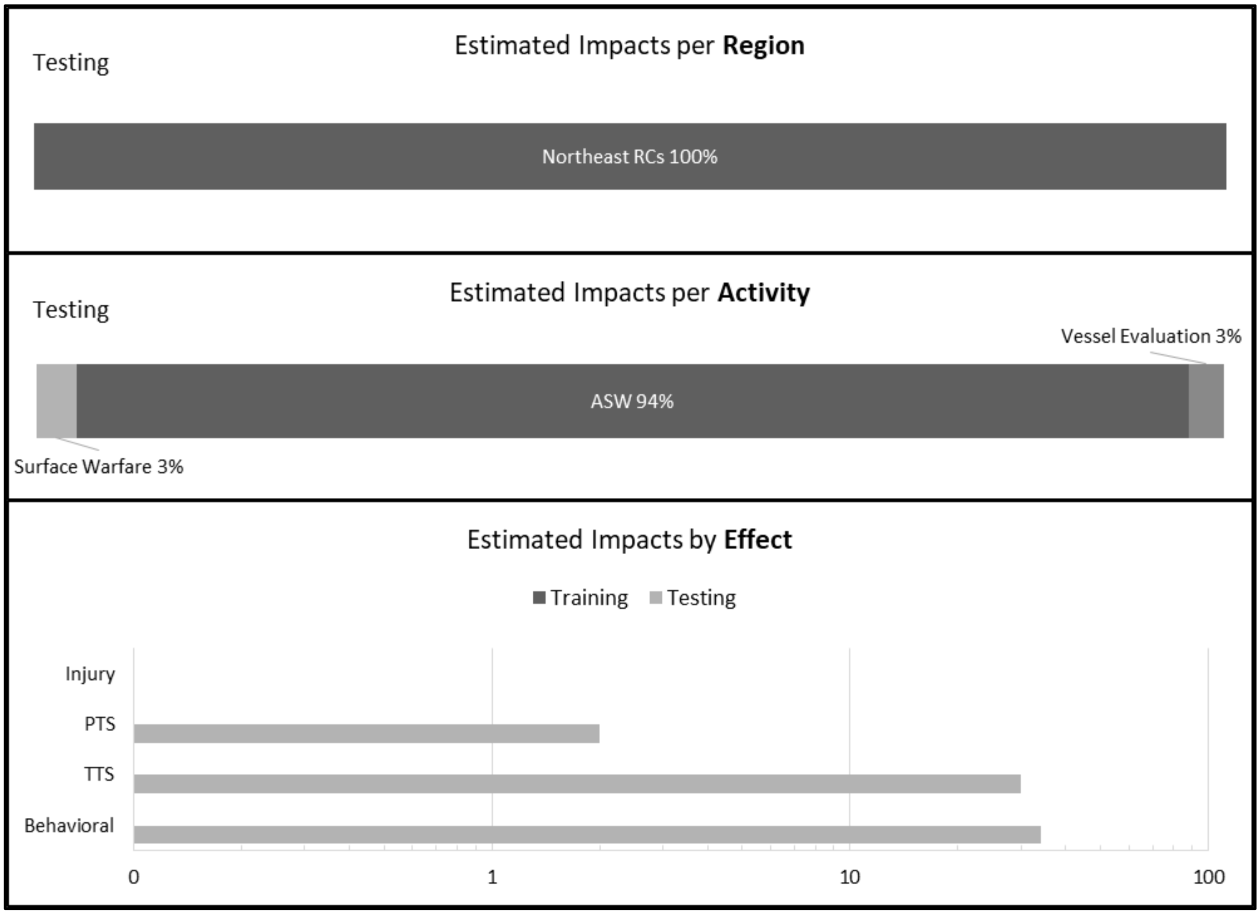
Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No impacts are estimated during training activities. No PTS or injury (non-auditory) are estimated for this species. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-148: Gray Seal Impacts Estimated per Year from the Maximum Number of Explosions During Testing (Excluding Full Ship Shock Trials) Under Alternative 1



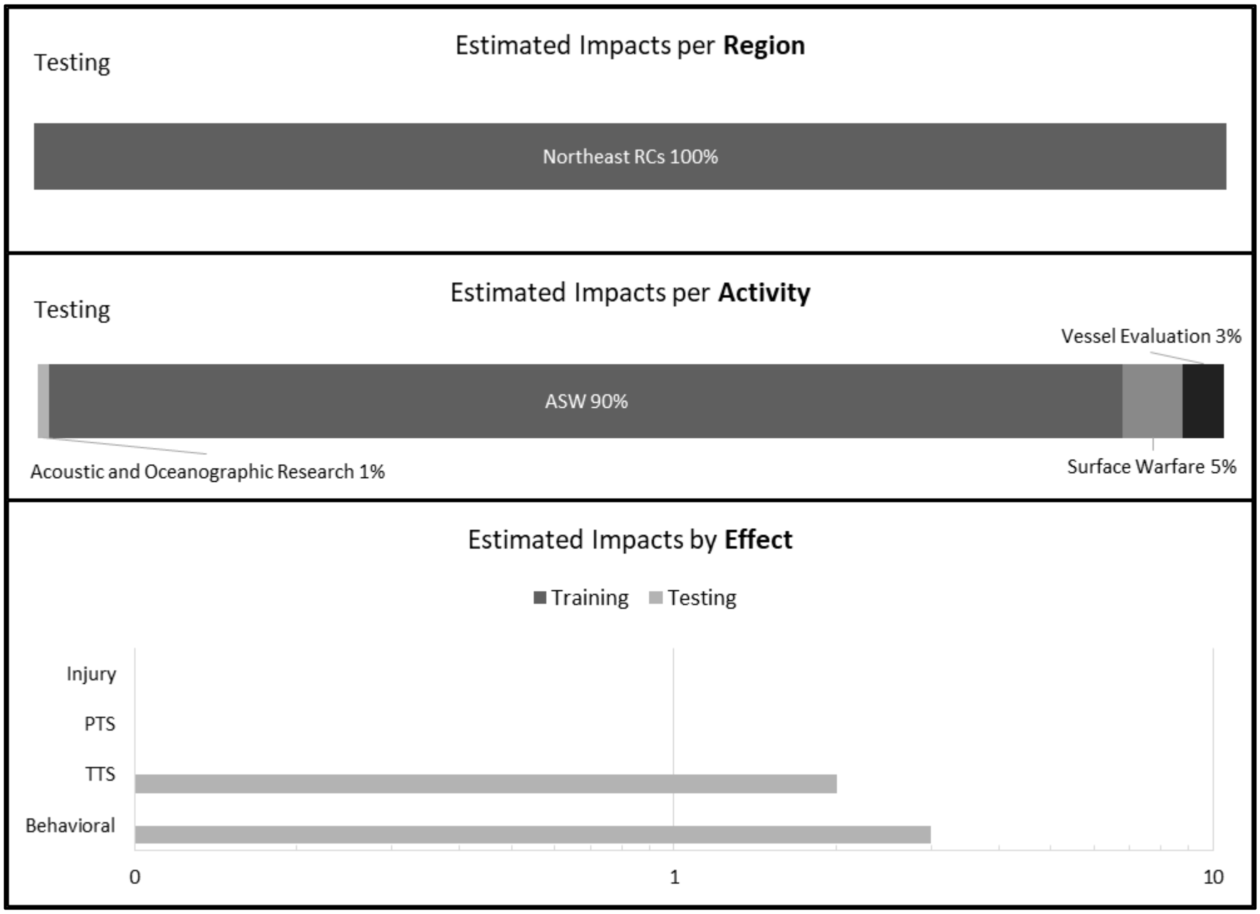
Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No impacts are estimated during training activities. No injury (non-auditory) is estimated for this species. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-149: Harbor Seal Impacts Estimated per Year from the Maximum Number of Explosions During Testing (Excluding Full Ship Shock Trials) Under Alternative 1



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No impacts are estimated during training activities. No injury (non-auditory) is estimated for this species. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-150: Harp Seal Impacts Estimated per Year from the Maximum Number of Explosions During Testing (Excluding Full Ship Shock Trials) Under Alternative 1



Region and activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No impacts are estimated during training activities. No PTS or injury (non-auditory) are estimated for this species. 100 percent western North Atlantic stock. ASW: Anti-Submarine Warfare; PTS: permanent threshold shift; RC: Range Complex; TTS: temporary threshold shift

Figure 3.7-151: Hooded Seal Impacts Estimated per Year from the Maximum Number of Explosions During Testing (Excluding Full Ship Shock Trials) Under Alternative 1

Impacts from Explosives Under Alternative 2 for Training Activities

Phocid seals may be exposed to sound or energy from explosions associated with training activities under Alternative 2 throughout the year, although the quantitative analysis estimates that no phocid seals would be impacted. Long-term consequences for individuals, 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 not result in the unintentional taking of phocid seals incidental to those activities.

Impacts from Explosives Under Alternative 2 for Testing Activities

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. The primary distinction is that explosive use under Alternative 2 for testing does increase slightly in some locations per year as compared to Alternative 1. Also, annual numbers of activities using explosives would be consistent year-to-year under Alternative 2 as compared to Alternative 1, which fluctuates annually. Therefore, over a multi-year period, the number of impacts for these species from testing under Alternative 2 may be greater than under Alternative 1 (see Appendix E, Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and 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 gray, harbor, harp, and hooded seals incidental to those activities.

Manatees (Endangered Species Act-Listed)

The manatee is primarily an inshore species, with most sightings occurring in warm fresh water, estuaries, and occasionally extremely nearshore coastal waters. Training activities that include explosions do not typically occur within or near West Indian manatee habitat, and therefore, impacts on manatees are unlikely. The only training activities involving explosions that would occur in West Indian manatee habitat involve the underwater detonation of small (2-lb.) charges in enclosed areas in the Key West Range Complex. Impacts, if any, to West Indian manatees would be minimal due to the low probability of occurrence, nature of the confined and restricted detonation locations, and implementation of mitigation. This detonation is enclosed by steel on four sides and concrete on the bottom; therefore, almost all acoustic energy will be vented to the air. The quantitative analysis estimates that no manatees would be impacted. Long-term consequences for individuals, the species, or stock would not be expected.

Manatees within the Port Canaveral and Mayport portions of the designated West Indian manatee critical habitat areas are unlikely to be exposed to sound or energy from explosives. The primary constituent elements of the habitat required by the West Indian manatee for feeding and breeding have been reported as the presence of seagrasses and warm water refuges, which would not be affected by these proposed activities.

Pursuant to the MMPA, the use of explosives during training or testing activities as described under Alternative 1 or 2 will not result in the unintentional taking of manatees incidental to those activities.

Pursuant to the ESA, the use of explosives during training or testing activities as described under Alternative 1 or 2 may affect ESA-listed manatees and would not affect designated critical habitat. The Navy has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.

3.7.3.2.2.4 Impacts from Explosives Under the No Action Alternative

Under the No Action Alternative, training or testing activities associated with the Proposed Action would not be conducted in the AFTT Study Area. Based on the analysis presented in Section 3.7.3.2.2.3 (Impacts from Explosives Under the Action Alternatives), impacts on individual marine mammals from explosive activities could occur under either alternative, but impacts on marine mammal populations are not anticipated. Therefore, discontinuing explosive activities under the No Action Alternative would remove the potential for impacts on individual marine mammals, but would not measurably improve the status of marine mammal populations or otherwise contribute to the recovery of threatened or endangered species that occur in the Study Area.

3.7.3.3 Energy Stressors

This section analyzes the potential impacts of energy stressors used during training and testing activities within the Study Area. This section includes analysis of the potential impacts of: (1) in-water electromagnetic devices and (2) high-energy lasers. General discussion of impacts can also be found in Section 3.0.3.6.2 (Conceptual Framework for Assessing Effects from Energy-Producing Activities).

3.7.3.3.1 Impacts from In-Water Electromagnetic Devices

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

Neither regulations nor scientific literature provide threshold criteria to determine the significance of the potential effects from actions that result in generation of an electromagnetic field. Data regarding the influence of electromagnetic fields on cetaceans are inconclusive and are based primarily on the assumptions that marine mammals can sense variations in the earth's magnetic field and that they use those magnetic field variations for navigation. There has been renewed interest in this topic of inquiry given the potential for electromagnetic fields generated by undersea power cables to possibly affect geo-navigation in migrating marine mammals (Gill et al., 2014; Kremers et al., 2014; Kremers et al., 2016a; 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.

Most of the early research investigated the possible correlations of where live-stranding locations occurred to determine if there was an associated local variation in the earth's magnetic field (Kirschvink, 1990; Klinowska, 1985; Walker et al., 1992). Species included long-finned and short-finned pilot whales, striped dolphin, Atlantic spotted dolphin, Atlantic white-sided dolphin, fin whale, common dolphin, harbor porpoise, sperm whale, and pygmy sperm whale, which had livestranding locations that correlated with areas where the earth's magnetic field was locally weaker than surrounding areas (Kirschvink, 1990). These statistical associations for locally weaker areas represented a total intensity variation of less than 0.05 microtesla in the magnetic field (Kirschvink et al., 1986). While this correlation had seemed to have also been demonstrated for bottlenose dolphins in the Atlantic (Kirschvink et al., 1986), there was no correlation found in the Pacific (Kirschvink, 1990). Subsequent research regarding fin whale sightings over the continental shelf off the northeastern United States was consistent with the findings involving stranded fin whales (Kirschvink, 1990), supporting the hypothesis that fin whales possess a magnetic sense and that they use it to migrate (Walker et al., 1992). Bureau of Ocean Energy Management (2011) reviewed available information on electromagnetic and magnetic field sensitivity of marine organisms (including marine mammals) for impact assessment of offshore wind farms for the U.S. Department of the Interior and concluded there is no evidence to suggest any magnetic sensitivity for sea lions, fur seals, or sea otters (Bureau of Ocean Energy Management, 2011). However, the researchers concluded there was behavioral, anatomical, and theoretical evidence indicating that cetaceans sense magnetic fields.

Anatomical evidence suggests the presence of magnetic material in the brain (Pacific common dolphin, Dall's porpoise, bottlenose dolphin, Cuvier's beaked whale, and the humpback whale) and in the tongue and lower jawbones (harbor porpoise) (Bauer et al., 1985; Kirschvink, 1990). Zoeger et al. (1981) found what appeared to be nerve fibers associated with the magnetic material in a Pacific common dolphin and proposed that it may be used as a magnetic field receptor. Electrosensitivity was found in the Guiana dolphin (Czech-Damal et al., 2011). Kuzhetsov (1999) conducted experiments exposing bottlenose dolphins to permanent magnetic field intensities of 32, 108, and 168 microteslas and showed both behavioral and physiological reactions during 79 percent, 63 percent, and 53 percent of the trials, respectively (as summarized in Bureau of Ocean Energy Management (2011)). Behavioral reactions included sharp exhalations, acoustic activity, and movement, and physiological reactions included a change in heart rate. Kremers et al. (2014) conducted another experiment to observe the spontaneous reactions of captive bottlenose dolphins from a magnetized device compared to a demagnetized device. Results from this experiment confirmed that dolphins are capable of perceiving magnetic fields from a distance of more than 1.5 m from the 1.2 tesla magnetic strength device; creating a magnetic field with a strength of approximately 0.051 to 0.240 tesla between 2 to 5 cm from the source (Kremers et al., 2014). The dolphins approached the magnetized device with shorter latency compared to the demagnetized device that was identical in form and density and otherwise undistinguishable through echolocation (Kremers et al., 2014). The findings also suggest that dolphins may be able to discriminate between two items based on their magnetic properties (Kremers et al., 2016b). It is still unclear whether magnetic fields are attractive or repulsive to dolphins (Kremers et al., 2014; Kremers et al., 2016b) and further studies on the magnetic perception threshold on dolphin behavior need to be conducted (Kremers et al., 2016b).

Based on the limited available literature, no evidence suggests any magnetic sensitivity for polar bears, fur seals, walrus, earless seals, and manatees (Bureau of Ocean Energy Management, 2011).

Potential impacts on marine mammals associated with electromagnetic fields are most likely dependent on the animal's proximity to the source and the strength of the magnetic field. Because the in-water device creating the electromagnetic field is towed or is on an unmanned vehicle, it may not be possible to distinguish whether an avoidance reaction of an animal is the result of physical disturbance from the towed object or unmanned vehicle (Section 3.7.3.4.1, Impacts from Vessels and In-Water Devices) or from the presence of the electromagnetic field. As discussed in Section 3.0.3.3.3.1 (In-Water Electromagnetic Devices), electromagnetic fields associated with naval training and testing activities are relatively weak (only 10 percent of the earth's magnetic field at 24 m), temporary, and localized. Once the source is turned off or moves from the location, the electromagnetic field is gone. A marine mammal would have to be within the electromagnetic field (approximately 200 m from the source) during the activity to detect it.

3.7.3.3.1.1 Impacts from In-Water Electromagnetic Devices Under Alternative 1

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

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

Marine mammal species that do not occur in areas where Navy training activities that use in-water electromagnetic devices would be conducted include the bowhead whale, narwhal, beluga whale, white-beaked dolphin, common dolphin, ringed seal, bearded seal, walrus, and polar bear. These species are not further analyzed in this section because they would not be exposed to this energy stressor.

Although it is not fully understood, based on the available evidence described above, it is probable that marine mammals use the earth's magnetic field for orientation or migration (Walker et al., 1992). If a marine mammal was in proximity of an in-water electromagnetic field source associated with Navy training, emitting a field strong enough to be detected, and that animal is sensitive to the exposure, it is conceivable that this electromagnetic field could have an effect on a marine mammal, primarily impacting that animal's navigation.

Available literature on marine mammals involves investigating their ability to sense an electromagnetic field due to the potential it then may have on navigation and migration behaviors. Direct impacts on feeding or reproductive behaviors have not been documented, and impacts on marine mammals feeding and engaging in reproductive behaviors are not anticipated. If marine mammals are in fact sensitive to small variations in electromagnetic fields, any impacts from Navy training would be temporary and minor, and natural behavioral patterns would not be significantly altered or abandoned based on the Navy's in-water electromagnetic device having: (1) generated a relatively low-intensity magnetic field (essentially mimicking the magnetic field of a steel vessel); (2) a very localized magnetic field proximate to the moving in-water electromagnetic device; (3) been maneuvered by the Navy to maintain a specified distance away from marine mammals, as stated with regard to vessels and towed in-water devices in Chapter 5 (Mitigation), which consequently would provide some avoidance of in-water electromagnetic devices that are towed from manned platforms; and (4) a short duration (hours) of use for training.

The use of in-water electromagnetic devices associated with Navy training would not occur within North Atlantic right whale northeast critical habitat area but would be conducted within the southeast critical habitat area. Since North Atlantic right whales primarily occur within the southeast critical habitat in the winter, any potential overlap of occurrence with Navy training activities in this area would be seasonal. Physical and biological features identified for North Atlantic right whale conservation and considered in the critical habitat designation include water temperatures, depths, and sea surface conditions that are suitable for the southern calving habitats (National Marine Fisheries Service, 2015a). These habitat features would not be impacted by in-water electromagnetic devices.

Training activities involving in-water electromagnetic devices conducted within inshore waters surrounding Savannah, Georgia; Kings Bay, Georgia; Mayport, Florida; Port Canaveral, Florida; and

Tampa, Florida, would occur within West Indian manatee critical habitat. Any potential overlap of Navy training activities with these areas would be minimal based on the limited overlap between West Indian manatee critical habitat and all other inshore waters in the Study Area. Moreover, impacts from electromagnetic fields to manatees have not been documented in the available literature. The current critical habitat designation for the West Indian manatee does not identify specific physical and biological features essential for species conservation; however, essential habitat features have been reported to include warm water refuges, various food sources (seagrasses and freshwater vegetation), travel corridors, and shelter for calving (75 *Federal Register* 1574–1581, January 12, 2010). These habitat features would not be impacted by in-water electromagnetic devices.

The use of in-water electromagnetic devices during training activities as described under Alternative 1 will not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of in-water electromagnetic devices during training activities as described under Alternative 1 will have no effect on North Atlantic right whale and West Indian manatee critical habitats. The use of in-water electromagnetic devices would have no effect on bowhead whale or ringed seal and may affect blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA. The Navy has consulted with NMFS and the USFWS as required by section 7(a)(2) of the ESA in that regard.

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

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

Marine mammal species that do not occur in areas where Navy testing activities that use in-water electromagnetic devices would be conducted include the bowhead whale, narwhal, beluga whale, white-beaked dolphin, common dolphin, ringed seal, bearded seal, walrus, and polar bear. These species are not further analyzed in this section because they would not be exposed to this energy stressor.

Although it is not fully understood, based on the available evidence described above, it is probable that marine mammals use the earth's magnetic field for orientation or migration (Walker et al., 1992). If a marine mammal was in proximity of an in-water electromagnetic field source associated with Navy testing, emitting a field strong enough to be detected, and that animal is sensitive to the exposure, it is conceivable that this electromagnetic field could have an effect on a marine mammal, primarily impacting that animal's navigation. Available literature on marine mammals involves investigating their ability to sense an electromagnetic field due to the potential it then may have on navigation and migration behaviors. Direct impacts on feeding or reproductive behaviors have not been documented and impacts on marine mammals feeding and engaging in reproductive behaviors are not anticipated. If marine mammals are in fact sensitive to small variations in electromagnetic fields, any impacts from Navy testing would be temporary and minor, and natural behavioral patterns would not be significantly altered or abandoned based on the Navy's in-water electromagnetic device having: (1) generated a relatively low-intensity magnetic field (essentially mimicking the magnetic field of a steel vessel); (2) a very localized magnetic field proximate to the moving in-water electromagnetic device; (3) been maneuvered by the Navy to maintain a specified distance away from marine mammals, as stated with regard to vessels and towed in-water devices in Chapter 5 (Mitigation), which consequently would provide some avoidance of in-water electromagnetic devices that are towed from manned platforms; and (4) a short duration (hours) of use for testing.

In-water electromagnetic device use associated with Navy testing would not occur within North Atlantic right whale northeast critical habitat area but would occur within the southeast critical habitat area. Since North Atlantic right whales primary occur within the southeast critical habitat in the winter, any potential overlap of occurrence with Navy testing activities in these areas would be seasonal. Physical and biological features identified for North Atlantic right whale conservation and considered in the critical habitat designation include water temperatures, depths, and sea surface conditions that are suitable for the southern calving habitats (National Marine Fisheries Service, 2015a). These habitat features would not be impacted by in-water electromagnetic devices.

Testing activities that use in-water electromagnetic devices would not be conducted within West Indian manatee critical habitat.

The use of in-water electromagnetic devices during testing activities as described under Alternative 1 will not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of in-water electromagnetic devices during testing activities as described under Alternative 1 will have no effect on North Atlantic right whale and West Indian manatee critical habitats. The use of in-water electromagnetic devices would have no effect on bowhead whale or ringed seal and may affect blue whale, Gulf of Mexico subspecies of Bryde’s whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA. The Navy has consulted with NMFS and the USFWS as required by section 7(a)(2) of the ESA in that regard.

3.7.3.3.1.2 Impacts from In-Water Electromagnetic Devices Under Alternative 2

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

As discussed in Section 3.0.3.3.3.1 (In-Water Electromagnetic Devices), training activities that use in-water electromagnetic devices would be identical under Alternatives 1 and 2. Refer to Section 3.7.3.3.1.1 (Impacts from In-Water Electromagnetic Devices Under Alternative 1), training activities, for a discussion of potential impacts to marine mammals.

The use of in-water electromagnetic devices during training activities as described under Alternative 2 will not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of in-water electromagnetic devices during training activities as described under Alternative 2 will have no effect on North Atlantic right whale and West Indian manatee critical habitats. The use of in-water electromagnetic devices would have no effect on bowhead whale or ringed seal and may affect blue whale, Gulf of Mexico subspecies of Bryde’s whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA.

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

As discussed in Section 3.0.3.3.3.1 (In-Water Electromagnetic Devices) the locations, numbers of testing activities, and potential effects associated with in-water electromagnetic device use would be the same under Alternatives 1 and 2. Refer to Section 3.7.3.3.1.1 (Impacts from In-Water Electromagnetic Devices Under Alternative 1) for a discussion of impacts on marine mammals.

The use of in-water electromagnetic devices during testing activities as described under Alternative 2 will not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of in-water electromagnetic devices during testing activities as described under Alternative 2 will have no effect on North Atlantic right whale and West Indian manatee critical habitats. The use of in-water electromagnetic devices would have no effect on bowhead whale or ringed seal and may affect blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA.

3.7.3.3.1.3 Impacts from In-Water Electromagnetic Devices Under the No Action Alternative

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

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

3.7.3.3.2 Impacts from In-Air Electromagnetic Devices

The use of in-air electromagnetic devices associated with Navy training and testing activities is not applicable to cetaceans and sirenians because in-air electromagnetic energy does not penetrate the ocean. For pinnipeds and polar bears that occur on land, in-air electromagnetic sources used during training or testing will never be in close enough proximity to those land based haul-outs or areas where polar bears occur to have an effect on those animals. As a result, in-air electromagnetic devices will not be analyzed further in this section.

3.7.3.3.3 Impacts from High-Energy Lasers

As discussed in Section 3.0.3.3.3.3 (Lasers), high-energy laser weapons activities involve evaluating the effectiveness high-energy laser deployed from a surface ship or a 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 was evaluated using statistical probability modeling (Appendix F, Military Expended Materials and Direct Strike Impact Analysis) 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 training or testing area, marine mammal density data, and animal footprint. 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 training and testing events was summed over 1 year in the training or testing area for each alternative. Finally, the marine mammal species with the highest average seasonal density within the training or testing 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 the laser.

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.

3.7.3.3.3.1 Impacts from High-Energy Lasers Under Alternative 1

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

As discussed in Section 3.0.3.3.3.3 (Lasers), high-energy laser use associated with training activities would occur within the Virginia Capes and Jacksonville Range Complexes. Navy training activities have the potential to expose marine mammals that occur within these areas to this energy stressor. Marine mammal species that do not occur in areas where Navy training activities that use high-energy lasers would be conducted include the bowhead whale, Bryde’s whale (Gulf of Mexico subspecies), narwhal, beluga whale, ringed seal, bearded seal, walrus, and polar bear. These species are not further analyzed in this section because they would not be exposed to this energy stressor.

The marine mammal species with the highest average seasonal density (short beaked common dolphin) in the location with the greatest number of training activities involving high-energy lasers under Alternative 1 (Virginia Capes Range Complex) was used in the probability analysis presented in Appendix F (Military Expended Materials and Direct Strike Impact Analysis).

Based on the statistical probability analysis described in Appendix F (Military Expended Materials and Direct Strike Impact Analysis) results indicate that no short beaked common dolphins would be struck by a high-energy laser annually. 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.

Navy training activities that use high-energy lasers would not occur within the northeast portion of North Atlantic right whale designated critical habitat but would occur in the southeast critical habitat area. Since North Atlantic right whales occur within the southeast critical habitat area primarily in winter months, any potential overlap with Navy training activities in these areas would be seasonal. Given the high level of certainty that no marine mammals would be struck by a high-energy laser, the Navy does not anticipate it would strike a North Atlantic right whale with a high-energy laser during training activities. Physical and biological features identified for North Atlantic right whale conservation and considered in the critical habitat designation include water temperatures, depths, and sea surface conditions that are suitable for the southern calving habitats (National Marine Fisheries Service, 2015a). These habitat features would not be impacted by high-energy lasers.

Training activities that use high-energy lasers would not occur within West Indian manatee critical habitat.

The use of high-energy lasers during training activities as described under Alternative 1 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of high-energy lasers during training activities as described under Alternative 1 would have no effect on North Atlantic right whale and West Indian manatee critical habitats. The use of high-energy lasers would have no effect on the Gulf of Mexico subspecies of Bryde's whale, bowhead whale, or ringed seal and may affect blue whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee. The Navy has consulted with NMFS and the USFWS as required by section 7(a)(2) of the ESA in that regard.

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

As discussed in Section 3.0.3.3.3.3 (Lasers), under Alternative 1, high-energy laser tests would primarily occur within the Virginia Capes Range Complex, but would also occur in the Northeast, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes. High-energy laser testing activities would also be conducted within the Naval Undersea Warfare Center, Newport Testing Range, South Florida Ocean Measurement Facility, and the Naval Surface Warfare Center Panama City Testing Range. Navy testing activities have the potential to expose marine mammals that occur within these locations to this energy stressor. Marine mammal species that do not occur in areas where Navy testing activities that use high-energy laser would be conducted include the bowhead whale, narwhal, beluga whale, ringed seal, bearded seal, walrus, and polar bear. These species are not further analyzed in this section because they would not be exposed to this energy stressor.

The marine mammal species with the highest average seasonal density (short beaked common dolphin) in the location with the greatest number of testing activities involving high-energy lasers under Alternative 1 (Virginia Capes Range Complex) were used in the probability analysis presented in Appendix F (Military Expended Materials and Direct Strike Impact Analysis).

Based on the statistical probability analysis described in Appendix F (Military Expended Materials and Direct Strike Impact Analysis), results indicate that no short beaked common dolphins would be struck by a high-energy laser annually. Considering the assumptions in the analysis 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.

Navy testing activities that use high-energy lasers would occur within the North Atlantic right whale's designated critical habitat year-round. Since North Atlantic right whales occur within the southeast critical habitat area primarily in winter months and occur within the northeast critical habitat area during summer months, any potential overlap with Navy testing activities in these areas would be seasonal. Given the high level of certainty that no marine mammals would be struck by a high-energy laser, the Navy does not anticipate it would strike a North Atlantic right whale with a high-energy laser during testing activities. Physical and biological features identified for North Atlantic right whale conservation and considered in the critical habitat designation include oceanic conditions that distribute and aggregate dense concentrations of copepods within the northern foraging habitats and water temperatures, depths, and sea surface conditions that are suitable for the southern calving habitats (National Marine Fisheries Service, 2015a). These habitat features would not be impacted by high-energy lasers.

Testing activities that use high-energy lasers would not be conducted within West Indian manatee critical habitat.

The use of high-energy lasers during testing activities as described under Alternative 1 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of high-energy lasers during testing activities as described under Alternative 1 would have no effect on North Atlantic right whale and West Indian manatee critical habitats. The use of high-energy lasers would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA. The Navy has consulted with NMFS and the USFWS as required by section 7(a)(2) of the ESA in that regard.

3.7.3.3.3.2 Impacts from High-Energy Lasers Under Alternative 2

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

As discussed in Section 3.0.3.3.3.3 (Lasers) the locations, numbers of activities, and potential effects associated with high-energy lasers use would be the same under Alternatives 1 and 2. Refer to Section 3.7.3.3.3.1 (Impacts from High-Energy Lasers Under Alternative 1) for a discussion of impacts on marine mammals.

The use of high-energy lasers during training activities as described under Alternative 2 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of high-energy lasers during training activities as described under Alternative 2 would have no effect on North Atlantic right whale and West Indian manatee critical habitats. The use of high-energy lasers would have no effect on the Gulf of Mexico subspecies of Bryde's whale, bowhead whale or ringed seal and may affect and may affect the blue whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA.

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

As discussed in Section 3.0.3.3.3.3 (Lasers) the locations, numbers of activities, and potential effects associated with high-energy lasers use would be the same under Alternatives 1 and 2. Refer to Section 3.7.3.3.3.1 (Impacts from High-Energy Lasers Under Alternative 1) for a discussion of impacts on marine mammals.

The use of high-energy lasers during testing activities as described under Alternative 2 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of high-energy lasers during testing activities as described under Alternative 2 would have no effect on North Atlantic right whale and West Indian manatee critical habitats. The use of high-energy lasers would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA.

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

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

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

3.7.3.4 Physical Disturbance and Strike Stressors

This section analyzes the potential impacts of the various types of physical disturbance, including the potential for strike during training and testing activities within the Study Area from: (1) Navy vessels; (2) in-water devices; (3) military expended materials, including non-explosive practice munitions and fragments from high-explosive munitions; (4) seafloor devices; and (5) pile driving.

The way a physical disturbance may affect a marine mammal would depend in part on the relative size of the object, the speed of the object, the location of the mammal in the water column, and reactions of marine mammals to anthropogenic activity, which may include avoidance or attraction. It is not known at what point or through what combination of stimuli (visual, acoustic, or through detection in pressure changes) an animal becomes aware of a vessel or other potential physical disturbances before reacting or being struck. Refer to Sections 3.7.3.1.1.3 (Physiological Stress) and 3.7.3.1.1.5 (Behavioral Reactions) for the discussion of the potential for disturbance from acoustic stimuli. Given that the presentation of a physical disturbance should be very rare and brief, the cost from the response is likely to be within the normal variation experienced by an animal in its daily routine unless the animal is struck. If a strike does occur, the cost to the individual could range from slight injury to death.

3.7.3.4.1 Impacts from Vessels and In-Water Devices

Vessels

Surface vessels can be a source of acute and chronic disturbance for cetaceans (Au & Green, 2000; Bejder et al., 2006a; Hewitt, 1985; Lusseau et al., 2009; Magalhães et al., 2002; Nowacek et al., 2007; Nowacek et al., 2004b; Richter et al., 2003; Richter et al., 2006; Watkins, 1986; Würsig & Richardson, 2008). Studies have established that cetaceans engage in avoidance behavior when surface vessels move toward them. Various research findings report that mysticetes have variable responses to vessels dependent on the context (Nowacek et al., 2004a; Richardson et al., 1995b; Watkins, 1986). Mysticetes are not the only cetaceans that have demonstrated responses to vessels. One study showed that harbor porpoises in a net-pen displayed behavioral responses (increasing swim speed or repeated alternating surfacing and diving behaviors [i.e., porpoising]) to the high-frequency components of vessel noise at long ranges (more than 1,000 m) in shallow waters (Dyndo et al., 2015). These distances correspond to where radiated noise would be more likely to elicit the response, rather than physical presence of the vessel (Dyndo et al., 2015; Palka & Hammond, 2001). Conversely, another study demonstrated that boat physical presence, and not just noise, was associated with a short-term reduction in foraging activity in bottlenose dolphins (Pirotta et al., 2015b). It is noteworthy that the dolphins associated with this report were exposed primarily to commercial and leisure boat traffic, not related to military vessel activities. Even repeated exposures from increasing vessel traffic in the same area resulting in increased responses to the disturbance may not be biologically significant. Mathematic modeling has predicted that bottlenose dolphin population dynamics would remain unchanged from a sixfold increase in vessel traffic (70 to 470 vessels per year) as dolphins are able to compensate for increased disturbance levels with little to no impacts on health and vital rates (New et al., 2013a). Aside from the potential for an increased risk of collision addressed below, physical disturbance from vessel use is not expected to result in more than a short-term behavioral response.

Hauled-out pinnipeds are also disturbed when approached at close distance, although the research indicates this is somewhat context-dependent (Andersen et al., 2012; Curtin et al., 2009; Hoover-Miller et al., 2013; Jansen et al., 2010; Johnson & Acevedo-Gutiérrez, 2007; Suryan & Harvey, 1998; Weiss & Morrill, 2014; Young et al., 2014). For example, one study showed that harbor seals were disturbed by tourism-related vessels, small boats, and kayaks that stopped or lingered by haulout sites, but that the seals "do not pay attention to" passing vessels at closer distances (Johnson & Acevedo-Gutiérrez, 2007). Pinnipeds in the water generally appear less responsive (Richardson et al., 1995b) than those at haulout sites. Walrus and polar bears have also appeared to be attracted to vessels at times (Harwood et al., 2005) and manatees have displayed vulnerabilities to vessel impacts (e.g., (Nowacek et al., 2004b)).

In some circumstances, marine mammals respond to vessels with the same behavioral repertoire and tactics they employ when they encounter predators. It is not clear what environmental cue or cues marine animals might respond to; they may include the sounds of water being displaced by the ships, the sounds of the ships' engines, or a combination of environmental cues surface vessels produce while they transit. For example, in one study, North Atlantic right whales showed little overall reaction to the playback of sounds of approaching vessels, but they did respond to a novel sound by swimming strongly to the surface, which may increase their risk of collision (Nowacek et al., 2004a). While the analysis of potential impacts from the physical presence of the vessel is presented here, the analysis of potential impacts in response to sounds produced by vessel movement or transit is addressed in Section 3.7.3.1.5 (Impacts from Vessel Noise).

Vessel speed, size, and mass are all important factors in determining potential impacts of a vessel strike to marine mammals (Conn & Silber, 2013; Gende et al., 2011; Silber et al., 2010; Vanderlaan & Taggart, 2007; Wiley et al., 2016). For large vessels, speed and angle of approach can influence the severity of a strike. Based on modeling conducted by Silber et al. (2010), researchers found that whales at the surface experienced impacts that increased in magnitude with the ship's increasing speed.

Vessel strikes from commercial, recreational, and Navy vessels are known to have resulted in serious injury and occasional fatalities to cetaceans (Abramson et al., 2011; Berman-Kowalewski et al., 2010; Calambokidis, 2012; Douglas et al., 2008; Laggner, 2009; Lammers et al., 2003; Van der Hoop et al., 2012; Van der Hoop et al., 2013). Reviews of the literature on ship strikes mainly involve collisions between commercial vessels and whales (Jensen & Silber, 2004; Laist et al., 2001).

In the AFTT Study Area, commercial traffic is heaviest in the nearshore waters, near major ports and in the shipping lanes along the entire U.S. East Coast and along the northern coast of the Gulf of Mexico while Navy vessel traffic is primarily concentrated between the mouth of the Chesapeake Bay, Virginia and Jacksonville, Florida (Mintz, 2012). An examination of vessel traffic within the AFTT Study Area determined that Navy vessel occurrence is two orders of magnitude lower than that of commercial traffic. The study also revealed that while commercial traffic is relatively steady throughout the year, Navy vessel usage within the range complexes is episodic, based on specific exercises being conducted at different times of the year (Mintz, 2012); however, Navy vessel use within inshore waters occurs regularly and routinely consists of high speed small craft movements.

Large Navy vessels (greater than 18 m in length) within the offshore areas of the AFTT 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 full 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 is generally a reduction of 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 to 50 knots or more, depending on the mission). While these speeds are considered averages and representative of most events, some vessels need to operate outside of these parameters during certain situations.

The ability 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. Differences between most large Navy ships and commercial ships also include the following:

- The Navy has several standard operating procedures for vessel safety that will benefit marine mammals through a reduction in the potential for vessel strike, as discussed in Section 2.3.3.2 (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 to certify that they have demonstrated all necessary skills. While on watch, personnel employ visual search and reporting procedures in accordance with the U.S. Navy Lookout Training Handbook or civilian equivalent. Watch personnel are responsible for using correct scanning procedures while monitoring an assigned sector and report any indication of danger to the ship and personnel on board, such as a floating or partially submerged object or piece of debris, periscope, surfaced submarine, wisp of smoke, flash of light, or surface disturbance. As a standard collision avoidance procedure, watch personnel also monitor for marine mammals that have the potential to be in the direct path of the ship. Navy vessels are required to operate in accordance with applicable navigation rules, including Inland Navigation Rules (33 Code of Federal Regulations 83) and the International Regulations for Preventing Collisions at Sea, which were formalized in the Convention on the International Regulations for Preventing Collisions at Sea, 1972. Applicable navigation requirements include, but are not limited to, Rule 5 (Lookouts) and Rule 6 (Safe Speed). These rules require that vessels at all times proceed at a safe speed so that proper and effective action can be taken to avoid collision and so they can be stopped within a distance appropriate to the prevailing circumstances and conditions.
- 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 Navy's 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 the need to change direction is necessary.
- Navy ships operate at the slowest speed possible consistent with either transit needs or training or testing needs. While minimum speed is intended as a fuel conservation measure particular to a certain ship class, secondary benefits include a better ability to detect 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 1 day to 2 weeks as compared to straight line point-to-point commercial shipping.
- Navy overall crew size, including bridge crew, is much larger than merchant ships allowing for more potential watch personnel 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 or reduce 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, and implementing additional mitigation for manatees at Naval Station Mayport and Kings Bay, Georgia, and related to vessel movements within the Northeast North Atlantic Right Whale Mitigation Area and Southeast North Atlantic Right Whale Mitigation Area.

It is Navy policy to report all marine mammal strikes by Navy vessels. The information is collected by Office of the Chief of Naval Operations Environmental Readiness Division and provided to NMFS on an annual basis. Only the Navy and U.S. Coast Guard report in this manner. Therefore, it should be noted that Navy vessel strikes reported in the scientific literature and NMFS databases are the result of the Navy's commitment to reporting all vessel strikes to NMFS (even if it cannot be confirmed to be a marine mammal) rather than a greater frequency of collisions relative to other ship types. Most reported vessel strikes of marine mammals involve commercial vessels and occur over or near the continental shelf (Laist et al., 2001). Reporting of whale strikes by commercial vessels is not required, and, therefore, reporting rates are unknown but likely to be much lower than actual occurrences. The history of Navy vessel strikes reported in the AFTT Study Area from 2009 to 2017 is provided in Figure 3.7-152.

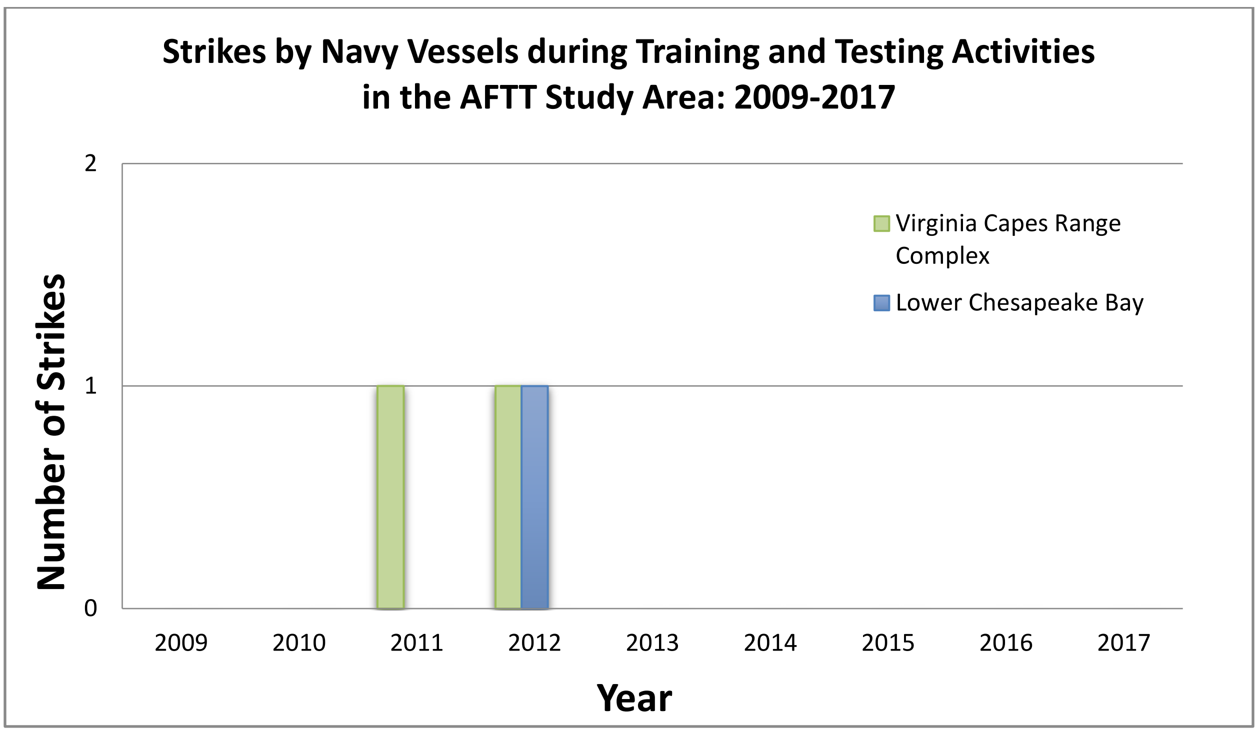


Figure 3.7-152: Navy Vessel Strikes Reported by Year (2009 to 2017)

To determine the potential for Navy vessel strikes, the Navy assessed the probability of large Navy vessels hitting individuals of different species of whales that occur in the AFTT Study Area incidental to training and testing activities. No strikes have been reported from small craft, so small craft usage was not included in the strike probability analysis. For large Navy vessels, a strike probability analysis was completed that considered actual data on vessel usage in the Study Area and past ship strike records. Data from the past 8 years (i.e., 2009 to 2016) are used to calculate the probability of a Navy vessel striking a whale during proposed training and testing activities in the Study Area. The year 2009 was selected because it is the beginning of programmatic permitting within the Atlantic and Pacific oceans; acknowledges advances in Navy marine species awareness training and overall enhanced sensitivity to marine resource issues in general; and is the first year of the codification of multiple marine species mitigation measures, including specific measures to avoid large whales by 500 yards so long as it is safe for navigation. Additionally, due to better data and knowledge of species presence, the period beginning in 2009 is more representative of current and reasonably foreseeable marine mammal occurrence in AFTT. The level of vessel use and the manner in which the Navy trains and tests in the future is expected to be consistent with this time period. From 2009 through present, a total of three reported whale strikes have occurred from Navy activities involving large vessels in the AFTT Study Area. The probability of a Navy vessel striking a whale during proposed activities in the Study Area are based on strike data and vessel steaming days from 2009 to 2016 because information on steaming days in 2017 was not available at the time of this analysis. A detailed analysis of the strike probability analysis is presented in Appendix F (Military Expended Materials and Direct Strike Impact Analysis).

Mysticetes

Vessel strikes have been documented for almost all of the mysticete species (Van der Hoop et al., 2012). This includes blue whales (Berman-Kowalewski et al., 2010; Calambokidis, 2012; Van Waerebeek et al., 2007), fin whales (Douglas et al., 2008; Van Waerebeek et al., 2007), North Atlantic right whales (Firestone, 2009; Fonnesbeck et al., 2008; Vanderlaan et al., 2009; Wiley et al., 2016) sei whales (Felix & Van Waerebeek, 2005; Van Waerebeek et al., 2007), Bryde's whales (Felix & Van Waerebeek, 2005; Van Waerebeek et al., 2007), minke whales (Van Waerebeek et al., 2007), and humpback whales (Douglas et al., 2008; Lammers et al., 2003; Van Waerebeek et al., 2007).

Research suggests that the increasing noise in the ocean has made it difficult for whales to detect approaching vessels, which has indirectly raised the risk of vessel strike (Elvin & Taggart, 2008). For example, North Atlantic right whales are documented to show little overall reaction to the playback of sounds of approaching vessels, suggesting that some whales perform only a last-second flight response (Nowacek et al., 2004a). Some individuals may become habituated to low-frequency sounds from shipping and fail to respond to an approaching vessel (National Marine Fisheries Service, 2008b). Because surface activity includes feeding, breeding, and resting, whales may be engaged in this activity and not notice an approaching vessel. On the other hand, the lack of an acoustic cue of vessel presence can be detrimental as well. One study documented multiple cases where humpback whales struck anchored or drifting vessels; in one case a humpback whale punched a 1.5 m hole through the hull of an anchored 22 m wooden sailboat, and another instance a humpback whale rammed a powered down 10 m fiberglass sailboat (Neilson et al., 2012). These results suggest that either the whales did not detect the vessel, or they intentionally struck it. In this study, vessel strikes to multiple cetacean species were included in the investigation; however, humpback whales were the only species that displayed this type of interaction with an unpowered vessel. Another study found that 79 percent of reported collisions between sailing vessels and cetaceans occurred when the vessels were under sail, suggesting it may be difficult for whales to detect the faint sound of sailing vessels (Ritter, 2012).

Vessel strikes are considered a threat to North Atlantic right whale survival (Firestone, 2009; Fonnesbeck et al., 2008; Knowlton & Brown, 2007; Nowacek et al., 2004a; Vanderlaan et al., 2009). Studies of North Atlantic right whales tagged in April 2009 on the Stellwagen Bank feeding grounds found that right whales spent most of their time at a depth of 6.5 ft., which makes them less visible at the water's surface (Bocconcelli, 2009; Parks & Wiley, 2009).

Generally, mysticetes are larger than odontocetes and are not able to maneuver as well as odontocetes to avoid vessels. In addition, mysticetes do not typically aggregate in large groups and are therefore difficult to visually detect from the water surface. Mysticetes that occur within the AFTT Study Area have varying patterns of occurrence and distribution, which overlap with areas where vessel use associated with Navy training and testing activities would occur.

Odontocetes

In general, odontocetes move quickly and seem to be less vulnerable to vessel strikes than other cetaceans; however, most small whale and dolphin species have at least occasionally suffered from vessel strikes, including killer whale (Van Waerebeek et al., 2007; Visser & Fertl, 2000), short-finned and long-finned pilot whales (Aguilar et al., 2000; Van Waerebeek et al., 2007), bottlenose dolphin (Bloom & Jager, 1994; Van Waerebeek et al., 2007; Wells & Scott, 1997), white-beaked dolphin (Van Waerebeek et al., 2007), short-beaked common dolphin (Van Waerebeek et al., 2007), spinner dolphin (Camargo & Bellini, 2007; Van Waerebeek et al., 2007), striped dolphin (Van Waerebeek et al., 2007), Atlantic spotted dolphin (Van Waerebeek et al., 2007), and pygmy sperm whales (*Kogia breviceps*) (Van Waerebeek et al., 2007). Beaked whales documented in vessel strikes include Arnoux's beaked whale (Van Waerebeek et al., 2007), Cuvier's beaked whale (Aguilar et al., 2000; Van Waerebeek et al., 2007), and several species of *Mesoplodon* (Van Waerebeek et al., 2007). However, evidence suggests that beaked whales may be able to hear the low-frequency sounds of large vessels and thus avoid collision (Ketten, 1998). Sperm whales may be exceptionally vulnerable to vessel strikes as they spend extended periods of time "rafting" at the surface to restore oxygen levels within their tissues after deep dives (Jaquet & Whitehead, 1996; Watkins et al., 1999). Overall, collision avoidance success is dependent on a marine mammal's ability to identify and locate the vessel from its radiated sound and the animal's ability to maneuver away from the vessel in time. Based on hearing capabilities and dive behavior, sperm whales may not be capable of successfully completing an escape maneuver, such as a dive, in the time available after perceiving a fast-moving vessel. This supports the suggestion that vessel speed is a critical parameter for sperm whale collision risks (Gannier & Marty, 2015).

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

Pinnipeds

Ship strikes were not reported as a global threat to pinniped populations by Kovacs et al. (2012). Pinnipeds in general appear to suffer fewer impacts from vessel strikes than do cetaceans or sirenians.

This may be due, at least in part, to the large amount of time they spend on land (especially when resting and breeding) and their high maneuverability in the water. A review of seal stranding data from Cape Cod, Massachusetts, found that from 1999 to 2004, 622 pinniped strandings were recorded by the Cape Cod Stranding Network. Of these 622 strandings, 11 (approximately 2 percent) were found to be caused by boat collisions. Mortalities of pinnipeds (specifically harbor seals and gray seals) have initially been attributed to injuries sustained from ducted propellers on vessels such as workboats, tugs, and other support vessels (Bexton et al., 2012). However, further investigations have lead researchers to conclude that injuries that appeared to be the result of propellers were actually due to gray seal predation, cannibalism, and infanticide (Brownlow et al., 2016).

Polar Bears

Richardson et al. (1995b) reported that polar bears generally show little reaction to shipping traffic, and reactions tend to be short term and localized. Polar bears spend a large amount of their time on sea ice or on land areas without ice access during the summer (Monnett & Gleason, 2006), where they would not be vulnerable to vessel strikes.

West Indian Manatees

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

In addition to disturbance, West Indian manatees are particularly susceptible to vessel collisions (both collisions with the hull and propeller strikes) because they hover near the surface of the water, move very slowly, and spend most of their time in inshore waters where vessel traffic tends to be more concentrated (Calleson & Frohlich, 2007; Gerstein, 2002; Haubold et al., 2006; Runge et al., 2007). Vessel strikes are the direct agent of most human-caused deaths to adult West Indian manatees (Rommel et al., 2007), accounting for approximately 18 percent of all manatee deaths and 15 percent of all manatee injuries recorded in Florida between 2008 and 2012 (U.S. Fish and Wildlife Service, 2014a). In calendar year 2015, 21 percent of all manatee deaths were the result from interactions with watercraft (Florida Fish and Wildlife Conservation Commission, 2015). An analysis of a 5-year subset (2000 to 2004) of historical mortality data suggests that a disproportionate number of propeller-caused watercraft-related mortalities could be attributed to propeller diameters greater than or equal to 17 in., suggesting that these were caused by watercraft greater than 40 ft. (Rommel et al., 2007). The USFWS indicates that manatees are probably struck by smaller watercraft more often, but the likelihood of mortality is dependent on the force of collision, which is a factor of the speed and size of the vessel.

Martin et al. (2015b) found that the expected number of manatee and boat encounters in a given area increased with vessel speed and distance traveled by the boat. The findings in Rycyk et al. (2018) on manatee response time to slower vessels suggest collisions with slow-moving vessels are less likely to be lethal compared to high-speed vessels.

Not all collisions are fatal, as evidenced by the fact that most West Indian manatees in Florida bear scars from previous boat strikes (Rommel et al., 2007). In fact, the Manatee Individual Photo-identification System identifies more than 3,000 Florida manatees by scar patterns mostly caused by boats, and most catalogued manatees have more than one scar pattern, indicative of multiple boat strikes (81 *Federal Register* 1000–1026, January 8, 2016). Nonlethal injuries may reduce the breeding success of females (Haubold et al., 2006) and may lower a manatee's immune response (Halvorsen & Keith, 2008).

In-Water Devices

In-water devices are generally smaller (several inches to 111 ft.) than most Navy vessels. 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 activities would occur under each alternative, see Section 3.0.3.3.4.1 (Vessels and In-Water Devices). Devices that could pose a collision risk to marine mammals are those operated at high speeds and are unmanned. The Navy reviewed torpedo design features and a large number of previous anti-submarine warfare torpedo exercises to assess the potential of torpedo strikes on marine mammals. The tactical software that guides U.S. Navy torpedoes is sophisticated and should not identify a marine mammal as a target. All training and testing torpedoes are recovered after being fired at targets and are reconfigured for re-use. Review of the exercise torpedo records indicates there has never been an impact on a marine mammal or other marine organism. In thousands of exercises in which torpedoes were fired or in-water devices used, there have been no recorded or reported instances of a marine species strike.

Since some in-water devices are identical to support craft, marine mammals could respond to the physical presence of the device similar to how they respond to the physical presence of a vessel.

In-water devices, such as unmanned underwater vehicles, and in-water devices towed from unmanned platforms, that move slowly through the water are highly unlikely to strike marine mammals because the mammal could easily avoid the object. In-water devices towed by manned platforms are unlikely to strike a marine mammal because of the observers on the towing platform and other standard safety measures employed when towing in-water devices. It is possible that marine mammal species that occur in areas that overlap with in-water device use associated with the Proposed Action may experience some level of physical disturbance, but it is not expected to result in more than a momentary behavioral response.

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

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

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

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

Vessel movements associated with training activities within inshore waters would occur within or near Boston, Massachusetts; Groton, Connecticut; Narragansett Bay, Rhode Island; Earle, New Jersey; Delaware Bay, Delaware; James River and tributaries; York River; the Lower Chesapeake Bay; Hampton Roads, Virginia; Norfolk, Virginia; Wilmington, North Carolina; Morehead City, North Carolina; Cooper River, South Carolina; Savannah, Georgia; Kings Bay, Georgia; Mayport, Florida; St. Johns River, Florida; Port Canaveral, Florida; Tampa, Florida; St. Andrew Bay, Florida; Beaumont, Texas, and Corpus Christi, Texas. In addition, high-speed small craft movements would be conducted within inshore waters including and surrounding Narragansett Bay, Rhode Island; James River and tributaries, Virginia; York River, Virginia; the Lower Chesapeake Bay; Coopers River, South Carolina; Mayport, Florida; St. Johns River, Florida; Port Canaveral, Florida; and St. Andrew Bay, Florida. Refer to Table 3.0-18 (Number and Location of Activities Including Vessels) through Table 3.0-20 (Number of High Speed Vessel Hours for Small Craft Associated with Training Activities in Inshore Waters of the Study Area) for the numbers of activities that use vessels in different locations within the AFTT Study Area.

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

Physical disturbance from large vessel and in-water devices would be more likely in the continental shelf portions than in the open ocean portions of the AFTT Study Area because of the concentration of large vessel movements and in-water device activities in those areas. Marine mammal species that occur over the continental shelf would therefore have a greater potential for impacts, and include mysticete, odontocete, and pinniped species described in Section 3.7.3.4.1 (Impacts from Vessels and In-Water Devices).

Large vessels may occasionally be required to operate at speeds that are higher than average operating speeds when participating in certain training activities. Large vessels operating at higher speeds may pose a greater strike risk to marine mammals because there would be less time for the vessel crew to detect a marine mammal and maneuver to avoid a strike, and there would be less time over a given distance for the animal to react and avoid the vessel. However, the potential for greater risk may be offset by marine mammal avoidance behavior occurring at a greater distance due to the higher noise levels that are typically generated by any vessel transiting at high speed. Historically, the few vessel strikes on whales that have occurred in the AFTT Study Area (see Appendix F, Military Expended Materials and Direct Strike Impact Analysis) have not been associated with vessels operating at higher speeds. As noted above, vessels do not travel at higher than average speeds unless required by specific operational circumstances; therefore, any increase in the risk of a strike would be minimal compared to the risk of strike from all vessel use proposed under Alternative 1.

Physical disturbance from small crafts would be more likely in the inshore water locations listed in Table 3.0-19 (Number and Location of Activities in Inshore Waters Including Vessels), especially in areas where high-speed training activities occur. Marine mammal species with the greatest potential for impact are those that occur in the inshore waters (e.g., bottlenose dolphins, harbor porpoise, manatees, and pinniped species). Navy training activities involving vessels and in-water devices may occur year-round; therefore, impacts from physical disturbance would depend on each species' seasonal patterns of occurrence or degree of residency in the continental shelf portions of the AFTT Study Area. As previously indicated, any physical disturbance from vessel movements and use of in-water devices is not expected to result in more than a momentary behavioral response.

Historical vessel use (steaming days) and ship strike data were used to calculate the probability of a direct strike during proposed training activities in the offshore portion of the AFTT Study Area by a large Navy vessel. Between 2009 and 2016, there were a total of 39,040 steaming days where Navy ships were at-sea in the AFTT Study Area, resulting in three reported whale strikes in that same time period. This corresponds to an average of 0.00008 strikes per steaming day. Based on the annual average from 2009 to 2016, the Navy estimates that 24,400 steaming days will occur over any 5-year period associated with the anticipated MMPA authorization. Given a strike rate of 0.00008 strikes per steaming day, the expected number of whale strikes over a 5-year period is 1.875. These values were used to determine the rate parameters to calculate a series of Poisson probabilities. A Poisson distribution is often used to describe random occurrences when the probability of an occurrence is small (e.g., count data such as cetacean sighting data, or, in this case, strike data, are often described as a Poisson or over-dispersed Poisson distribution). In modeling strikes as a Poisson process, it is assumed that the strike rate (0.00008 strikes per steaming day) applies to the future and the Poisson distribution is used to estimate the number of strikes over some future time period. The Poisson probabilities are calculated in Appendix F (Military Expended Materials and Direct Strike Impact Analysis). Results of the strike probability analysis based on a Poisson distribution indicate that there is a:

- 15 percent probability of striking zero whales in a 5-year period
- 29 percent probability of striking one whale in a 5-year period
- 27 percent probability of striking two whales in a 5-year period
- 17 percent probability of striking three whales in a 5-year period
- 8 percent probability of striking four whales in a 5-year period
- 3 percent probability of striking five whales in a 5-year period

Most Navy-reported whale strikes are not identified to the species level however, the Navy predicts that large whales have the potential to be struck by a large vessel as a result of training activities in the offshore portion of the Study Area.

The Navy will continue to implement procedural mitigation to avoid or reduce potential impacts from vessel and towed in-water device strikes on marine mammals throughout the Study Area (see Section 5.3.4, Physical Disturbance and Strike Stressors). 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), and requiring underway vessels and in-water devices that are towed from manned surface platforms to maneuver to maintain a specified distance from marine mammals. The Navy will implement mitigation that is specific to manatees at Naval Station Mayport and Kings Bay, Georgia. For example, while underway in the turning basins, channels, and waterways adjacent to Naval Station Mayport, the Navy will ensure that small boats operating out of Naval Station Mayport will be fitted with manatee propeller guards, and vessels will comply with all federal, state, and local Manatee Protection Zones and reduce speed in accordance with established operational safety and security procedures. When mooring pierside at Kings Bay, Georgia, the Navy will ensure proper fendering techniques (e.g., the use of buoys that keep submarines 20 ft. off the quay wall) to prevent submarines from injuring a manatee.

The Navy will also implement procedural mitigation specific to North Atlantic right whales. The Navy will broadcast awareness notification messages with North Atlantic right whale Dynamic Management Area information to alert Navy assets on the possible presence of a North Atlantic right whale in the area. Platforms will use the information to assist their visual observation of applicable mitigation zones during training activities. This will make units aware of North Atlantic right whale aggregations to better plan and conduct activities to minimize interactions with this species. In addition to procedural mitigation, the Navy will continue to implement additional mitigation within select mitigation areas to avoid or reduce potential interactions between vessels and North Atlantic right whales. For example, year-round in the Northeast North Atlantic Right Whale Mitigation Area, which encompasses the full extent of the northeast North Atlantic right whale critical habitat, the Navy will conduct a web query or e-mail inquiry to the National Oceanographic and Atmospheric Administration Northeast Fisheries Science Center's North Atlantic Right Whale Sighting Advisory System to obtain the latest North Atlantic right whale sighting information. Vessels will implement speed reductions in the mitigation area after they observe a North Atlantic right whale, if they are within 5 NM of a sighting reported to the Right Whale Sighting Advisory System within the past week and when operating at night or during periods of poor visibility. The Navy will also implement a 10-knot speed restriction during certain portions of non-explosive torpedo activities in the Northeast North Atlantic Right Whale Mitigation Area. Seasonally within the Jacksonville Operating Area and the Southeast North Atlantic Right Whale Mitigation Area, which encompass a portion of the southeast North Atlantic right whale critical habitat, before transiting or conducting military readiness activities, the Navy will initiate communication with the Fleet Area Control and Surveillance Facility, Jacksonville to obtain Early Warning System North Atlantic right whale sightings data. The Fleet Area Control and Surveillance Facility, Jacksonville, will advise vessels of all reported whale sightings in the vicinity. Within the Jacksonville Operating Area, the Navy will use the reported sightings information as it plans specific details of the events (e.g., timing, location, duration to minimize potential interactions with North Atlantic right whales to the maximum extent practicable and to assist visual observations of applicable mitigation zones. Within the Southeast North Atlantic Right Whale Mitigation Area, vessels will use the reported sightings information to minimize potential interactions with North Atlantic right whales during transits and will implement speed reductions after they observe a North Atlantic right whale if they are within 5 NM of a sighting reported within the past 12 hours or when operating at night or during periods of poor visibility. To the maximum extent practicable, vessels will minimize north-south transits within the Southeast North Atlantic Right Whale Mitigation Area. The Navy's mitigation measures are detailed in Chapter 5 (Mitigation) and are expected to reduce the risk of a strike to the point that a North Atlantic right whale vessel strike is not likely to occur, nor has one ever been recorded, and vessel strikes of all other mysticetes are not anticipated.

Feeding areas for fin whales, humpback whales, minke whales, and sei whales as well as a small and resident area for harbor porpoises have been identified (LaBrecque et al., 2015a) that seasonally overlap with portions of the Northeast Range Complexes within the Study Area. Navy training activities that involve vessel movements and the use of in-water devices within the Northeast Range Complexes could occur year-round, however, any potential overlap with feeding activities in these biologically important areas would be seasonal. Harbor porpoises resident to the northern Gulf of Maine and southern Bay of Fundy within the Northeast Range Complexes may be impacted year-round. Physical disturbance from vessels and in-water device use may result in a momentary behavioral response but would not result in abandonment of feeding behaviors in these areas or cause resident marine mammals to avoid these areas.

LaBrecque et al. (2015a) also identified a migratory corridor, two reproductive areas, and three feeding areas for North Atlantic right whales that seasonally overlap with portions of the AFTT Study Area, including the Northeast, Virginia Capes, Navy Cherry Point, and Jacksonville Range Complexes. Any potential overlap of Navy activities that involve vessel movement and the use of in-water devices with seasonal presence of North Atlantic right whales while engaged in migrating, reproductive, and feeding activities in these biologically important areas would be limited to those times of year. Vessel movement and in-water device use may occur within the North Atlantic right whale's designated critical habitat year-round. Physical and biological features identified for North Atlantic right whale conservation and considered in the critical habitat designation include oceanic conditions that distribute and aggregate dense concentrations of copepods within the northern foraging habitats and water temperatures, depths, and sea surface conditions that are suitable for the southern calving habitats (National Marine Fisheries Service, 2015a). These habitat features would not be impacted by vessels and in-water devices.

It is possible that North Atlantic right whales encountered could be disturbed by the physical presence of large vessels and in-water devices. Disturbance within the southeast critical habitat is mostly likely to occur in winter months and during summer months within the northeast critical habitat; however, the direct route that the Navy predominantly uses for large vessels between Norfolk and Jacksonville avoids a good portion of the coastal North Atlantic right whale migratory corridor and reproductive areas as well as critical habitat, especially off the coasts of South Carolina and Georgia. Disturbance due to the physical presence of vessels and in-water devices is not expected to result in more than a momentary behavioral response and would not result in a permanent abandonment or alteration of migrating, reproductive, and feeding behaviors in these areas. Refer to Section 3.7.3.1.5 (Impacts from Vessel Noise) for a discussion on disturbance and impacts caused by vessel noise. The Navy does not anticipate that it will strike a North Atlantic right whale because of the extensive mitigation in place to reduce the risk of a strike to that species.

LaBrecque et al. (2015b) also identified one year-round small and resident area for Bryde's whales and three small and resident areas for bottlenose dolphins that overlap with the Gulf of Mexico Range Complex. Five additional small and resident areas for bottlenose dolphins were identified along the U.S. East Coast (LaBrecque et al., 2015a); three of which overlap with the Jacksonville Range Complex, including Naval Submarine Base Kings Bay and Naval Station Mayport and two of which overlap with the Navy Cherry Point Range Complex. Training activities that involve large vessels and in-water device use within the Navy Cherry Point, Jacksonville, and Gulf of Mexico Range Complexes could occur year-round. Physical disturbance from the presence of large vessels and in-water devices may result in a momentary behavioral response and but would not cause resident marine mammals to avoid these areas.

The use of small crafts associated with Navy training activities within inshore waters would occur on a more regular basis than offshore vessel use and typically involve high speed (greater than 10 knots) vessel movements. The inshore waters are generally more confined waterways where mysticetes and offshore odontocete species do not typically occur. As stated in Section 3.7.3.4.1 (Impacts from Vessels and In-Water Devices), odontocetes known to occur within inshore waters, such as bottlenose dolphins and harbor porpoises, are not as susceptible to vessel strikes as compared to mysticetes. In addition, no vessel strikes of marine mammals have been reported due to Navy inshore training activities. Therefore, the Navy does not anticipate that it will strike odontocetes as a result training activities in inshore waters.

Pinniped occurrence within the northeast and mid-Atlantic portions of the AFTT Study Area is seasonal, typically outside established range complexes where the majority of Navy large vessel movements are conducted. Pinnipeds also seasonally occur within inshore waters and near the mouth of the Chesapeake Bay where high speed small craft movements associated with inshore training would be conducted year-round. While it is possible that during Navy training activities, large vessels could transit outside the range complex areas, large vessel movements are expected to be very infrequent and would have limited overlap with pinniped occurrence over continental shelf waters. High speed small craft movements within the lower Chesapeake Bay would occur frequently; however, pinnipeds spend large amounts of time on the land and display high maneuverability in the water, suggesting they could avoid interactions with small crafts. Compared to cetaceans and sirenians, pinnipeds are not as susceptible to vessel strikes; therefore, the Navy does not anticipate that it will disturb or strike pinnipeds.

While it is possible that during training activities, vessels could transit outside of the established range complexes in locations where bowhead whales occur, these transits are expected to be very infrequent, reducing the likelihood of bowhead whale strikes from Navy vessels. In-water devices are not anticipated to be used where bowhead whales, ringed seals, or polar bears occur. Therefore, these species are not expected to be affected by the Navy’s in-water device use associated with training activities in the AFTT Study Area.

Polar bear occurrence within the AFTT Study Area generally does not overlap with areas of high levels of Navy vessel traffic. It is possible that vessel movements associated with Navy training and testing activities could occur outside established range complexes, however these movements are expected to be very infrequent. The Navy does not anticipate that it will disturb or strike polar bears.

The Navy does not anticipate encountering a manatee during the use of in-water devices from training activities. Manatees occur in a very limited portion of the AFTT Study Area, primarily close to shore in the inshore and coastal waters of the mid-Atlantic states and the Gulf coast of Florida, and there are few training activities that may involve the use of in-water devices there. Potential impacts on manatees would only result from Navy training activities that include small craft use in the inshore waters of the mid-Atlantic states and the Gulf coast of Florida. High-speed small craft movements would primarily occur within inshore waters associated with Narragansett, Rhode Island; James River and tributaries; York River; the Lower Chesapeake Bay; and Cooper River, South Carolina. Training activities that occur in this northern portion of the AFTT Study Area would not have an impact on manatees since they typically do not occur there. Training activities that use small crafts within inshore waters of Mayport, Florida; St. Johns River; Port Canaveral, Florida; and St. Andrew Bay are limited, yet have the potential to impact manatees in these areas.

In the St. Johns River, areas of known manatee occurrence have been designated by the Florida Fish and Wildlife Conservation Commission as Manatee Protection Zones. These areas are marked with signs and enforce vessel speed restrictions to protect manatees from boat strikes. Navy training units follow all manatee protection rules and are briefed on requirements before each exercise. Similar precautions would be followed for high speed small craft movements in Port Canaveral and St. Andrew Bay.

Vessel movements within inshore waters of Savannah, Georgia; Kings Bay, Georgia; Mayport, Florida; St. Johns River; Port Canaveral, Florida; Tampa, Florida; and St. Andrew Bay would co-occur with manatees. However, there have been no manatee boat strikes as a result of Navy training in inshore waters of the AFTT Study Area. Implementation of mitigation measures in these areas would further reduce the likelihood of a strike. Disturbance due to the physical presence of vessels and in-water devices is not expected to result in more than a momentary behavioral response. Manatees also occur in the coastal waters of Puerto Rico, which is within the AFTT Study Area, but no training is anticipated in these areas. Based on these factors and the implementation of mitigation, the Navy does not anticipate that it will disturb or strike West Indian manatees.

Vessel movements and in-water device use would occur within West Indian manatee designated critical habitat, specifically within inshore waters associated with Mayport and Port Canaveral, Florida, and the St. Johns River, year-round. Disturbance within manatee habitat is most likely to occur during spring, summer, or fall, because manatees generally move farther inshore during winter. The current critical habitat designation for the West Indian manatee does not identify specific physical and biological features essential for species conservation, but essential habitat features have been reported to include warm water refuges, various food sources (seagrasses and freshwater vegetation), travel corridors, and shelter for calving (75 *Federal Register* 1574–1581, January 12, 2010). These habitat features would not be impacted by vessel and in-water device use during training activities within the designated critical habitat.

Vessel movement and in-water device use related to training activities occur near marine mammals only on an incidental basis. Navy mitigation measures described in Chapter 5 (Mitigation) will help the Navy avoid interactions with marine mammals, which would further reduce any potential physical disturbance and direct strike impacts from vessels. Long-term consequences to populations of marine mammals are not expected to result from vessel movement and in-water device use associated with the proposed training exercises.

The use of vessels during training activities as described under Alternative 1 could result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard. In addition, the use of in-water devices during training activities as described under Alternative 1 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of vessels and in-water devices during training activities as described under Alternative 1 would have no effect on North Atlantic right whale and West Indian manatee critical habitats. The use of vessels and in-water devices may affect the blue whale, bowhead whale, Gulf of Mexico subspecies of

Bryde's whale, fin whale, North Atlantic right whale, ringed seal, sei whale, sperm whale, and West Indian manatee, as defined by the ESA. The Navy has consulted with NMFS and the USFWS as required by section 7(a)(2) of the ESA in that regard.

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

As indicated in Section 3.0.3.3.4.1 (Vessels and In-Water Devices), testing activities primarily involve large vessel movement. However, the number of activities that include large vessel movement and use for testing is comparatively lower than the number of training activities. In addition, testing often occurs jointly with a training event, so it is likely that the testing activity would be conducted from a training vessel. Vessel movement and use in conjunction with testing activities could be widely dispersed throughout the Study Area, but would be concentrated near naval ports, piers, range complexes, testing ranges, and especially off the northeast U.S. coast, off south Florida, and in the Gulf of Mexico. Specifically, offshore testing activities that include vessels would be conducted within the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes, the Naval Undersea Warfare Center, Newport Testing Range; South Florida Ocean Measurement Facility Testing Range; and the Naval Surface Warfare Center, Panama City Division Testing Range. In addition, vessel movements associated with testing activities would occur within inshore waters surrounding Bath, Maine; Portsmouth, New Hampshire; Newport, Rhode Island; Groton, Connecticut; Little Creek, Virginia; Norfolk, Virginia; Kings Bay, Georgia; Mayport, Florida; Port Canaveral, Florida; and Pascagoula, Mississippi.

Propulsion testing, which sometimes includes ships operating at speeds in excess of 30 knots, and use of large high-speed unmanned surface vessels occurs infrequently but may pose a higher strike risk because of the high speeds at which some vessels need to transit to complete the testing activity. These activities would occur in the Northeast, Virginia Capes, Jacksonville, and Gulf of Mexico Range Complexes. However, there are just a few of these events proposed per year, so the increased risk is nominal compared to all vessel use proposed for testing activities under Alternative 1.

Also, as discussed in Section 3.0.3.3.4.1 (Vessels and In-Water Devices), testing activities involving the use of in-water devices would occur in the AFTT Study Area at any time of year. Under Alternative 1, testing activities involving the use of in-water devices would be conducted throughout the AFTT Study Area, including the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes, the Naval Undersea Warfare Center, Newport Testing Range, South Florida Ocean Measurement Facility, and the Naval Surface Warfare Center Panama City Testing Range. In-water devices are not anticipated to be used where bowhead whales, ringed seals, or polar bears occur. Therefore, these species are not expected to be affected by the Navy's in-water device use associated with testing activities in the AFTT Study Area.

The Navy will continue to implement procedural mitigation to avoid or reduce potential impacts from vessel and in-water device strikes on marine mammals throughout the Study Area (see Section 5.3.4, Physical Disturbance and Strike Stressors). 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) and requiring underway vessels and in-water devices that are towed from manned surface platforms to maneuver to maintain a specified distance from marine mammals. The Navy will implement mitigation specific to manatees at Naval Station Mayport and Kings Bay, Georgia. For example, while underway in the turning basins, channels, and waterways adjacent to Naval Station Mayport, the Navy will ensure that small boats operating out of Naval Station Mayport will be fitted with manatee propeller guards, and vessels will comply with all federal, state, and local Manatee Protection Zones and reduce speed in accordance with established operational safety and security procedures. When mooring pierside at Kings Bay, Georgia, the Navy will ensure proper fendering techniques (e.g., the use of buoys that keep submarines 20 ft. off the quay wall) to prevent submarines from injuring a manatee.

The Navy will also implement procedural mitigation that is specific to North Atlantic right whales. The Navy will broadcast awareness notification messages with North Atlantic right whale Dynamic Management Area information to alert Navy assets on the possible presence of a North Atlantic right whale in the area. Platforms will use the information to assist their visual observation of applicable mitigation zones during testing activities. This will make units aware of North Atlantic right whale aggregations to better plan and conduct activities to minimize interactions with this species. In addition to procedural mitigation, the Navy will continue to implement additional mitigation within select mitigation areas to avoid or reduce potential interactions between vessels and North Atlantic right whales. For example, year-round in the Northeast North Atlantic Right Whale Mitigation Area, which encompasses the full extent of the northeast North Atlantic right whale critical habitat, the Navy will conduct a web query or e-mail inquiry to the National Oceanographic and Atmospheric Administration Northeast Fisheries Science Center's North Atlantic Right Whale Sighting Advisory System to obtain the latest North Atlantic right whale sighting information. Vessels will implement speed reductions in the mitigation area after they observe a North Atlantic right whale, if they are within 5 NM of a sighting reported to the Right Whale Sighting Advisory System within the past week, and when operating at night or during periods of poor visibility. The Navy will also implement a 10-knot speed restriction during certain portions of non-explosive torpedo activities in the Northeastern North Atlantic Right Whale Mitigation Area. Within the mitigation area, the Navy will conduct all torpedo (non-explosive) testing during daylight hours in Beaufort sea states 3 or less. During transits and normal firing, support vessels will maintain a speed of no more than 10 knots. During submarine target firing, ships will maintain speeds of no more than 18 knots. During vessel target firing, ship speeds may exceed 18 knots for brief periods of time (e.g., 10 to 15 minutes). Seasonally within the Jacksonville Operating Area and the Southeast North Atlantic Right Whale Mitigation Area, which encompass a portion of the southeast North Atlantic right whale critical habitat, before transiting or conducting military readiness activities, the Navy will initiate communication with the Fleet Area Control and Surveillance Facility, Jacksonville, to obtain Early Warning System North Atlantic right whale sightings data. The Fleet Area Control and Surveillance Facility, Jacksonville, will advise vessels of all reported whale sightings in the vicinity. Within the Jacksonville Operating Area, the Navy will use the reported sightings information as it plans specific details of the events (e.g., timing, location, duration) to minimize potential interactions with North Atlantic right whales to the maximum extent practicable and to assist visual observations of applicable mitigation zones. Within the Southeast North Atlantic Right Whale Mitigation Area, vessels will use the reported sightings information to minimize potential interactions with North Atlantic right whales during transits and will implement speed reductions after they observe a North Atlantic right whale, if they are within 5 NM of a sighting reported within the past 12 hours or when operating at night or during periods of poor visibility. To the maximum extent practicable, vessels will minimize north-south transits within the Southeast North Atlantic Right Whale Mitigation Area. The Navy's mitigation measures are detailed in Chapter 5 (Mitigation) and are expected to reduce the risk of a strike to the point that a North Atlantic right whale vessel strike is not likely to occur and vessel strikes of all other mysticetes are not anticipated.

Feeding areas for fin whales, humpback whales, minke whales, and sei whales as well as a small and resident area for harbor porpoises have been identified (LaBrecque et al., 2015a) that seasonally overlap with portions of the Northeast Range Complexes within the Study Area. Navy testing activities that involve vessel transit and the use of in-water devices within the Northeast Range Complexes could occur year-round, however, any potential overlap with feeding activities in these biologically important areas would be seasonal. Harbor porpoises resident to the northern Gulf of Maine and southern Bay of Fundy within the Northeast Range Complexes may be impacted year-round. Physical disturbance from the presence of vessels and in-water devices may result in a momentary behavioral response and but would not result in abandonment of feeding behaviors in these areas or cause resident marine mammals to avoid these areas.

LaBrecque et al. (2015a) also identified a migratory corridor, two reproductive areas, and three feeding areas for North Atlantic right whales that seasonally overlap with portions of the AFTT Study Area, including the Northeast, Virginia Capes, Navy Cherry Point, and Jacksonville Range Complexes. Any potential overlap of Navy activities that use vessels and in-water devices with seasonal presence of North Atlantic right whales while engaged in migrating, reproductive, and feeding activities in these biologically important areas would be limited to those times of year. Vessel transit and in-water device use may occur within the North Atlantic right whale's designated critical habitat year-round. It is possible that North Atlantic right whales encountered could be disturbed by the physical presence of vessels and in-water devices. Physical and biological features identified for North Atlantic right whale conservation and considered in the critical habitat designation include oceanic conditions that distribute and aggregate dense concentrations of copepods within the northern foraging habitats and water temperatures, depths, and sea surface conditions that are suitable for the southern calving habitats (National Marine Fisheries Service, 2015a). These habitat features would not be impacted by vessel movements and in-water device use.

Physical disturbance within the southeast critical habitat is mostly likely to occur in winter months and during summer months within the northeast critical habitat; however, the direct route that the Navy predominantly uses for large vessels between Norfolk and Jacksonville avoids a good portion of the coastal North Atlantic right whale migratory corridor and reproductive areas as well as critical habitat, especially off the coasts of South Carolina and Georgia. Disturbance due to the physical presence of vessels and in-water devices is not expected to result in more than a momentary behavioral response and would not result in a permanent abandonment or alteration of migrating, reproductive, and feeding behaviors in these areas. Refer to Section 3.7.3.1.5 (Impacts from Vessel Noise) for a discussion on disturbance and impacts caused by vessel noise. The Navy does not anticipate that it will strike a North Atlantic right whale because of the extensive mitigation in place to reduce the risk of a strike to that species.

One year-round small and resident area for Bryde's whales and three small and resident areas for bottlenose dolphins have been identified (LaBrecque et al., 2015b) that overlap with the Gulf of Mexico Range Complex. Five additional small and resident areas for bottlenose dolphins were identified within some estuaries and nearshore waters along the U.S. East Coast (LaBrecque et al., 2015a); two of which overlap with the Navy Cherry Point Range Complex and three overlap with the Jacksonville Range Complex, including Charleston OPAREA, Naval Submarine Base Kings Bay, and Naval Station Mayport. Navy testing activities that involve vessel transit and the use of in-water devices within the Navy Cherry Point, Jacksonville, and Gulf of Mexico Range Complexes could occur year-round. Physical disturbance from the presence of vessels and in-water devices may result in a momentary behavioral response and but would not cause resident marine mammals to avoid these areas.

Marine mammals resident to, or engaging in migratory, reproductive, and feeding behaviors within the range complexes of the AFTT Study Area, but outside the biologically important areas discussed above, may be impacted by vessels and in-water devices from Navy testing activities. Impacts, including physical disturbance and strike, would be similar as what was previously discussed for odontocetes and mysticetes in the Section 3.7.3.4.1 (Impacts from Vessels and In-Water Devices). Based on Navy vessel strike data (2009 to 2016) presented in Appendix F (Military Expended Materials and Direct Strike Impact Analysis) and a consideration of the mitigation discussed in Chapter 5 (Mitigation), the Navy does not anticipate that any cetacean would be struck by a vessel as a result of testing activities in the Study Area.

Manatees primarily occur in the inshore waters of mid-Atlantic states and the Gulf coast of Florida. Since manatees generally occur in a very limited portion of the AFTT Study Area, the Navy does not anticipate that vessel movement will injure any manatees and encounters with in-water devices are not likely. There are just a few testing activities that occur close to shore where manatees may be encountered, but testing activities conducted in the northern portion of the AFTT Study Area would not have an impact on manatees since they typically do no occur there. Physical disturbance of manatees is most likely to occur during spring, summer, or fall, because manatees generally move farther inshore during winter. Based on these factors and the implementation of mitigation, the Navy does not anticipate that it will strike a manatee.

Vessel movement and in-water device use during testing activities would occur in very small portions of the West Indian manatee designated critical habitat, specifically near Mayport and Port Canaveral, Florida, year-round. The current critical habitat designation for the West Indian manatee does not identify specific physical and biological features essential for species conservation, but essential habitat features have been reported to include warm water refuges, various food sources (seagrasses and freshwater vegetation), travel corridors, and shelter for calving (75 *Federal Register* 1574–1581, January 12, 2010). These habitat features would not be impacted by vessel movement and in-water device use during testing activities.

Vessel movement and in-water device use related to testing activities occur near marine mammals only on an incidental basis. Navy mitigation measures described in Chapter 5 (Mitigation) will help the Navy avoid interactions with marine mammals, which would further reduce any potential physical disturbance and direct strike impacts on marine mammals from vessels. Long-term consequences to populations of marine mammals are not expected to result from vessel movement and in-water device use associated with the proposed testing activities.

The use of vessels during testing activities as described under Alternative 1 could result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA. The Navy has requested authorization from NMFS as required by section 101(a)(5)(A) of the MMPA in that regard. In addition, the use of in-water devices during testing activities as described under Alternative 1 will not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of vessel and in-water devices during testing activities as described under Alternative 1 will have no effect on North Atlantic right whale and West Indian manatee critical habitats. The use of vessels and in-water devices may affect the blue whale, bowhead whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, ringed seal, sei whale, sperm whale, and West Indian manatee, as defined by the ESA. The Navy has consulted with NMFS and the USFWS as required by section 7(a)(2) of the ESA in that regard.

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

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

As shown in Table 3.0-18 (Number and Location of Activities Including Vessels), the locations of offshore training activities that use vessels are the same for Alternatives 1 and 2. However, the number of offshore training activities that use vessels would increase by approximately 2 percent both annually and over 5 years under Alternative 2. As shown in Table 3.0-19 (Number and Location of Activities in Inshore Waters Including Vessels), training activities that include vessel movement within inshore waters of the AFTT Study Area would be the same under Alternatives 1 and 2. Similarly, training activities involving high-speed small craft movements within inshore waters of the AFTT Study Area are the same under Alternatives 1 and 2. Even with the nominal increase in offshore training activity levels described above, Navy training activities would remain consistent with the levels of activity and types of activities undertaken in the AFTT Study Area over the last decade. Consequently, the level for which physical disturbance and strikes are expected to occur is likely to remain consistent with the previous decade.

Table 3.0-22 (Number and Location of Activities Including In-Water Devices) shows that the locations of training events within both offshore and inshore waters of the Study Area that use in-water devices would be the same under Alternatives 1 and 2. In addition, the number of training activities that use in-water devices within inshore waters of the AFTT Study Area annually and over 5 years are identical between Alternatives 1 and 2. However, the number of offshore training activities that use in-water devices would increase by approximately 5 percent annually and 6 percent over 5 years. This level of increased in-water device use would not appreciably change the potential for physical disturbance or strike of a marine mammal. Therefore, impacts from training activities involving vessels and in-water devices under Alternative 2 would be similar to Alternative 1 and the analyses presented in Section 3.7.3.4.1.1 (Impacts from Vessels and In-Water Devices Under Alternative 1) for training activities are applicable to training activities under Alternative 2.

The use of vessels during training activities as described under Alternative 2 could result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA. The use of in-water devices as described under Alternative 2 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of vessels and in-water devices during training activities as described under Alternative 1 would have no effect on North Atlantic right whale and West Indian manatee critical habitats and may affect the blue whale, bowhead whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, ringed seal, sei whale, sperm whale, and West Indian manatee, as defined by the ESA.

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

As shown in Table 3.0-18 (Number and Location of Activities Including Vessels), the offshore and inshore locations for testing activities that involve vessel movement would be the same under Alternatives 1 and 2. In addition, the annual and 5-year numbers of inshore testing activities that involve vessel movements are identical under Alternatives 1 and 2. However, the number of offshore testing activities would increase by 0.3 percent annually and by approximately 7 percent over 5 years. As previously indicated, the number of testing activities that involve vessels is much lower than the number of training activities. Furthermore, testing activities may be conducted simultaneously with a training event, using a training vessel. The proposed increase in offshore vessel use from testing activities under Alternative 2 would still be consistent with the levels of activity and types of activities undertaken in the AFTT Study Area over the last decade. Therefore, the level for which physical disturbance and strikes are expected to occur would remain consistent with the previous decade.

In addition, Table 3.0-22 (Number and Location of Activities Including In-Water Devices) shows that the locations of testing activities that use in-water devices are the same under Alternatives 1 and 2. The number of testing activities that use in-water devices would increase by less than 0.1 percent annually and by 11 percent over 5 years. This level of increased use of in-water devices does not substantially change the potential for physical disturbance or strike of a marine mammal. Therefore, impacts from testing activities involving vessels and in-water devices under Alternative 2 would be similar to Alternative 1, and the analyses presented in Section 3.7.3.4.1.1 (Impacts from Vessels and In-Water Devices Under Alternative 1) for testing activities are applicable to testing activities under Alternative 2.

The use of vessels during testing activities as described under Alternative 2 could result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA. The use of in-water devices during testing activities as described under Alternative 2 will not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of vessels and in-water devices during testing activities as described under Alternative 2 would have no effect on North Atlantic right whale and West Indian manatee critical habitats and may affect the blue whale, bowhead whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, ringed seal, sei whale, sperm whale, and West Indian manatee, as defined by the ESA.

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

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

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

3.7.3.4.2 Impacts from Aircraft and Aerial Targets

Impacts from aircraft and aerial targets are not applicable to marine mammals because they do not occur in airborne environments and will not be analyzed further in this section. Refer to Section 3.7.3.4.3 (Impacts from Military Expended Materials) for impacts from target fragments and Section 3.7.3.1 (Acoustic Stressors) for potential disturbance from aircraft.

3.7.3.4.3 Impacts from Military Expended Materials

This section analyzes the strike potential to marine mammals from the following categories of military expended materials: (1) all sizes of non-explosive practice munitions, (2) fragments from high-explosive munitions, and (3) expendable targets and target fragments, and (4) expended materials other than munitions, such as sonobuoys, expended bathythermographs, and torpedo accessories. For a discussion of the types of activities that use military expended materials, refer to Appendix B (Activity Stressor Matrices) and for a discussion on where they are used and how items would be used or expended under each alternative, see Section 3.0.3.3.4.2 (Military Expended Materials). As described in Appendix F (Military Expended Materials and Direct Strike Impact Analysis), for physical disturbance and strike stressors as it relates to marine mammals, impacts from fragments from high-explosive munitions are included in the analysis presented in Section 3.7.3.2 (Explosive Stressors), and are not considered further in this section. Potential impacts from military expended materials as ingestion stressors to marine mammals are discussed in Section 3.7.3.6.1 (Impacts from Military Expended Materials - Munitions) and Section 3.7.3.6.2 (Impacts from Military Expended Materials Other Than Munitions).

The primary concern is the potential for a marine mammal to be hit with a military expended material at or near the water's surface, which could result in injury or death. While disturbance or strike from an item falling through the water column is possible, it is not very likely because the objects generally sink slowly through the water based on the weights of expended materials and can be avoided by most marine mammals. Therefore, the discussion of military expended materials strikes focuses on the potential of a strike at the surface of the water.

While no strike from military expended materials has ever been reported or recorded, the possibility of a strike still exists. Therefore, the potential for marine mammals to be struck by military expended materials was evaluated using statistical probability modeling to estimate potential direct strike exposures to a marine mammal under a worst-case scenario. Specific details of the modeling approach, including model selection and calculation methods, are presented in Appendix F (Military Expended Materials and Direct Strike Impact Analysis).

To estimate potential direct strike exposures, a scenario was calculated using the marine mammal species with the highest average monthly density in areas with the highest amounts of military expended material expenditures, specifically Virginia Capes and Jacksonville Range Complexes. This is considered a worst-case scenario because, as described below, exposure calculations of a single military item hitting an animal assumes all activities would be conducted during the season associated with the marine mammal species with the highest average seasonal density and that all marine mammals have equal densities. These highest estimates would provide reasonable comparisons for all other areas and species. For estimates of expended materials in all areas, see Section 3.0.3.3.4.2 (Military Expended Materials).

For all the remaining marine mammal species with lesser densities, this highest likelihood approach would overestimate the likelihood of a strike. Direct strike exposures of marine mammal species protected under the ESA are estimated separately from non-ESA species. Because the ESA has specific standards for understanding the likelihood of impacts on each endangered species, estimates were made for all endangered marine mammal species found in the areas where the highest levels of military expended materials would be expended. In this way, the appropriate ESA conclusions could be based on the highest estimated probabilities of a strike for those species.

Input values include materials data (frequency, footprint, and type), size of the training or testing area, marine mammal density data, and size of the animal. To estimate the potential of military expended materials to strike a marine mammal, the impact area of each category of military expended materials analyzed for marine mammals was totaled over 1 year in the area with highest combined amounts of military expended materials for each of the alternatives.

The analysis of the potential for a marine mammal strike is influenced by the following assumptions:

- The model is two-dimensional and assumes that all marine mammals 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 & Block, 2009).
- The model also does not take into account the fact that most of the projectiles fired during training and testing activities are fired at targets, and most projectiles hit those targets, so only a very small portion of those would hit the water with their maximum velocity and force.
- The model assumes the animal is stationary and does not account for any movement of the marine mammal or any potential avoidance of the training or testing activity.

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

The model output (Appendix F, Military Expended Materials and Direct Strike Impact Analysis) provides a reasonably high level of certainty that marine mammals would not be struck by military expended materials. These results are summarized in the following sections discussing impacts under each alternative.

3.7.3.4.3.1 Impacts from Military Expended Materials Under Alternative 1

Impacts from Military Expended Materials Under Alternative 1 for Training Activities

Training activities in offshore waters that involve military expended materials under Alternative 1 would occur in the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West and Gulf of Mexico Range Complexes. In addition training activities that involve military expended materials would be conducted within inshore waters within and around Narragansett, Rhode Island; James River and tributaries; York River, Virginia; the Lower Chesapeake Bay; Cooper River, South Carolina; and Port Canaveral, Florida. Proposed training activities that use military expended materials do not overlap with areas where bowhead whales, narwhal, beluga whale, ringed seals, or polar bears occur, and, therefore, these species are not likely to be exposed to this stressor.

The model results presented in Appendix F (Military Expended Materials and Direct Strike Impact Analysis) estimate representative marine mammal exposures from direct strike during training activities in the Virginia Capes and Jacksonville Range Complexes. These range complexes were chosen because they constitute the areas with the highest estimated numbers and concentrations of military expended materials analyzed for marine mammals and would provide a reasonable comparison for all other areas with fewer expended materials. Based on a worst-case scenario, the results indicate with a reasonable level of certainty that no marine mammals would be struck by military expended materials. Direct strike exposure estimates range from 0.0 blue whales to 0.1 short-beaked common dolphins in the Virginia Capes Range Complex over the course of a year. In addition, direct strike exposure estimates are essentially zero (maximum exposure estimate of 0.01 for Atlantic spotted dolphin) for all marine mammal species in the Jacksonville Range Complex. As discussed above, this does not take into account the assumptions that likely overestimate potential impacts and the behavior of marine mammals (e.g., short-beaked common dolphins and Atlantic spotted dolphins travel in groups and are relatively easy to spot), which would reduce the risk of a strike.

Navy training activities that involve military expended materials would occur within the North Atlantic right whale's designated critical habitat year-round. Since North Atlantic right whales occur within the southeast critical habitat area primarily in winter months and occur within the northeast critical habitat area during summer months, any potential overlap with Navy training in these areas would be seasonal. Given that no marine mammals would be struck by military expended materials as analyzed in Appendix F (Military Expended Materials and Direct Strike Impact Analysis), the Navy does not anticipate that military expended materials associated with training activities would strike a North Atlantic right whale. Physical and biological features identified for North Atlantic right whale conservation and considered in the critical habitat designation include oceanic conditions that distribute and aggregate dense concentrations of copepods within the northern foraging habitats and water temperatures, depths, and sea surface conditions that are suitable for the southern calving habitats (National Marine Fisheries Service, 2015a). These habitat features would not be impacted by military expended materials.

The risk of the West Indian manatee to be exposed to military expended materials during training activities is highly unlikely because its primarily inshore/coastal distribution does not overlap the offshore areas where the Navy conducts training activities that expend these materials. Manatees may be exposed to military expended materials in the inshore waters of mid-Atlantic states and the Gulf coast of Florida. Since manatees generally occur in a very limited portion of the AFTT Study Area, the Navy does not anticipate that military expended materials associated with training activities would strike a manatee.

Training activities that involve military expended materials would occur within West Indian manatee critical habitat, specifically in inshore waters near Port Canaveral, Florida. The current critical habitat designation for the West Indian manatee does not identify specific physical and biological features essential for species conservation, but essential habitat features have been reported to include warm water refuges, various food sources (seagrasses and freshwater vegetation), travel corridors, and shelter for calving (75 *Federal Register* 1574–1581, January 12, 2010). These habitat features would not be impacted by military expended materials.

The Navy will implement mitigation (e.g., not conducting gunnery activities against a surface target within a specified distance from marine mammals) to avoid or reduce potential impacts from military expended materials on marine mammals throughout the Study Area (see Section 5.3.4, Physical Disturbance and Strike Stressors). The Navy will implement additional seasonal mitigation within the Southeast North Atlantic Right Whale Mitigation Area to further avoid potential interactions with military expended materials. For example, the Navy will not conduct gunnery activities in the mitigation area during North Atlantic right whale calving season. While designed specifically for enhanced protection of North Atlantic right whales, the mitigation will consequently help avoid potential impacts of military expended materials on all marine mammal species that are present in the mitigation area during the applicable season.

Training activities involving military expended materials as described under Alternative 1 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

Training activities involving military expended materials as described under Alternative 1 would have no effect on North Atlantic right whale and West Indian manatee critical habitats. Training activities involving military expended materials would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA. The Navy has consulted with NMFS and the USFWS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Military Expended Materials Under Alternative 1 for Testing Activities

Testing activities that involve military expended materials under Alternative 1 would primarily occur in the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes within the Study Area. Other areas include the Naval Undersea Warfare Center, Newport Testing Range; the South Florida Ocean Measurement Facility Testing Range; and the Naval Surface Warfare Center, Panama City Testing Range. Proposed testing activities that use military expended materials do not overlap with areas where bowhead whales, narwhal, beluga whale, ringed seals, or polar bears occur, and, therefore, these species are not likely to be exposed to this stressor.

The results presented in Appendix F (Military Expended Materials and Direct Strike Impact Analysis) indicate a reasonable level of certainty that no marine mammals would be struck by military expended materials. Direct strike exposures are essentially zero (maximum exposure estimate of 0.03 for short-beaked common dolphin) for all marine mammal species in the Virginia Capes Range Complex over the course of a year. Similarly, direct strike exposures are essentially zero (maximum exposure estimate of 0.02 for Atlantic spotted dolphin) for all marine mammal species in the Jacksonville Range Complex. As previously discussed, this does not take into account the assumptions that likely overestimate potential impacts and the behavior of marine mammals (e.g., spotted dolphins travel in groups and are relatively easy to spot), which would make the risk even lower.

Navy testing activities that involve military expended materials would occur within the North Atlantic right whale's designated critical habitat year-round. Since North Atlantic right whales occur within the southeast critical habitat area primarily in winter months and occur within the northeast critical habitat area during summer months, any potential overlap with Navy training in these areas would be seasonal. Given that no marine mammals would be struck by military expended materials analyzed in Appendix F (Military Expended Materials and Direct Strike Impact Analysis), the Navy does not anticipate that military expended materials associated with testing activities would strike a North Atlantic right whale. Physical and biological features identified for North Atlantic right whale conservation and considered in the critical habitat designation include oceanic conditions that distribute and aggregate dense concentrations of copepods within the northern foraging habitats and water temperatures, depths, and sea surface conditions that are suitable for the southern calving habitats (National Marine Fisheries Service, 2015a). These habitat features would not be impacted by military expended materials.

Manatees primarily occur in the inshore waters of mid-Atlantic states and the Gulf coast of Florida. Based on the limited overlap between manatees occurrence in the Study Area and the results from the statistical probability model presented in Appendix F (Military Expended Materials and Direct Strike Impact Analysis), the Navy does not anticipate that military expended materials associated with training activities would strike a manatee. In addition, testing activities that involve military expended materials would not be conducted within West Indian manatee critical habitat.

The Navy will implement mitigation (e.g., not conducting gunnery activities against a surface target within a specified distance from marine mammals) to avoid or reduce potential impacts from military expended materials on marine mammals throughout the Study Area (see Section 5.3.4, Physical Disturbance and Strike Stressors). The Navy will implement additional seasonal mitigation within the Southeast North Atlantic Right Whale Mitigation Area to further avoid potential interactions with military expended materials. For example, the Navy will not conduct gunnery activities in the mitigation area during North Atlantic right whale calving season. While designed specifically for enhanced protection of North Atlantic right whales, the mitigation will consequently help avoid potential impacts of military expended materials on all marine mammal species that are present in the mitigation area during the applicable season.

Testing activities involving military expended materials as described under Alternative 1 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

Testing activities involving military expended materials as described under Alternative 1 would have no effect on North Atlantic right whale and West Indian manatee critical habitats. Testing activities involving military expended materials would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA. The Navy has consulted with NMFS and the USFWS as required by section 7(a)(2) of the ESA in that regard.

3.7.3.4.3.2 Impacts from Military Expended Materials Under Alternative 2

Impacts from Military Expended Materials Under Alternative 2 for Training Activities

The locations of all training activities that involve military expended materials are the same under Alternatives 1 and 2. In addition, the amounts of non-explosive practice munitions expended annually and over 5 years are identical under Alternatives 1 and 2. The number of expendable targets within offshore portions of the AFTT Study Area would increase by 3 percent annually and by 4 percent over 5 years. The use of expended materials other than munitions within inshore portions of the Study Area are the same under Alternatives 1 and 2, but would increase within the offshore portions of the AFTT Study Area by 0.3 percent annually and 0.4 percent over 5 years under Alternative 2.

Probability analyses conducted for training activities under Alternative 2 yielded nearly identical exposures compared to Alternative 1; short-beaked common dolphin exposures in the Virginia Capes Range Complex only increased by 0.00001. Similarly, Atlantic spotted dolphin exposures in the Jacksonville Range Complex only increased by 0.0004. These results provide a high level of certainty that no marine mammals would be struck by military expended materials under Alternative 2. In addition, the results indicate that fractional increases in expendable targets and expended materials other than munitions proposed under Alternative 2 do not substantially increase the potential for direct strike to marine mammals. Therefore, the associated impacts on marine mammals are expected to be identical to Alternative 1 as presented in Section 3.7.3.4.3.1 (Impacts from Military Expended Materials Under Alternative 1) for training activities.

Training activities involving military expended materials as described under Alternative 2 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

Training activities involving military expended materials as described under Alternative 2 would have no effect on North Atlantic right whale and West Indian manatee critical habitats. Training activities involving military expended materials would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA.

Impacts from Military Expended Materials Under Alternative 2 for Testing Activities

The locations of all testing activities that involve military expended materials are the same under Alternatives 1 and 2. The annual amount of non-explosive practice munitions is the same for both Alternatives, but would increase by 1 percent over 5 years under Alternative 2. Similarly, the annual numbers of expendable targets would also be the same under Alternatives 1 and 2; however, the 5-year total would increase by 3 percent under Alternative 2. Expended materials other than munitions would increase under Alternative 2 by only 0.2 percent annually and by 1 percent over 5 years.

Probability analyses conducted for testing activities under Alternative 2 yielded nearly identical exposures compared to Alternative 1; short-beaked common dolphin exposures in the Virginia Capes Range Complex only increased by 0.00001. Similarly, Atlantic spotted dolphin exposures in the Jacksonville Range Complex also only increased by 0.00001. These results provide a high level of certainty that no marine mammals would be struck by military expended materials under Alternative 2. Fractional increases in the amounts of non-explosive practice munitions, expended targets, and expended materials other than munitions do not appreciably increase marine mammal direct strike exposure estimates. Therefore, the associated impacts on marine mammals are expected to be identical to Alternative 1 as presented in Section 3.7.3.4.3.1 (Impacts from Military Expended Materials Under Alternative 1) for testing activities.

Testing activities involving military expended materials as described under Alternative 2 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

Testing activities involving military expended materials as described under Alternative 2 would have no effect on North Atlantic right whale and West Indian manatee critical habitats. Testing activities involving military expended materials would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde’s whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA.

3.7.3.4.3.3 Impacts from Military Expended Materials Under the No Action Alternative

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

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

3.7.3.4.4 Impacts from Seafloor Devices

For a discussion of the types of activities that use seafloor devices see Appendix B (Activity Stressor Matrices), and for a discussion on where they are used and how many activities would occur under each alternative, see Section 3.0.3.3.4.3 (Seafloor Devices). These include items placed on, dropped on, or moved along the seafloor such as mine shapes, anchor blocks, anchors, bottom-placed devices, and bottom-crawling unmanned underwater vehicles. The likelihood of any marine mammal species encountering seafloor devices is considered low because these items are either stationary or move very slowly along the bottom. In the unlikely event that a marine mammal is in the vicinity of a seafloor device, the stationary or very slowly moving devices would not be expected to physically disturb or alter natural behaviors of marine mammals. The only seafloor device used during training and testing activities that has the potential to strike a marine mammal at or near the surface is an aircraft-deployed mine shape, which is used during aerial mine laying activities. These devices are identical to non-explosive practice bombs, and, therefore, the analysis of the potential impacts from those devices are covered in Section 3.7.3.4.3 (Impacts from Military Expended Materials) and are not further analyzed in this section.

3.7.3.4.4.1 Impacts from Seafloor Devices Under Alternative 1

Impacts from Seafloor Devices Under Alternative 1 for Training Activities

Offshore training activities that use seafloor devices under Alternative 1 would primarily occur in the Virginia Capes Range Complex. Other offshore locations include Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes; and the Naval Surface Warfare Center, Panama City Testing Range. In addition, training activities that use seafloor devices would be conducted within inshore waters including and surrounding Boston, Massachusetts; Earle, New Jersey; Delaware Bay, Delaware; Hampton Roads, Virginia; the Lower Chesapeake Bay; James River and tributaries; York River; Morehead City, North Carolina; Wilmington, North Carolina; Savannah, Georgia; Kings Bay, Georgia; Mayport, Florida; Port Canaveral, Florida; Tampa, Florida; Truman Harbor, Florida; Demolition Key, Florida; Beaumont, Texas; and Corpus Christi, Texas. Species such as the bowhead whale, narwhal, beluga whale, ringed seal, and polar bear, whose ranges are outside of the areas where these materials would normally be expended, are not likely to be exposed to this stressor. Therefore these species are not further analyzed under this section.

Based on the analysis in Section 3.7.3.4.3.1 (Impacts from Military Expended Materials Under Alternative 1) for training activities, there is a reasonable level of certainty that no marine mammals would be struck by seafloor devices.

Navy training activities that involve seafloor devices would occur within the North Atlantic right whale southeast critical habitat area year-round. Since North Atlantic right whales occur within the southeast critical habitat area primarily in winter months, any potential overlap with Navy training in these areas would be seasonal. The Navy does not anticipate that the use of seafloor devices would result in physical disturbance or direct strike of North Atlantic right whales. Physical and biological features identified for North Atlantic right whale conservation and considered in the critical habitat designation include oceanic conditions that distribute and aggregate dense concentrations of copepods within the northern foraging habitats and water temperatures, depths, and sea surface conditions that are suitable for the southern calving habitats (National Marine Fisheries Service, 2015a). These habitat features would not be impacted by seafloor devices.

The risk of the West Indian manatee to be exposed to seafloor devices during Navy training activities is highly unlikely because its primarily inshore/coastal distribution does not overlap the offshore areas where the Navy generally conducts the types of activities that use these devices. Training activities that use seafloor devices would occur within West Indian manatee critical habitat, specifically in inshore waters near Port Canaveral, Florida, and to a limited extent, Mayport, Florida. The Navy does not anticipate that the use of seafloor devices would result in physical disturbance or direct strike of manatees. The current critical habitat designation for the West Indian manatee does not identify specific physical and biological features essential for species conservation, but essential habitat features have been reported to include warm water refuges, various food sources (seagrasses and freshwater vegetation), travel corridors, and shelter for calving (75 *Federal Register* 1574–1581, January 12, 2010). These habitat features would not be impacted by seafloor devices.

The use of seafloor devices during training activities as described under Alternative 1 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of seafloor devices during training activities as described under Alternative 1 would have no effect on North Atlantic right whale and West Indian manatee critical habitats. The use of seafloor devices would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA. The Navy has consulted with NMFS and the USFWS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Seafloor Devices Under Alternative 1 for Testing Activities

Testing activities that involve the use of seafloor devices under Alternative 1 would occur in the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes; Naval Undersea Warfare Center, Newport Testing Range; South Florida Ocean Measurement Facility Testing Range; and Naval Surface Warfare Center, Panama City Testing Range. Species such as the bowhead whale, narwhal, beluga whale, ringed seal, and polar bear, whose ranges are outside of the areas where these materials would be normally be expended, are not likely to be exposed to this stressor. Therefore, these species are not further analyzed under this section.

Based on the analysis in Section 3.7.3.4.3.1 (Impacts from Military Expended Materials Under Alternative 1) for testing activities, there is a reasonable level of certainty that no marine mammals would be struck by seafloor devices.

Navy testing activities that involve seafloor devices would occur within the North Atlantic right whale's designated critical habitat year-round. Since North Atlantic right whales occur within the southeast critical habitat area primarily in winter months and occur within the northeast critical habitat area during summer months, any potential overlap with Navy training in these areas would be seasonal. The Navy does not anticipate that the use of seafloor devices would result in physical disturbance or direct strike of North Atlantic right whales. Physical and biological features identified for North Atlantic right whale conservation and considered in the critical habitat designation include oceanic conditions that distribute and aggregate dense concentrations of copepods within the northern foraging habitats and water temperatures, depths, and sea surface conditions that are suitable for the southern calving habitats (National Marine Fisheries Service, 2015a). These habitat features would not be impacted by seafloor devices.

The risk of the West Indian manatee to be exposed to seafloor devices during Navy testing activities is highly unlikely because its primarily inshore/coastal distribution does not overlap the offshore areas where the Navy generally conducts the types of activities that use these devices. Manatees may be exposed to this stressor in the Gulf of Mexico during testing activities conducted in the nearshore environment, though they are very rarely encountered in those areas. The Navy does not anticipate that the use of seafloor devices would result in physical disturbance or direct strike of manatees. Testing activities that involve seafloor devices would not be conducted within West Indian manatee critical habitat.

The use of seafloor devices during testing activities as described under Alternative 1 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of seafloor devices during testing activities as described under Alternative 1 would have no effect on North Atlantic right whale and West Indian manatee critical habitats. The use of seafloor devices would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee. The Navy has consulted with NMFS and the USFWS as required by section 7(a)(2) of the ESA in that regard.

3.7.3.4.4.2 Impacts from Seafloor Devices Under Alternative 2

Impacts from Seafloor Devices Under Alternative 2 for Training Activities

As stated in Section 3.0.3.3.4.3 (Seafloor Devices) training activities that involve seafloor devices are the same under Alternatives 1 and 2. Based on the analysis in Section 3.7.3.4.3.2 (Impacts from Military Expended Materials Under Alternative 2) for training activities, there is a reasonable level of certainty that no marine mammals would be struck by seafloor devices.

The use of seafloor devices during training activities as described under Alternative 2 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of seafloor devices during training activities as described under Alternative 2 would have no effect on North Atlantic right whale and West Indian manatee critical habitats. The use of seafloor devices would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA.

Impacts from Seafloor Devices Under Alternative 2 for Testing Activities

As stated in Section 3.0.3.3.4.3 (Seafloor Devices) the location of testing activities that use seafloor devices are the same under Alternatives 1 and 2; however the number of testing activities proposed under Alternative 2 would increase by 2 percent annually and by approximately 7 percent over 5 years. Based on the analysis in Section 3.7.3.4.3.2 (Impacts from Military Expended Materials Under Alternative 2) for testing activities, there is a reasonable level of certainty that no marine mammals would be struck by seafloor devices.

The use of seafloor devices during testing activities as described under Alternative 2 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of seafloor devices during testing activities as described under Alternative 2 would have no effect on North Atlantic right whale and West Indian manatee critical habitats. The use of seafloor devices would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA.

3.7.3.4.4.3 Impacts from Seafloor Devices Under the No Action Alternative

Impacts from Seafloor Devices Under the No Action Alternative for Training and Testing Activities

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

3.7.3.4.5 Impacts from Pile Driving

Impact pile driving and vibratory pile removal associated with the training activity to construct an Elevated Causeway System, as described in Chapter 2 (Description of Proposed Action and Alternatives) and Table 2.3-2 (Proposed Training Activities), was considered as a potential physical disturbance and strike stressor. Section 3.0.3.3.1.3 (Pile Driving) provides additional details on pile driving and removal activities, including noise levels measured from similar construction activity and the duration of each phase of the training. Construction of an Elevated Causeway System, and therefore pile driving, would not occur during testing activities in the AFTT Study Area.

Impacts to marine mammals from pile driving activities as an acoustic stressor are addressed in Section 3.7.3.1.4 (Impacts from Pile Driving). This section addresses the physical presence of the resulting temporary pier to be constructed for the Elevated Causeway System as a potential physical disturbance stressor and the potential for direct strike during pile driving.

The pier would be no longer than 1,520 ft. , with 119 supporting piles on the beach and out into shallow coastal waters of Joint Expeditionary Base Little Creek-Fort Story in the Virginia Capes Range Complex or Marine Corps Base Camp Lejeune in the Navy Cherry Point Range Complex. The entire training activity, including pile driving and removal, would occur over approximately 30 days. Few marine mammal species are known to occupy the coastal waters of Virginia and North Carolina. While manatees typically inhabit coastal waters, they do not regularly occur this far north in the AFTT Study Area. Pinniped occurrence documented in Virginia and North Carolina is primarily from stranding records (Hayes et al., 2017; Swingle et al., 2016); therefore, the potential for pinnipeds to co-occur with these training activities is considered low. Given the nearshore locations for this training activity and the temporary nature of the structures, it is not likely that marine mammals would experience physical disturbance from the presence of the temporary pier structure. Furthermore, it is not likely that any marine mammal would be struck by a piling during installation. Mitigation measures discussed in Chapter 5 (Mitigation) would be conducted to further reduce any potential for impacts. Therefore, the Navy has determined that the Elevated Causeway System training activity would not strike a marine mammal or result in physical disturbance impacts above those associated with acoustic impacts described in Section 3.7.3.1.4 (Impacts from Pile Driving). Accordingly, this activity is not considered further in this section.

3.7.3.5 Entanglement Stressors

This section analyzes the potential for entanglement of marine mammals as the result of proposed training and testing activities within the Study Area. This analysis includes the potential impacts from three types of military expended materials: (1) wires and cables, (2) decelerators/parachutes, and (3) biodegradable polymers. The number and location of training and testing exercises that involve the use of items that may pose an entanglement risk are provided in Section 3.0.3.3.5 (Entanglement Stressors). General discussion of impacts can also be found in Section 3.0.3.6.4 (Conceptual Framework for Assessing Effects from Entanglement).

These materials could be encountered by marine mammals, and, if encountered, may have the potential to entangle marine mammals in the AFTT Study Area at the surface, in the water column, or along the seafloor. Since potential impacts depend on how a marine mammal encounters and reacts to items that pose an entanglement risk, the following subsections discuss research relevant to specific groups or species. Risk factors such as animal size, sensory capabilities, and foraging methods are also considered in the potential risk for entanglement. Most entanglements discussed are attributable to marine mammal encounters with fishing gear or other non-military materials that float or are suspended at the surface. Entanglement events are difficult to detect from land or from a boat as they may occur at considerable distances from shore and typically take place underwater. Smaller entangled animals are inherently less likely to be detected than larger ones, but larger animals may subsequently swim off while still entangled, towing lines or fishing gear behind them. The likelihood of witnessing an entanglement event is therefore typically low (Benjamins et al., 2014). However, the properties and size of these military expended materials, as described in Section 3.0.3.3.5 (Entanglement Stressors) and

Section 3.0.3.6.4 (Conceptual Framework for Assessing Effects from Entanglement), makes entanglement unlikely.

Since, there has never been a reported or recorded instance of a marine mammal entangled in military expended materials (Henry et al., 2016; National Oceanic and Atmospheric Administration Marine Debris Program, 2014b), the Navy considered the available literature and reports on entanglement. These reports indicate that active and derelict fishing gear is the predominant cause of entanglement. The reason for this, and the ways that fishing gear may be different from military expended materials are as follows: (1) fishing gear is most often used in areas of high productivity where whales may congregate and feed; whereas military expended materials are generally used in broad, diverse, open ocean areas and expenditures are not concentrated; (2) fishing gear is designed to trap/entangle marine life and are made with a high breaking strength to withstand prolonged use in the ocean environment; military expended materials are not designed to persist in the ocean environment for long periods of time and are not designed to entangle or capture marine life; and (3) fishing gear and ropes are designed to float or be suspended in the water column for long periods of time, whereas most military expended materials sink immediately and rapidly.

Mysticetes

Mysticete species with documented entanglement reports include humpback whales, North Atlantic right whales, Bryde's whales, minke whales, gray whales, and bowhead whales (Cassoff et al., 2011; National Oceanic and Atmospheric Administration Marine Debris Program, 2014b). Aside from Bryde's whales, all of those species have records directly linking entanglement to marine debris as opposed to active fishing gear (Baulch & Perry, 2014; Laist, 1997). It has been estimated that a minimum of 52 percent and a maximum of 78 percent of whales have been non-lethally entangled in their lifetime (Neilson et al., 2009). Between 2010 and 2014, there were 209 confirmed reports of baleen whale entanglement along the Atlantic Canadian Provinces, U.S. Atlantic Coast, and the Gulf of Mexico; 36 of these resulted in mortality (Henry et al., 2016). Impacted species included North Atlantic right whales, humpback whales, fin whales, and minke whales. Cassoff et al. (2011) report that in the western North Atlantic, mortality due to entanglement has slowed the recovery of some populations of mysticetes. Included in their analysis of 21 entanglement-related mortalities were minke, Bryde's, North Atlantic right whale, and humpback whales. As described in Section 3.7.2.2.2 (North Atlantic Right Whale [*Eubalaena glacialis*]), NMFS declared an unusual mortality event beginning June 2017 for North Atlantic right whales throughout their range along the Atlantic coast, with mortalities to date totaling 18 (National Marine Fisheries Service, 2018b). Full necropsy examinations have been conducted on 11 of the 18 North Atlantic right whale carcasses (National Marine Fisheries Service, 2018b). The results of necropsy reports for seven whales found in the southern Gulf of St. Lawrence are summarized in Daoust et al. (2018). Primary cause of death for two of the whales were attributed to acute entanglement in snow crab fishing gear with subsequent drowning (Daoust et al., 2018).

Entanglement of many large whales most often begins with rope being caught in its baleen plates. Based on feeding adaptations for mysticetes, oral entanglement may pose one of the greatest threats to survival, due to impaired foraging and possibly loss of function of the hydrostatic seal (formed when upper and lower lips come together and keep the mouth closed), requiring the whale to expend energy to actively keep the mouth closed during swimming (Cassoff et al., 2011). Impaired foraging could lead to deterioration of health, making the animal more susceptible to disease or eventual starvation over a long period of time. Compounding the issue, trailing lengths of rope or line may become wrapped around the animal's appendages as it struggles to free itself (Kozuck, 2003), limiting the animal's mobility. This reduced mobility can also reduce foraging success or even limit the animal's ability to surface. Notably, the single acute cause of entanglement mortalities has been associated with drowning from multiple body parts being entangled (Cassoff et al., 2011).

Common sources of entanglements for mysticetes include line and net fragments attached through the mouth or around the tail and flippers (National Oceanic and Atmospheric Administration Marine Debris Program, 2014b). Rope diameter and breaking strengths may also determine an animal's ability to break free from entanglement. Increased rope strength has been found to be positively correlated with injury severity in right whales, but not for humpback whales (Knowlton et al., 2016). Minke whales were also found entangled in lower breaking strength ropes (10.47 kilonewtons [2,617 lb.-force]) than both humpback and right whales (17.13 and 19.30 kilonewtons [3,851 and 4,339 lb.-force], respectively) (Knowlton et al., 2016). These are significantly greater than the breaking strength of torpedo guidance wires (maximum 42 lb.-force) as described in Section 3.0.3.3.5.1 (Wires and Cables). Entanglement would be more likely for materials with similar physical properties as those described above.

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

Military expended material is expected to sink to the ocean floor. It is possible that marine mammals could encounter these items within the water column as they sink to the bottom. Less buoyant items that sink faster are not as likely to become entangled with a marine mammal compared to more buoyant materials that would sink slower to the floor. Mysticetes that occupy the water column or skim feed along the water surface would have to encounter a military expended material at the same time and location it is either expended or as it sinks. Mysticete species that feed near or at the bottom in the areas where activities make use of military expended materials could encounter items that have already sunk and, therefore, do not have to be present at the precise time when items are expended. Seasonally present when feeding throughout the Northeast Range Complexes within the AFTT Study Area, humpback whales are the only mysticete occurring in the Study Area that regularly feeds near the seafloor and would have the additional risk of being exposed to entangling military expended materials that have already sunk.

Odontocetes

Odontocete species with documented records of marine debris entanglement, excluding fishing gear, are the sperm whale, bottlenose dolphin, harbor porpoise, and Dall's porpoise (National Oceanic and Atmospheric Administration Marine Debris Program, 2014b). Bottlenose dolphins are the most commonly entangled odontocete, with most entanglements involving monofilament line, net fragments, and rope attached to appendages (National Oceanic and Atmospheric Administration Marine Debris Program, 2014b). Heezen (1957) reported two confirmed instances of sperm whales entangled in the slack lengths of telegraph cable near cable repair sites along the seafloor. These whales likely became entangled while feeding along the bottom, as the cables were most often found wrapped around the jaw. Other sperm whale entanglements in gill nets have been reported in areas outside the AFTT Study Area, resulting in various behavioral responses, injuries and in some cases, mortalities to individuals (Haase & Felix, 1994; Jacobsen et al., 2010; Pace et al., 2008). Juvenile harbor porpoises exposed to 0.5-in. diameter white nylon ropes in both vertical and horizontal planes treated the ropes as barriers, more frequently swimming under than over them. However, porpoises feeding on fish in the area crossed the ropes more frequently and became less cautious, suggesting that rope poses a greater risk in a feeding area than in a transit area. For harbor porpoises feeding on the bottom, rope suspended near the seafloor is more likely to entangle than rope higher in the water column because the animals' natural tendency is to swim beneath barriers (Kastelein et al., 2005a).

Pinnipeds

Entanglement is considered a serious threat to several populations of pinnipeds (Kovacs et al., 2012); 67 percent of pinniped species have been recorded as entangled (Kuhn et al., 2015). Younger pinnipeds appear to be more prone to entanglement than adults (Hofmeyr et al., 2006; Page et al., 2004). A young pup may become so entangled that its body becomes constricted by the material as it grows. Death may occur by strangulation or severing of the arteries (Derraik, 2002). Other species of seals, such as harbor seals, gray seals, and harp seals can also get entangled in nets and fishing line when young and then grow with the lines wrapped around their necks or appendages, causing deep wounds and eventually death. Between 2004 and 2008, the annual mean entanglement rate for gray seals at a haul-out site in Cornwall (in the United Kingdom), ranged from 3.6 to 5 percent; mortality rates were likely higher for entangled animals (Allen et al., 2012). Gray and harbor seals also become entangled and drown in the U.S. Northeast Sink Gillnet Fishery (Johnston et al., 2015).

Polar Bear

In a review conducted by Kuhn et al. (2015) on the interaction between marine debris and wildlife, only one occurrence of entanglement in polar bears was documented, but no further details regarding the material was provided.

West Indian Manatees

Entanglements have been documented for manatees (Beck & Barros, 1991; Forrester et al., 1975; O'Shea et al., 1985). Manatee foraging behaviors may predispose them to entanglement with fishery gear because they are extremely tactile, meaning they need to be in close proximity or physically touching an object in order to gain extensive information about it (Adimey et al., 2014). In addition, manatees have limited abilities to detect finer objects, such as monofilament, until it is already wrapped around them (Adimey et al., 2014), leading to an increased risk of entanglement (Bauer et al., 2012).

Fishery gear interactions with Florida manatees were analyzed from stranding records collected between 1997 and 2009 in Florida and results found that approximately 8 percent of the manatee cases were identified as fishery gear interactions (Adimey et al., 2014). Of the 380 reported cases, 76 percent consisted of hook and line interactions and 22 percent were from trap pot gear (Adimey et al., 2014).

3.7.3.5.1 Impacts from Wires and Cables

For a discussion of the types of activities that use wires and cables see Appendix B (Activity Stressor Matrices) and for a discussion on where they are used and how many wires and cables would be expended under each alternative, see Section 3.0.3.3.5.1 (Wires and Cables). The likelihood of a marine mammal encountering and becoming entangled in a fiber optic cable depends on several factors. The length of the cable varies (up to about 3,000 m) and greater lengths may increase the likelihood that a marine mammal could become entangled. The physical characteristics of the fiber optic material render the cable easily broken when tightly kinked or bent at a sharp angle, but highly resistant to breaking when wrapped or looped around an object. The fiber optic cables are 0.24 mm in diameter. They would be suspended within the water column during the activity, and then be expended to sink to the seafloor over time. The behavior and feeding strategy of a species can determine whether they may encounter items on the seafloor, where cables will be available for longer periods of time. There is potential for those species that feed on the seafloor to encounter cables and potentially become entangled; however, the relatively few cables being expended within the AFTT Study Area limits the potential for encounters. The amount of time that the cable is in the same vicinity as a marine mammal can increase the likelihood of it posing an entanglement risk. Since the cable will only be within the water column during the activity, the likelihood of a marine mammal encountering and becoming entangled while a cable sinks within the water column is extremely low.

Similar to fiber optic cables discussed above, guidance wires may pose an entanglement threat to marine mammals either in the water column or after the wire has settled to the seafloor. The likelihood of a marine mammal encountering and becoming entangled in a guidance wire depends on several factors. With the exception of a chance encounter with the guidance wire while it is sinking to the seafloor (at an estimated rate of 0.7 ft. per second), it is most likely that a marine mammal would only encounter a guidance wire once it had settled on the seafloor. Since the guidance wire will only be within the water column during the activity, the likelihood of a marine mammal encountering and becoming entangled while the wire sinks within the water column is extremely low. Guidance wires are copper coated in polyethylene, are less than 0.05 in. in diameter, and have a relatively low tensile breaking strength (42 lb.) In addition, based on degradation times, the guidance wires would break down within 1 to 2 years and no longer pose an entanglement risk. The length of the guidance wires varies, as described in Section 3.0.3.3.5.1 (Wires and Cables), but greater lengths increase the likelihood that a marine mammal could become entangled. The behavior and feeding strategy of a species can determine whether it may encounter items on the seafloor, where guidance wires will most likely be available. There is potential for those species that feed on the seafloor to encounter guidance wires and potentially become entangled; however, the relatively few guidance wires being expended within the AFTT Study Area limits the potential for encounters.

Sonobuoy wires are used to attach the surface antenna and float unit with the subsurface hydrophone assembly unit of a sonobuoy. They are slightly longer than fiber optic cables (up to 1,500 ft.) and have a tensile breaking strength of 40 lb. Operationally, sonobuoys remain suspended in the water column for up to 30 hours, which would increase the likelihood that a marine mammal could encounter a sonobuoy wire either while it is suspended or as it sinks. Marine mammals could encounter the sonobuoy wires while in operation in the water column, and species that feed on the bottom could encounter the wires after they have sunk to the seafloor.

Marine mammal species that occur within the AFTT Study Area were evaluated based on the likelihood of encountering these items. Mysticete, odontocete, pinniped, and sirenian species that occur where these training and testing activities take place and forage on the bottom could encounter these items once they settle to the seafloor.

An evaluation of potential environmental impacts related to guidance wire left at sea where torpedo tests are conducted by the Navy suggests there is an extremely low entanglement potential for marine animals found within these range areas (Swope & McDonald, 2013). The chance that an individual animal would encounter expended cables or wires is most likely low based on (1) the sparse distribution of both the cables and wires expended throughout the Study Area, (2) the fact that the wires and cables will sink upon release, and (3) the relatively few marine mammals that are likely to feed on the bottom in the deeper waters where these would be expended. It is very unlikely that an animal would get entangled even if it encountered a cable or wire while it was sinking or upon settling to the seafloor. A marine mammal would have to swim through loops, become twisted within the cable or wire, or in the case of mysticetes, get the cable or wire stuck in their baleen to become entangled, and given the properties of the expended wires (low breaking strength, sinking rates, and reluctance to coiling or looping) this seems unlikely. As indicated in the report by Neilson et al. (2009), a large percentage of whales have been non-lethally entangled in their lifetime, suggesting some degree of ability to become disentangled. So while an animal may initially become entangled in a cable or wire while either swimming in the water column or feeding on the bottom, they may become free in situations where the item breaks or if it is only loosely attached and the animal is able to maneuver to free itself from permanent entanglement. As a result, no long-term impacts would occur. Based on the estimated concentration of expended cables and wires, impacts from cables or wires are extremely unlikely to occur. In fact, current data suggests that torpedo guidance wires do not present a physical hazard in the marine environment (Swope & McDonald, 2013).

3.7.3.5.1.1 Impacts from Wires and Cables Under Alternative 1

Impacts from Wires and Cables Under Alternative 1 for Training Activities

Training activities under Alternative 1 would expend wires and cables within the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, and Gulf of Mexico Range Complexes as well as other AFTT areas. Wires would be expended in greatest concentration within the Jacksonville Range Complex, which is approximately 50,090 square nautical miles (NM^2) resulting in one wire per 2 NM^2 throughout the entire Jacksonville Range Complex. Cables would be expended in the greatest concentration within the Virginia Capes Range Complex, which is approximately 27,672 NM^2. As a result, there would one cable per 446 NM^2 throughout the entire Virginia Capes Range Complex per year if they were expended evenly throughout the area. Refer to Appendix F (Military Expended Materials and Direct Strike Impact Analysis) for more detailed information on the area impacted by various military expended materials. The bowhead whale, narwhal, beluga whale, ringed seal, bearded seal, walrus, and polar bear do not occur in these areas and are not discussed further in this section.

Marine mammals resident to, or engaging in migratory, reproductive, and feeding behaviors within the range complexes of the AFTT Study Area may encounter wires and cables expended during Navy training activities. Potential entanglement impacts on blue whales are expected to be similar to the other mysticete species discussed above. Potential impacts on odontocete and pinniped species that occur in the areas listed above would be similar to what was described in Section 3.7.3.5.1 (Impacts from Wires and Cables). Based on the low concentration of expended wires and cables combined with their physical characteristics, the Navy anticipates that no marine mammals would become entangled.

Navy training activities that expend wires and cables would occur within the North Atlantic right whale's designated critical habitat year-round. Since North Atlantic right whales occur within the southeast critical habitat area primarily in winter months and occur within the northeast critical habitat area during summer months, any potential overlap with Navy training activities in these areas would be seasonal. The Navy does not anticipate that the expended wires and cables would entangle a North Atlantic right whale. Physical and biological features identified for North Atlantic right whale conservation and considered in the critical habitat designation include oceanic conditions that distribute and aggregate dense concentrations of copepods within the northern foraging habitats and water temperatures, depths, and sea surface conditions that are suitable for the southern calving habitats (National Marine Fisheries Service, 2015a). These habitat features would not be impacted by wires and cables.

Although manatees may occur in coastal areas of the Gulf of Mexico, training activities that use fiber optic cables, guidance wires, and sonobuoy cables would not take place in shallow waters where manatees would be feeding and potentially encounter these items on the seafloor. Training activities that expend wires and cables will not occur within West Indian manatee critical habitat.

The use of wires and cables during training activities as described under Alternative 1 will not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of wires and cables during training activities as described under Alternative 1 will have no effect on North Atlantic right whale and West Indian manatee critical habitat. The use of wires and cables would have no effect on the bowhead whale, ringed seal, and West Indian manatee and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, and sperm whale, as defined by the ESA. The Navy has consulted with NMFS and the USFWS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Wires and Cables Under Alternative 1 for Testing Activities

Testing activities proposed under Alternative 1 would expend wires and cables within the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes. Other locations include the Naval Undersea Warfare Center, Newport Testing Range; South Florida Ocean Measurement Facility Testing Range; and the Naval Surface Warfare Center, Panama City Testing Range in the AFTT Study Area. The bowhead whale, narwhal, beluga whale, ringed seal, bearded seal, walrus, and polar bear do not occur in these areas and are not discussed further in this section.

Wires would be expended with the greatest concentration in the Northeast Range Complex, which is 45,619 NM^2 in size. If expended evenly throughout the area, there would be one wire per approximately 2 NM^2. Cables would be expended with greatest concentration in the Naval Surface Warfare Center, Panama City Testing Range, which is 7,966 NM^2 in size, resulting in approximately one cable per 24 NM^2 if expended evenly throughout the area. Refer to Appendix F (Military Expended Materials and Direct Strike Impact Analysis) for more detailed information on the area impacted by various military expended materials.

Marine mammals resident to, or engaging in migratory, reproductive, and feeding behaviors within the range complexes of the AFTT Study Area may encounter wires and cables expended during Navy testing activities. Potential entanglement impacts on blue whales are expected to be similar to the other mysticete species discussed above. Potential impacts on odontocete and pinniped species that occur in the areas listed above would be similar to what was described in Section 3.7.3.5.1 (Impacts from Wires and Cables). Based on the low concentration of expended wires and cables combined with their physical characteristics, the Navy anticipates that no marine mammals would become entangled.

Navy testing activities would expend wires and cables within the North Atlantic right whale's designated critical habitat year-round. Since North Atlantic right whales occur within the southeast critical habitat area primarily in winter months and occur within the northeast critical habitat area during summer months, any potential overlap with Navy testing activities in these areas would be seasonal. The Navy does not anticipate that wires and cables would entangle a North Atlantic right whale. Physical and biological features identified for North Atlantic right whale conservation and considered in the critical habitat designation include oceanic conditions that distribute and aggregate dense concentrations of copepods within the northern foraging habitats and water temperatures, depths, and sea surface conditions that are suitable for the southern calving habitats (National Marine Fisheries Service, 2015a). These habitat features would not be impacted by cables and wires expended during testing activities.

Although manatees may occur in coastal, estuarine, and riverine areas along the southeast and Gulf of Mexico coasts of the United States, testing activities that use fiber optic cables, guidance wires, and sonobuoy cables would not take place in shallow waters where manatees would be feeding and therefore potentially encounter these items on the seafloor. Testing activities that expend wires and cables would be conducted within a small portion of West Indian manatee critical habitat that occurs within the South Florida Ocean Measurement Facility. The potential for wires and cables to be expended in this area would be very low based on the limited overlap between West Indian manatee critical habitat and the South Florida Ocean Measurement Facility area. The Navy does not anticipate that a West Indian manatee would become entangled in expended wires and cables. The current critical habitat designation for the West Indian manatee does not identify specific physical and biological features essential for species conservation, but essential habitat features have been reported to include warm water refuges, various food sources (seagrasses and freshwater vegetation), travel corridors, and shelter for calving (75 *Federal Register* 1574–1581, January 12, 2010). These habitat features would not be impacted by cables and wires expended during testing activities.

The use of wires and cables during testing activities as described under Alternative 1 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of wires and cables during testing activities as described under Alternative 1 would have no effect on North Atlantic right whale and West Indian manatee critical habitat. The use of wires and cables would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA. The Navy has consulted with NMFS and the USFWS as required by section 7(a)(2) of the ESA in that regard.

3.7.3.5.1.2 Impacts from Wires and Cables Under Alternative 2

Impacts from Wires and Cables Under Alternative 2 for Training Activities

The locations of training activities that expend wires and cables are the same under Alternatives 1 and 2. The number of wires expended during training activities would increase under Alternative 2 by 2 percent annually and by 3 percent over 5 years. The number of cables expended during training activities would increase under Alternative 2 by 1 percent annually and by 8 percent over 5 years. While there would be a small increase in the total number of wires and cables expended throughout the AFTT Study Area under Alternative 2, it is not expected to substantially increase the risk of entanglement to marine mammals over what was analyzed under Alternative 1. The analyses presented in Section 3.7.3.5.1.1 (Impacts from Wires and Cables Under Alternative 1) for training activities would therefore apply to training activities under Alternative 2.

The use of wires and cables during training activities as described under Alternative 2 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of wires and cables during training activities as described under Alternative 2 would have no effect on North Atlantic right whale and West Indian manatee critical habitat. The use of wires and cables would have no effect on the bowhead whale, ringed seal, and West Indian manatee and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, and sperm whale, as defined by the ESA.

Impacts from Wires and Cables Under Alternative 2 for Testing Activities

The locations of testing activities that expend wires and cables would be identical under Alternatives 1 and 2. However, the number of wires expended during testing activities would slightly increase under Alternative 2 by less than 1 percent annually and by 3 percent over 5 years. In addition, there would be a 1 percent increase in the number of cables expended annually and an 8 percent increase over 5 years. This level of increase proposed under Alternative 2 does not appreciably increase the risk of entanglement to marine mammals above what was analyzed for Alternative 1. Therefore, the analyses presented in Section 3.7.3.5.1.1 (Impacts from Wires and Cables Under Alternative 1) for testing activities would also apply to Alternative 2 testing activities.

The use of wires and cables during testing activities as described under Alternative 2 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of wires and cables during testing activities as described under Alternative 2 would have no effect on North Atlantic right whale and West Indian manatee critical habitat. The use of wires and cables would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA.

3.7.3.5.1.3 Impacts from Wires and Cables Under the No Action Alternative

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

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

3.7.3.5.2 Impacts from Decelerators/Parachutes

For a discussion of the types of activities that use decelerators/parachutes, see Appendix B (Activity Stressor Matrices), and for a discussion on where they are used and how many decelerators/parachutes would be used or expended under each alternative. See Section 3.0.3.3.5.2 (Decelerators/Parachutes). Training and testing activities that introduce decelerators/parachutes into the water column can occur anywhere in the AFTT Study Area and may pose an entanglement risk to marine mammals. Potential impacts from decelerators/parachutes as ingestion stressors to marine mammals are discussed in Section 3.7.3.6.2 (Impacts from Military Expended Materials Other Than Munitions).

As described in Section 3.0.3.3.5.2 (Decelerators/Parachutes), decelerators/parachutes used during the proposed activities range in size from 18 in. up to 80 ft. in diameter. A small decelerator/parachute has short attachment cords (1 to 3 ft.) and upon water impact may remain at the surface for 5 to 15 seconds before it sinks to the seafloor, where it becomes flattened. Sonobuoy decelerators/parachutes are designed to sink within 15 minutes, but the rate of sinking depends on sea conditions and the shape of the decelerator/parachute; the duration of the descent depends on the water depth. Prior to reaching the seafloor, a decelerator/parachute could be carried along in a current or become snagged on a hard structure near the bottom. Conversely, the decelerator/parachute and associated lines could settle to the bottom, where it would be buried by sediment in most soft bottom areas or colonized by attaching and encrusting organisms, which would further stabilize the material and reduce the potential for reintroduction as an entanglement risk.

Illumination flares and targets use medium-sized parachutes, which are up to 19 ft. in diameter with attachment cords 18 ft. long. Some aerial targets use large and extra-large decelerators/parachutes. Large parachutes are up to 50 ft. in diameter, and extra-large parachutes are up to 80 ft. in diameter. More information on large and extra-large paracords can be found in Section 3.0.3.3.5.2 (Decelerators/Parachutes). The majority of these larger sized decelerators/parachutes that would be expended are the medium parachutes, with a small amount of large and extra-large decelerators/parachutes being expended. The large and extra-large decelerators/parachutes have long attachment cords, up to 70 ft. and 82 ft. in length, respectively, and upon water impact may remain at the surface for up to 5 minutes before sinking to the seafloor. As previously stated, the rate of sinking depends on sea conditions and the shape of the decelerator/parachute, and the duration of the descent depends on water depth.

Entanglement of a marine mammal in a decelerator/parachute assembly at the surface or within the water column would be unlikely due to decelerator/parachute size and distribution of decelerators/parachutes expended in the Study Area. The decelerator/parachute would have to land directly on an animal or an animal would have to swim into it and become entangled within the cords or fabric panel before it sinks or while it is sinking through the water column. Once on the seafloor, if bottom currents are present, the cruciform fabric panels may temporarily billow and pose an entanglement threat to marine animals with bottom-feeding habits; however, the probability of a marine mammal encountering a decelerator/parachute assembly on the seafloor and accidental entanglement in the fabric panel or short suspension cords is unlikely. The majority of small and medium decelerators/parachutes expended will occur in deep ocean areas and sink to the bottom relatively quickly.

The main potential for entanglement is with the large and extra-large decelerators/parachutes. While the large parachutes would eventually sink and flatten, there is the potential that these decelerators/parachutes could remain suspended in the water column or billow at the seafloor for a longer period of time before flattening. The length of the parachute lines poses an entanglement risk as well. The main concentration of large decelerators/parachutes is expended within the Virginia Capes Range Complex, with the potential to be expended in the Northeast, Jacksonville, or Gulf of Mexico Range Complexes. For aerial targets that are launched from shore, as they would be in the Virginia Capes Range Complex, efforts are made to recover the large decelerators/parachutes if it is safe to do so; however, this analysis assumes they are not recovered. The extra-large decelerators/parachutes are only expended in the Virginia Capes Range Complex on an infrequent basis and during training only.

The chance that an individual animal would encounter expended decelerators/parachutes that have sunk to the bottom is low based on the sparse distribution of the decelerators/parachutes expended throughout the Study Area and the relatively few marine mammals that feed on the bottom. Mysticetes found within the AFTT Study Area are not expected to encounter decelerators/parachutes on the seafloor because, with the exception of humpback whales, they do not feed there. The majority of decelerators/parachutes will be expended in deep ocean areas, which are not the shallow water locations where humpback whales feed on the bottom. The possibility of odontocetes, pinnipeds, and manatees becoming entangled exists for species that feed on the bottom in areas where decelerators/parachutes have been expended. This is unlikely because decelerators/parachutes are primarily used in exercises that occur in waters far out to sea. Species that are known to feed on the bottom in deep water as well as the mid-water column include beaked whales, sperm whales, and dwarf/pygmy sperm whales. The possibility of these species becoming entangled exists if an animal is feeding in areas where decelerators/parachutes have been expended, but it is considered unlikely because of the infrequency of use of larger-sized decelerators/parachutes. Sunken decelerator/parachutes would eventually flatten and become encrusted with benthic organisms, lowering the risk of entanglement. There has never been any recorded or reported instance of a marine mammal becoming entangled in a decelerator/parachute; thus, decelerators/parachutes are not likely to be an entanglement hazard.

3.7.3.5.2.1 Impacts from Decelerators/Parachutes Under Alternative 1

Impacts from Decelerators/Parachutes Under Alternative 1 for Training Activities

Training activities under Alternative 1 would expend decelerators/parachutes within the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes, along with other AFTT areas. The area with the greatest concentration of small and medium expended decelerators/parachutes would be within the Jacksonville Range Complex, where one small parachute would be expended per 2 NM^2, if evenly distributed throughout the area. The area with the greatest concentration of large and extra-large expended decelerators/parachutes would be within the Virginia Capes Range Complex. These types of decelerators/parachutes would have the potential to be expended from shore seaward. Extra-large decelerators/parachutes are only expended within the Virginia Capes Range Complex. Refer to Appendix F (Military Expended Materials and Direct Strike Impact Analysis) for more detailed information on the area impacted by various military expended materials. The bowhead whale, narwhal, beluga whale, ringed seal, bearded seal, walrus, and polar bear do not occur in these areas and are not discussed further in this section.

Marine mammals resident to, or engaging in migratory, reproductive, and feeding behaviors within the range complexes of the AFTT Study Area may encounter decelerators/parachutes expended during Navy training activities. Potential entanglement impacts on blue whales are expected to be similar to those discussed in Section 3.7.3.5.2 (Impacts from Decelerators/Parachutes). Similarly, potential impacts on odontocete and pinniped species that occur in the areas listed above would be the same as what was described in Section 3.7.3.5.2 (Impacts from Decelerators/Parachutes). Based on the low concentration of expended decelerator/parachutes, the Navy anticipates that no marine mammals would become entangled in decelerators/parachutes.

Navy training activities would expend decelerators/parachutes within the North Atlantic right whale's designated critical habitat year-round. Since North Atlantic right whales occur within the southeast critical habitat area primarily in winter months and occur within the northeast critical habitat area during summer months, any potential overlap with Navy training activities in these areas would be seasonal. Based on the low concentration of decelerators/parachutes that would be expended within the Northeast, Virginia Capes, Navy Cherry Point, and Jacksonville Range Complexes, combined with the general discussion presented in Section 3.7.3.5 (Entanglement Stressors) and Section 3.7.3.5.2 (Impacts from Decelerators/Parachutes), the Navy does not anticipate that training activities involving decelerators/parachutes would entangle a North Atlantic right whale. Physical and biological features identified for North Atlantic right whale conservation and considered in the critical habitat designation include oceanic conditions that distribute and aggregate dense concentrations of copepods within the northern foraging habitats and water temperatures, depths, and sea surface conditions that are suitable for the southern calving habitats (National Marine Fisheries Service, 2015a). These habitat features would not be impacted by decelerators/parachutes.

Training activities that expend decelerators/parachutes will not occur within West Indian manatee critical habitat.

The use of decelerators/parachutes during training activities as described under Alternative 1 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of decelerators/parachutes during training activities as described under Alternative 1 would have no effect on North Atlantic right whale and West Indian manatee critical habitat. The use of decelerators/parachutes would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA. The Navy has consulted with NMFS and the USFWS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Decelerators/Parachutes Under Alternative 1 for Testing Activities

Testing activities proposed under Alternative 1 would expend decelerators/parachutes primarily within the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes. Other locations include the Naval Undersea Warfare Center Newport Testing Range; South Florida Ocean Measurement Facility Testing Range; and the Naval Surface Warfare Center, Panama City Testing Range. Decelerators/parachutes would be expended with greatest concentration in the Virginia Capes Range Complex; approximately one decelerator/parachute would be expended per 5 NM^2, if evenly distributed throughout the area. Refer to Appendix F (Military Expended Materials and Direct Strike Impact Analysis) for more detailed information on the area impacted by various military expended materials. The bowhead whale, narwhal, beluga whale, ringed seal, bearded seal, walrus, and polar bear do not occur in these areas and are not discussed further in this section.

Marine mammals resident to, or engaging in migratory, reproductive, and feeding behaviors within the range complexes of the AFTT Study Area may encounter decelerators/parachutes expended during Navy testing activities. Potential entanglement impacts on blue whales are expected to be similar to those discussed in Section 3.7.3.5.2 (Impacts from Decelerators/Parachutes). Similarly, potential impacts on odontocete and pinniped species would be the same as what was described in Section 3.7.3.5.2 (Impacts from Decelerators/Parachutes). Based on the low concentration of expended decelerators/parachutes, the Navy does not anticipate that the decelerators/parachutes would entangle any marine mammals in the AFTT Study Area.

Navy testing activities would expend decelerators/parachutes within the North Atlantic right whale's designated critical habitat year-round. Since North Atlantic right whales occur within the southeast critical habitat area primarily in winter months and occur within the northeast critical habitat area during summer months, any potential overlap with Navy testing activities in these areas would be seasonal. Based on the low concentration of decelerators/parachutes that would be expended with the Northeast and Virginia Capes Range Complexes, combined with the general discussion presented in Section 3.7.3.5 (Entanglement Stressors) and Section 3.7.3.5.2 (Impacts from Decelerators/Parachutes), the Navy does not anticipate that the decelerators/parachutes would entangle a North Atlantic right whale. Physical and biological features identified for North Atlantic right whale conservation and considered in the critical habitat designation include oceanic conditions that distribute and aggregate dense concentrations of copepods within the northern foraging habitats and water temperatures, depths, and sea surface conditions that are suitable for the southern calving habitats (National Marine Fisheries Service, 2015a). These habitat features would not be impacted by decelerators/parachutes expended during testing activities.

Testing activities that expend decelerators/parachutes would not be conducted within West Indian manatee critical habitat.

The use of decelerators/parachutes during testing activities as described under Alternative 1 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of decelerators/parachutes during testing activities as described under Alternative 1 would have no effect on North Atlantic right whale and West Indian manatee critical habitat. The use of decelerators/parachutes would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA. The Navy has consulted with NMFS and the USFWS as required by section 7(a)(2) of the ESA in that regard.

3.7.3.5.2.2 Impacts from Decelerators/Parachutes Under Alternative 2

Impacts from Decelerators/Parachutes Under Alternative 2 for Training Activities

The annual numbers of decelerators/parachutes expended during training activities within the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, and Key West Range Complexes and other AFTT areas are identical for Alternatives 1 and 2. However, training activities that expend decelerators/parachutes would increase within the Gulf of Mexico Range Complex under Alternative 2. The concentration of decelerators/parachutes released in the Gulf of Mexico Range Complex would be low; approximately one decelerator/parachute per 37 NM^2 if expended evenly throughout the area. Combined, there would be a 2 percent increase in the total number of expended decelerators/parachutes over 5 years across all range complexes mentioned above. This level of increase is not expected to substantially increase the risk of entanglement to marine mammals. Potential impacts from training activities that expend decelerators/parachutes under Alternative 2 would be the same as what was presented in Section 3.7.3.5.2.1 (Impacts from Decelerators/Parachutes Under Alternative 1) for training activities. Therefore, the Navy anticipates that no marine mammals would become entangled in decelerators/parachutes from training activities under Alternative 2.

The use of decelerators/parachutes during training activities as described under Alternative 2 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of decelerators/parachutes during training activities as described under Alternative 2 would have no effect on North Atlantic right whale and West Indian manatee critical habitat. The use of decelerators/parachutes would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA.

Impacts from Decelerators/Parachutes Under Alternative 2 for Testing Activities

The locations of testing activities that expend decelerators/parachutes are the same under Alternatives 1 and 2. However the total number of decelerators/parachutes expended during testing activities would increase by approximately 2 percent annually and by 9 percent over 5 years under Alternative 2. This level of increase is not expected to appreciably increase the risk of entanglement to marine mammals that occur in these areas. Potential impacts from testing activities that expend decelerators/parachutes presented in Section 3.7.3.5.2.1 (Impacts from Decelerators/Parachutes Under Alternative 1) for testing activities would be applicable to testing activities under Alternative 2. Therefore, the Navy anticipates that no marine mammals would become entangled in decelerators/parachutes.

The use of decelerators/parachutes during testing activities as described under Alternative 2 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of decelerators/parachutes during testing activities as described under Alternative 2 would have no effect on North Atlantic right whale and West Indian manatee critical habitat. The use of decelerators/parachutes would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA.

3.7.3.5.2.3 Impacts from Decelerators/Parachutes Under the No Action Alternative

Impacts from Decelerators/Parachutes Under the No Action Alternative for Training and Testing Activities

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

3.7.3.5.3 Impacts from Biodegradable Polymer

For a discussion of the types of activities that use biodegradable polymers see Appendix B (Activity Stressor Matrices) and for a discussion on where they are used and how many activities would occur under each alternative, see Section 3.0.3.3.5.3 (Biodegradable Polymer). Navy activities that involve vessel entanglement systems include the development of the biodegradable polymer and would be associated with testing activities in the AFTT Study Area. As indicated by its name, vessel entanglement systems that make use of biodegradable polymers are designed to entangle the propellers of in-water vessels, which would significantly slow and potentially stop the advance of the vessel. Biodegradable polymers degrade to smaller compounds as a result of microorganisms and enzymes. The rate of biodegradation could vary from hours to years and the type of small molecules formed during degradation can range from complex to simple products, depending on whether the polymers are natural or synthetic (Karlsson & Albertsson, 1998). Based on the constituents of the biodegradable polymer the Navy proposes to use, it is anticipated that the material will breakdown into small pieces within a few days to weeks. This will breakdown further and dissolve into the water column within weeks to a few months. The final products which are all environmentally benign will be dispersed quickly to undetectable concentrations. Unlike other entanglement stressors, biodegradable polymers only retain their strength for a relatively short period of time, therefore the potential for entanglement by a 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.

3.7.3.5.3.1 Impacts from Biodegradable Polymer Under Alternative 1

Impacts from Biodegradable Polymer Under Alternative 1 for Training Activities

Biodegradable polymer would not be used during Navy training activities associated with the Proposed Action.

Impacts from Biodegradable Polymer Under Alternative 1 for Testing Activities

Testing activities under Alternative 1 that use biodegradable polymers would be conducted within the Virginia Capes, Jacksonville, Gulf of Mexico, and Key West Range Complexes, as well as the Naval Undersea Warfare Division, Newport Testing Range. The number of testing activities involving biodegradable polymers conducted in these areas is relatively low, as shown in Table 3.0-42 (Number and Location of Activities Including Biodegradable Polymers During Testing). Based on the small levels of activity, the concentration of these items being expended throughout these areas is likewise considered low and the Navy does not anticipate that any marine mammals would become entangled with biodegradable polymers. The bowhead whale, narwhal, beluga whale, ringed seal, bearded seal, walrus, and polar bear do not occur in areas where biodegradable polymers would be expended and, therefore, would not be exposed to this stressor.

Navy testing activities that expend biodegradable polymers would not be conducted in the northeast critical habitat area, but would be conducted in the southeast critical habitat area within the Jacksonville Range Complex. Since North Atlantic right whales occur within the southeast critical habitat area primarily in winter months, any potential overlap with Navy testing activities in this area would be seasonal. The Navy does not anticipate that the expended biodegradable polymer would entangle a North Atlantic right whale. Physical and biological features identified for North Atlantic right whale conservation and considered in the critical habitat designation include water temperatures, depths, and sea surface conditions that are suitable for the southern calving habitats (National Marine Fisheries Service, 2015a). These habitat features would not be impacted by biodegradable polymers.

Although manatees may occur in coastal areas of the Gulf of Mexico, testing activities that expend biodegradable polymers would not take place in shallow waters where manatees would be present and, therefore, manatees would not encounter these items. Testing activities that expend biodegradable polymers would not occur within West Indian manatee critical habitat.

The use of biodegradable polymers during testing activities as described under Alternative 1 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of biodegradable polymers during testing activities as described under Alternative 1 would have no effect on North Atlantic right whale and West Indian manatee critical habitat. The use of biodegradable polymers would have no effect on the bowhead whale, ringed seal, and West Indian manatee and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, and sperm whale, as defined by the ESA. The Navy has consulted with NMFS and the USFWS as required by section 7(a)(2) of the ESA in that regard.

3.7.3.5.3.2 Impacts from Biodegradable Polymer Under Alternative 2

Impacts from Biodegradable Polymer Under Alternative 2 for Training Activities

Biodegradable polymers would not be used during Navy training activities associated with the Proposed Action.

Impacts from Biodegradable Polymer Under Alternative 2 for Testing Activities

As discussed in Section 3.0.3.3.5.3 (Biodegradable Polymer) the locations and numbers of activities that include biodegradable polymers would be the same under Alternatives 1 and 2. Therefore potential effects associated with biodegradable polymers would also be same. Refer to Section 3.7.3.5.3.1 (Impacts from Biodegradable Polymer Under Alternative 1) for a discussion of potential impacts on marine mammals.

The use of biodegradable polymers during testing activities as described under Alternative 2 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

The use of biodegradable polymers during testing activities as described under Alternative 2 would have no effect on North Atlantic right whale and West Indian manatee critical habitat. The use of biodegradable polymers would have no effect on the bowhead whale, ringed seal, and West Indian manatee, may affect blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, and sperm whale, and have no effect on West Indian manatees, as defined by the ESA.

3.7.3.5.3.3 Impacts from Biodegradable Polymer Under the No Action Alternative

Impacts from Biodegradable Polymer Under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the proposed training or testing activities in the AFTT Study Area. Biodegradable polymer use is not a part of ongoing Navy activities in the Study Area and this entanglement stressor would not be introduced into the marine environment under the No Action Alternative. Therefore no change in baseline conditions of the existing environment would occur.

3.7.3.6 Ingestion Stressors

This section analyzes the potential impacts of the various types of ingestion stressors used during training and testing activities within the Study Area. This analysis includes the potential impacts from the following types of military expended materials: non-explosive practice munitions (small- and medium-caliber), fragments from high-explosives, fragments from targets, chaff, flare casings (including plastic end caps and pistons), decelerators/parachutes, and biodegradable polymers. For a discussion on the types of activities that use these materials refer to Appendix B (Activity Stressor Matrices) and for a discussion on where they are used and how many items would be expended under each alternative, see Section 3.0.3.3.6 (Ingestion Stressors). General discussion of impacts can also be found in Section 3.0.3.6.5 (Conceptual Framework for Assessing Effects from Ingestion).

The distribution and density of expended items plays a central role in the likelihood of impact on marine mammals. The Navy conducts training and testing activities throughout the Study Area and those that result in expended materials that could be ingested are widely distributed and low in density. The majority of material expended during Navy training and testing activities would likely penetrate into the seafloor and not be accessible to most marine mammals. Since potential impacts depend on where these items are expended and how a marine mammal feeds, the following subsections discuss important information for specific groups or species.

Mysticetes

Since baleen whales feed by filtering large amounts of water, they like encounter and consume plastic debris at higher rates than other marine animals (National Oceanic and Atmospheric Administration Marine Debris Program, 2014a). Species that feed at the surface or in the water column include blue, fin, Bryde's, minke, and sei whales. While humpback whales may feed by lunging through the water after krill and fish, there are data confirming that humpback whales display bottom-feeding behaviors in areas of high concentrations of preferred prey, the northern sand lance (*Ammodytes dubius*) (Hain et al., 1995; Ware et al., 2014).

Baleen whales are believed to routinely encounter microplastics within the marine environment based on concentrations of these items and baleen whale feeding behaviors (Andrady, 2011). Observations of bowhead whale mouths have provided insights into potential threats to bowhead and right whales from oral entanglement of marine debris, including a greater probability of lethal consequences due to interference of the hydrostatic oral seal (Lambertsen et al., 2005). In a comprehensive review of documented ingestion of debris by marine mammals by Laist (1997), there are two species of mysticetes (bowhead and minke whale) with records of having ingested debris items that included plastic sheeting and a polythene bag. This effort was followed up by a comparative summary of the earlier review with additional information and the number of mysticete species with documented records of ingestion increased to seven species, including right whales, pygmy right whales, gray whales, and four rorqual species (Bergmann et al., 2015). Information compiled by (Williams et al., 2011) listed humpback whale, fin whale, minke whale as three species of mysticetes known to have ingested debris including items the authors characterized as fishing gear, polyethylene bag, plastic sheeting, plastic bags, rope, and general debris. Besseling et al. (2015) documented the first occurrence of microplastics in the intestines of a humpback whale.

Feeding behaviors of mysticete species suggest that potential encounters with ingestion stressors would only occur when the items are on the water surface at the same time and locations where animals are skim feeding or while engulfing prey in the water column as items sink to the bottom. Bottom-feeding humpback whales may also encounter ingestion stressors that have already sunk.

Odontocetes

Beaked whales use suction feeding to ingest benthic prey and may incidentally ingest other items (MacLeod et al., 2003). Both sperm whales and beaked whales are known to incidentally ingest foreign objects while foraging; however, this does not always result in negative consequences to health or vitality (Laist, 1997; Walker & Coe, 1990). While this incidental ingestion has led to sperm whale mortality in some cases, (Whitehead, 2003) suggested the scale to which this affects sperm whale populations was not substantial. Sperm whales are recorded as having ingested fishing net scraps, rope, wood, and plastic debris such as plastic bags and items from the seafloor (Jacobsen et al., 2010; Walker & Coe, 1990; Whitehead, 2003).

Weaned juveniles who are investigating multiple types of prey items, may be particularly vulnerable to ingesting non-food items, as found in a study of juvenile harbor porpoises (Baird & Hooker, 2000). A male pygmy sperm whale reportedly died from blockage of two stomach compartments by hard plastic, and a Blainville's beaked whale (*Mesoplodon densirostris*) washed ashore in Brazil with a ball of plastic thread in its stomach (Derraik, 2002). In a comprehensive review of documented ingestion of debris by marine mammals, odontocetes had the most ingestion records, with 21 species represented (Laist, 1997). A follow-up to this review revealed an increase in odontocete ingestion of marine debris. Bergmann et al. (2015) reported 40 odontocete species have documented records of ingestion.

Pinnipeds

Pinnipeds are opportunistic foragers, primarily feeding within the water column, but may also forage on the seafloor. Most of the seal species within the AFTT Study Area feed both within the water column and on the seafloor, and walruses feed primarily on benthic invertebrates (Bluhm & Grandinger, 2008). In a review of documented ingestion of debris by marine animals, 36 percent of seal species were found to have ingested plastics (Kuhn et al., 2015). Laist (1997) reported ingestion of Styrofoam cups by northern elephant seals and Steller sea lions, and Bravo Rebolledo et al. (2013) reported plastics in the diet of harbor seals. There is a possibility of prey species transferring ingested debris to predators that consume then, as demonstrated by Eriksson and Burton (2003) for fur seals. This suggests that the risk of marine mammals ingesting debris may also depend on the likelihood that prey items would ingest debris. Even though some pinniped species feed on the bottom, such as harbor seals, it is unlikely that pinnipeds would encounter and incidentally or mistakenly consume military expended items associated with proposed Navy training and testing activities.

Polar Bears

Polar bears feed primarily on other marine mammals (especially ringed seals, bearded seals, and harp seals) while on land and ice or out at sea (Bluhm & Grandinger, 2008). Plastics have also been found when assessing food items identified in scat samples (Iversen et al., 2013).

West Indian Manatees

Manatees feed on seagrass beds in relatively shallow coastal or estuarine waters. In a comprehensive review of documented ingestion of debris by marine mammals, the West Indian manatee had ingestion records that included monofilament line, plastic bags, string, twine, rope, fish hooks, wire, paper, cellophane, and rubber bands (Laist, 1997). Some researchers suggest that manatees incidentally ingest fishing gear and plastic while foraging on plants in shallow habitats where debris can accumulate and become entwined in the food resources (Adimey et al., 2014; Beck & Barros, 1991). Ingestion of fishing gear can cause impaction, abdominal infections, inversions of the intestine (Beck & Barros, 1991) and other indirect effects.

3.7.3.6.1 Impacts from Military Expended Materials - Munitions

Different types of explosive and non-explosive practice munitions are expended offshore and within inshore waters during training and testing activities. This section analyzes the potential for marine mammals to ingest non-explosive practice munitions (to include munitions casings) and fragments from high-explosive munitions.

Types of non-explosive practice munitions generally include projectiles, missiles, and bombs. Of these, only small- or medium-caliber projectiles would be small enough for a marine mammal to ingest. Small- and medium-caliber projectiles include all sizes up to and including 2.25 in. in diameter. These solid metal materials would quickly move through the water column and settle to the seafloor. Ingestion of non-explosive practice munitions is not expected to occur in the water column because the munitions sink quickly. Instead, they are most likely to be encountered by species that forage on the bottom.

Types of high-explosive munitions that can result in fragments include demolition charges, projectiles, missiles, and bombs. Fragments would result from fractures in the munitions casing and would vary in size depending on the size of the NEW and munitions type; however, typical sizes of fragments are unknown. These solid metal materials would quickly move through the water column and settle to the seafloor; therefore, ingestion is not expected by most species. Fragments are primarily encountered by species that forage on the bottom. Other military expended materials such as targets, large-caliber projectiles, intact training and testing bombs, guidance wires, 55-gallon drums, sonobuoy tubes, and marine markers are too large for marine mammals to consume.

Based on the information summarized above in Section 3.7.3.6 (Ingestion Stressors), mysticetes found within the Study Area, with the exception of bottom-feeding humpback whales, are not expected to encounter non-explosive practice munitions on the seafloor. Ingestion of non-explosive practice munitions by odontocetes is likely to be incidental, with items being potentially consumed along with bottom-dwelling prey. Although incidental ingestion of non-explosive practice munitions by pinnipeds is not supported by autopsy evidence from stranded animals, it is possible because they feed on the seafloor. Polar bears feed primarily on other marine mammals and are not likely to encounter non-explosive practice munitions on the seafloor. Although manatees feed on the bottom, they only occur in limited areas where training activities would expend these items.

3.7.3.6.1.1 Impacts from Military Expended Materials - Munitions Under Alternative 1

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

Non-explosive Practice Munitions and Fragments from High-Explosive Munitions

As discussed in Section 3.0.3.3.6 (Ingestion Stressors), offshore training activities that expend non-explosive practice munitions and high-explosive munitions fragments would occur within the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes, as well as other AFTT areas outside of the range complexes. In addition, training activities that expend non-explosive practice munitions and high-explosive munitions fragments would occur within inshore waters including and surrounding Narragansett, Rhode Island; James River and tributaries; the Lower Chesapeake Bay; Cooper River, South Carolina; and Port Canaveral, Florida. Species occurring outside of these areas, including the bowhead whale, narwhal, beluga whale, ringed seal, bearded seal, walrus, and polar bear would not be exposed to potential ingestion stressors associated with Navy training activities.

The amount of non-explosive practice munitions and high-explosive munitions fragments that an individual animal would encounter is generally low based on the patchy distribution of both the projectiles and an animal's feeding habits. An animal would not necessarily ingest every projectile it encountered and if an animal attempts to ingest a projectile, it may reject it when it realizes it is not a food item. Nonetheless, research suggests that ingestion of certain non-food items would not result in injury or mortality to an individual, if the items do not become embedded in tissue (Wells et al., 2008a). Therefore, potential ingestion impacts from non-explosive practice munitions and fragments from high explosives would only occur in the unlikely event in which a marine mammal encounters an item, ingests it, and that item subsequently becomes embedded in tissue or is too large to pass through the digestive system. The Navy considers the likelihood of this occurring to be very low.

Marine mammals resident to, or engaging in migratory, reproductive, and feeding behaviors within the range complexes listed above need to be evaluated based on their feeding habits and potential to encounter non-explosive practice munitions and fragments from high-explosive munitions. Aside from humpback whales, most mysticete species that occur where these training activities take place are not expected to encounter military expended materials because they feed near the surface or within the water column. Odontocetes, pinnipeds, and manatees that occur in these areas and forage on the bottom may encounter military expended materials, but as previously stated, the possibility is considered low. Therefore, the Navy does not anticipate that any marine mammals would experience adverse ingestion impacts from non-explosive practice munitions and high-explosive munition fragments associated with training activities under Alternative 1.

Navy training activities that expend non-explosive practice munitions and high-explosive munitions fragments would occur within the North Atlantic right whale's designated critical habitat year-round. Since North Atlantic right whales occur within the southeast critical habitat area primarily in winter months and occur within the northeast critical habitat area during summer months, any potential overlap with Navy training activities in these areas would be seasonal. Similar to other mysticete species, feeding behaviors of North Atlantic right whales would only contribute to the risk of ingestion when they encounter items on the surface during skim feeding or in the water column while engulfing prey, which is not considered likely. Physical and biological features identified for North Atlantic right whale conservation and considered in the critical habitat designation include oceanic conditions that distribute and aggregate dense concentrations of copepods within the northern foraging habitats and water temperatures, depths, and sea surface conditions that are suitable for the southern calving habitats (National Marine Fisheries Service, 2015a). These habitat features would not be impacted by expended non-explosive practice munitions and high-explosive munitions fragments.

Training activities that expended non-explosive practice munitions and high-explosive munitions would occur within West Indian manatee designated critical habitat, specifically within inshore waters near Port Canaveral, Florida. Generally, manatees occur in limited areas where training activities would expend these items and the number of items expended within inshore waters where manatees feed is low compared to the total number of items expended throughout the AFTT Study Area. Therefore, the Navy does not anticipate that manatees would ingest non-explosive practice munitions and high-explosive munition fragments. The current critical habitat designation for the West Indian manatee does not identify specific physical and biological features essential for species conservation, but essential habitat features have been reported to include warm water refuges, various food sources (seagrasses and freshwater vegetation), travel corridors, and shelter for calving (75 *Federal Register* 1574–1581, January 12, 2010). These habitat features would not be impacted by military expended materials other than munitions.

Training activities involving military expended materials as described under Alternative 1 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

Training activities involving military expended materials–munitions as described under Alternative 1 would have no effect on North Atlantic right whale and West Indian manatee critical habitat. Training activities involving military expended materials–munitions would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA. The Navy has consulted with NMFS and the USFWS as required by section 7(a)(2) of the ESA in that regard.

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

Non-explosive Practice Munitions and Fragments from High-Explosive Munitions

As discussed in Section 3.0.3.3.6 (Ingestion Stressors), testing activities involving non-explosive practice munitions and high-explosive munitions fragments would be expended within the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes, as well as the Naval Undersea Warfare Center Newport Testing Range, the South Florida Ocean Measurement Facility, and the Naval Surface Warfare Center Panama City Testing Range. Species occurring outside of these areas, including the bowhead whale, narwhal, beluga whale, ringed seal, bearded seal, walrus, and polar bear would not be exposed to potential ingestion stressors associated with Navy testing activities.

The amount of non-explosive practice munitions and high-explosive munitions fragments that an individual animal would encounter is generally low based on the patchy distribution of both the projectiles and an animal's feeding habitat. An animal would not necessarily ingest every projectile it encountered. Furthermore, if an animal attempts to ingest a projectile it may reject it when it realizes it is not a food item. Nonetheless, research suggests that ingestion of certain non-food items would not result in injury or mortality to the individual, if the items do not become embedded in tissue (Wells et al., 2008a). Therefore, potential ingestion impacts from non-explosive practice munitions and fragments from high-explosive munitions would only occur in the unlikely event in which a marine mammal encounters an item, ingests it, and that item subsequently becomes embedded in tissue or is too large to be passed through the digestive system. The Navy considers the likelihood of this occurring to be very low.

Marine mammals resident to, or engaging in migratory, reproductive, and feeding behaviors within the range complexes listed above need to be evaluated based on their feeding habits and potential to encounter non-explosive practice munitions and fragments from high-explosive munitions. Aside from humpback whales, most mysticete species that occur where these training activities take place are not expected to encounter military expended materials–munitions because they feed near the surface or within the water column. Odontocete and pinniped species that occur in these areas and forage on the bottom may encounter military expended materials–munitions, but as previously stated, the possibility is considered low. Therefore, the Navy does not anticipate that any marine mammals would experience adverse ingestion impacts from non-explosive practice munitions and high-explosive munition fragments associated with testing activities under Alternative 1.

Navy testing activities that expend non-explosive practice munitions and high-explosive munition fragments would occur within the North Atlantic right whale's designated critical habitat year-round. Since North Atlantic right whales occur within the southeast critical habitat area primarily in winter months and occur within the northeast critical habitat area during summer months, any potential overlap with Navy testing activities in these areas would be seasonal. Similar to other mysticete species, feeding behaviors of North Atlantic right whales would only contribute to the risk of ingestion when they encounter items on the surface during skim feeding or in the water column while engulfing prey, which is not considered likely. Physical and biological features identified for North Atlantic right whale conservation and considered in the critical habitat designation include oceanic conditions that distribute and aggregate dense concentrations of copepods within the northern foraging habitats and water temperatures, depths, and sea surface conditions that are suitable for the southern calving habitats (National Marine Fisheries Service, 2015a). These habitat features would not be impacted by expended non-explosive practice munitions and high-explosive munitions fragments.

The potential for manatees to ingest non-explosive practice munitions and high-explosive munition fragments would be very low based on the limited overlap between West Indian manatee occurrence and the Study Area. The Navy does not anticipate that a West Indian manatee would ingest non-explosive practice munitions and high-explosive munition fragments. In addition, testing activities that expended non-explosive practice munitions and high-explosive munition fragments would not be conducted within West Indian manatee critical habitat.

Testing activities involving military expended materials–munitions as described under Alternative 1 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

Testing activities involving military expended materials–munitions as described under Alternative 1 would have no effect on North Atlantic right whale and West Indian manatee critical habitat. Testing activities involving military expended materials–munitions would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA. The Navy has consulted with NMFS and the USFWS as required by section 7(a)(2) of the ESA in that regard.

3.7.3.6.1.2 Impacts from Military Expended Materials - Munitions Under Alternative 2

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

Non-explosive Practice Munitions and Fragments from High-Explosive Munitions

Training activities that expend non-explosive practice munitions and high-explosive munition fragments are the same under Alternatives 1 and 2. Therefore, the analysis presented in Section 3.7.3.6.1.1 (Impacts from Military Expended Materials - Munitions Under Alternative 1) for training activities would also apply to training activities proposed for Alternative 2.

Training activities involving military expended materials–munitions as described under Alternative 2 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

Training activities involving military expended materials–munitions as described under Alternative 2 would have no effect on North Atlantic right whale and West Indian manatee critical habitat. Training activities involving military expended materials–munitions would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA.

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

Non-explosive Practice Munitions and Fragments from High-Explosive Munitions

Locations and annual testing activities that expend non-explosive practice munitions would be identical under Alternatives 1 and 2. However, the numbers of non-explosive practice munitions expended over 5 years would increase by 2 percent under Alternative 2. The locations where high-explosive munitions resulting in fragments would be expended during testing activities are also the same under both alternatives. However, the numbers of high-explosives resulting in fragments expended would slightly increase under Alternative 2 by 0.02 percent annually and by 6 percent over 5 years. This increased use of munition-related military expended materials would be fractional and would not appreciably increase the potential for adverse ingestion impacts on marine mammals. Therefore, the analysis presented in Section 3.7.3.6.1.1 (Impacts from Military Expended Materials - Munitions Under Alternative 1) for testing activities would also apply to testing activities proposed for Alternative 2.

Testing activities involving military expended materials–munitions as described under Alternative 2 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

Testing activities involving military expended materials–munitions as described under Alternative 2 would have no effect on North Atlantic right whale and West Indian manatee critical habitat. Testing activities involving military expended materials–munitions would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA.

3.7.3.6.1.3 Impacts from Military Expended Materials - Munitions Under the No Action Alternative

Impacts from Military Expended Materials - Munitions Under the No Action Alternative for Training and Testing Activities

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

3.7.3.6.2 Impacts from Military Expended Materials Other Than Munitions

Several different types of materials other than munitions are expended during training and testing activities in the AFTT Study Area. The following military expended materials other than munitions have the potential to be ingested by marine mammals:

- target-related materials
- chaff (including fibers, end caps, and cartridges)
- flares (including end caps, compression pads/pistons, and O-rings)
- decelerators/parachutes (cloth, nylon, and metal weights)
- biodegradable polymer

Target-Related Materials

At-sea targets are usually remotely operated airborne, surface, or subsurface traveling units, most of which are designed to be recovered for reuse. If they are severely damaged or displaced, targets may sink before they can be retrieved. Expendable targets include air-launched decoys, marine markers (smoke floats), cardboard boxes, and 10-ft. diameter red balloons tethered by a sea anchor. Most target fragments would sink quickly in the sea. Floating material, such as Styrofoam, may be lost from target boats and remain at the surface for some time, however during target recovery, personnel would collect as much floating debris and Styrofoam as possible.

Chaff

Chaff is an electronic countermeasure designed to reflect radar waves and obscure aircraft, vessels, and other equipment from radar tracking sources. Chaff is composed of an aluminum-coated glass fibers of silicon dioxide (U.S. Air Force, 1997). It is released or dispensed in cartridges or projectiles that contain millions of chaff fibers. When deployed, a diffuse cloud of fibers undetectable to the human eye is formed. Chaff is a very light material that can remain suspended in air anywhere from 10 minutes to 10 hours and can travel considerable distances from its release point, depending on prevailing atmospheric conditions (Arfsten et al., 2002; U.S. Air Force, 1997). Doppler radar has tracked chaff plumes containing approximately 900 grams (g) of chaff drifting 200 mi. from the point of release, with the plume covering greater than 400 cubic miles (1,667 cubic kilometers) (Arfsten et al., 2002).

The chaff concentrations that marine mammals could be exposed to following release of multiple cartridges (e.g., following a single day of training) are difficult to accurately estimate because it depends on several unknown factors. First, specific release points are not recorded and tend to be random, and chaff dispersion in air depends on prevailing atmospheric conditions. After falling from the air, chaff fibers would be expected to float on the sea surface for some period, depending on wave and wind action. The fibers would be dispersed further by sea currents as they float and slowly sink toward the bottom. Chaff concentrations in benthic habitats following release of a single cartridge would be lower than the values noted in this section, based on dispersion by currents and the enormous dilution capacity of the receiving waters.

Several literature reviews and controlled experiments have indicated that chaff poses little risk, except at concentrations substantially higher than those that could reasonably occur from military training (Arfsten et al., 2002; U.S. Air Force, 1997; U.S. Department of the Navy, 1999). Nonetheless, some marine mammal species within the Study Area could be exposed to chaff through direct body contact and ingestion. Chemical alteration of water and sediment from decomposing chaff fibers is not expected to result in exposure. Based on the dispersion characteristics of chaff, it is likely that marine mammals would occasionally come in direct contact with chaff fibers while at the water's surface and while submerged, but such contact would be inconsequential. Chaff is similar to fine human hair (U.S. Air Force, 1997). Because of the flexibility and softness of chaff, external contact would not be expected to impact most wildlife (U.S. Air Force, 1997) and the fibers would quickly wash off shortly after contact. Given the properties of chaff, skin irritation is not expected to be a problem (U.S. Air Force, 1997). Arfsten et al. (2002), Hullar et al. (1999), and U.S. Air Force (1997) reviewed the potential effects of chaff inhalation on humans, livestock, and other animals and concluded that the fibers are too large to be inhaled into the lungs. The fibers are predicted to be deposited in the nose, mouth, or trachea and are either swallowed or expelled; however, these reviews did not specifically consider marine mammals.

Based on the small size of chaff fibers, it appears unlikely that marine mammals would confuse the fibers with prey or feed on chaff fibers. However, marine mammals could occasionally ingest low concentrations of chaff incidentally from the surface, water column, or seafloor. While no studies were conducted to evaluate the effects of chaff ingestion on marine mammals, the effects are expected to be negligible, based on the low concentrations that could reasonably be ingested, the small size of chaff fibers, and available data on the toxicity of chaff and aluminum. In laboratory studies conducted by the University of Delaware (U.S. Department of the Navy, 1999), blue crabs and killifish were fed a food-chaff mixture daily for several weeks, and no significant mortality was observed at the highest exposure treatment. Similar results were found when chaff was added directly to exposure chambers containing filter-feeding menhaden. Histological examination indicated no damage from chaff exposures. A study on cow calves that were fed chaff found no evidence of digestive disturbance or other clinical symptoms (U.S. Air Force, 1997). Based on the dispersion characteristics of chaff, it is possible that marine mammals would occasionally come in direct contact with chaff fibers while either at the water's surface or while submerged, but such contact would be inconsequential.

Chaff cartridges, chaff canisters, and chaff components, including end caps, would also be released into the marine environment, where they would persist for long periods and could be ingested by marine mammals while initially floating on the surface and sinking through the water column. Chaff end caps and pistons would eventually sink in saltwater to the seafloor (Spargo, 2007), which reduces the likelihood of ingestion by marine mammals at the surface or in the water column.

Flares

Flares are designed to burn completely. The only material that would enter the water would be a small, round, plastic compression pad or piston (0.45 to 4.1 g depending on flare type). The flare compression pads and pistons float in sea water.

An extensive literature review and controlled experiments conducted by the U.S. Air Force demonstrated that self-protection flare use poses little risk to the environment or animals (U.S. Air Force, 1997). Nonetheless, marine mammals within the vicinity of flares could be exposed to light generated by the flares. Pistons and end caps from flares would have the same impact on marine mammals as discussed under chaff cartridges. It is unlikely that marine mammals would be exposed to any chemicals that produce either flames or smoke since these components are consumed in their entirety during the burning process. Animals are unlikely to approach or get close enough to the flame to be exposed to any chemical components.

Decelerators/Parachutes

As previously noted in Section 3.7.3.5.2 (Impacts from Decelerators/Parachutes), decelerators/ parachutes are classified into four different categories based on size: small, medium, large, and extra-large. The majority of expended decelerators/parachutes are in the small category, primarily associated with the use of sonobuoys. Decelerators/parachutes in the three remaining size categories (medium, up to 19 ft. in diameter; large, between 30 and 50 ft. in diameter; and extra-large, up to 80 ft. in diameter) are likely too big to be mistaken for prey items and ingested by a marine mammal. Therefore, only the small-sized decelerators/parachutes are considered further as potential ingestion stressors.

The majority of decelerators/parachutes are weighted and by design specification must sink below the surface within 5 minutes of contact with the water. Once on the seafloor, decelerators/parachutes become flattened (Environmental Sciences Group, 2005). Ingestion of a small decelerator/parachute by a marine mammal at the surface or within the water column would be unlikely, since the decelerator/parachute would not be available for very long before it sinks. Once on the seafloor, if bottom currents are present, the canopy may temporarily billow and be available for potential ingestion by marine animals with bottom-feeding habits.

Based on the information summarized above within the introduction to Section 3.7.3.6 (Ingestion Stressors), mysticetes found within the AFTT Study Area, with the exception of bottom-feeding humpback whales, are not expected to encounter decelerators/parachutes on the seafloor because they do not feed there. In general, the majority of the decelerators/parachutes (from sonobuoys) would be expended in deep ocean areas where humpback whales do not feed on the bottom. Ingestion of decelerators/parachutes by odontocetes and pinnipeds is unlikely but is possible if individuals are feeding on the bottom.

Biodegradable Polymer

As stated in Section 3.0.3.3.5.3 (Biodegradable Polymer) based on the constituents of the biodegradable polymer, it is anticipated that the material will break down into small pieces within a few days to weeks. The small pieces will breakdown further and dissolve into the water column within weeks to a few months and could potentially be incidentally ingested by marine mammals. 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.

3.7.3.6.2.1 Impacts from Military Expended Materials Other Than Munitions Under Alternative 1

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

As presented in Section 3.0.3.3.6 (Ingestion Stressors), military expended materials other than munitions would be expended during offshore training activities within the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes as well as other areas outside the range complexes. In addition, training activities that expend materials other than munitions would occur within inshore waters including and surrounding Narragansett Bay, Rhode Island; James River and tributaries; York River, Virginia; the Lower Chesapeake Bay; Cooper River, South Carolina; and Port Canaveral, Florida. Species that do not occur in these areas, including the bowhead whale, narwhal, beluga whale, ringed seal, bearded seal, harp seal, walrus, and polar bear, would not encounter military expended materials other than munitions and are not further analyzed in this section.

Target-related material, chaff, flares, decelerators/parachutes, and their subcomponents have the potential to be ingested by a marine mammal, although that is considered unlikely since most of these materials would quickly drop through the water column and settle on the seafloor. Some Styrofoam, plastic endcaps, chaff, and other small items may float for some time before sinking.

While the smaller items discussed here may pose a hazard to marine mammals, as discussed for non-explosive practice munitions ingestion, the impacts of ingesting these forms of expended materials on marine mammals would be minor because of the following factors:

- the limited geographic area where materials other than munitions are expended during a given event
- the limited period of time these military expended materials would remain in the water column
- the unlikely chance that a marine mammal might encounter and swallow these items on the seafloor, particularly given that many of these items would be expended over deep, offshore waters

The impacts of ingesting military expended materials other than munitions would be limited to cases where an individual marine mammal might eat an indigestible item too large to be passed through the gut. The marine mammals would not be preferentially attracted to these military expended materials, with the possible exception of decelerators/parachutes that may appear similar to the prey of some species such as sperm whales and beaked whales. For the most part, these military expended materials would most likely only be incidentally ingested by individuals feeding on the bottom in the precise location where these items were deposited. Non-munition military expended materials that would remain floating on the surface are too small to pose a risk of intestinal blockage to any marine mammal that happened to encounter it.

Marine mammals resident to, or engaging in migratory, reproductive, and feeding behaviors within the range complexes listed above need to be evaluated based on their feeding habits and potential to encounter projectiles. Aside from humpback whales, most mysticete species that occur where these training activities are conducted are not expected to encounter non-munition military items because they feed near the surface or within the water column. Odontocete and pinniped species that occur in these areas and forage on the bottom may encounter non-munition military expended materials, but as previously stated, the possibility is considered low. Therefore, the Navy does not anticipate that any marine mammals would experience adverse ingestion impacts from target-related material, chaff, flares, and decelerators/parachutes associated with training activities under Alternative 1.

Navy training activities that expend non-munition military expended materials would occur within the North Atlantic right whale's designated critical habitat year-round. Since North Atlantic right whales occur within the southeast critical habitat area primarily in winter months and occur within the northeast critical habitat area during summer months, any potential overlap with Navy training activities in these areas would also be seasonal. The Navy does not anticipate that North Atlantic right whales would ingest non-munition military expended materials. Physical and biological features identified for North Atlantic right whale conservation and considered in the critical habitat designation include oceanic conditions that distribute and aggregate dense concentrations of copepods within the northern foraging habitats and water temperatures, depths, and sea surface conditions that are suitable for the southern calving habitats (National Marine Fisheries Service, 2015a). These habitat features would not be impacted by military expended materials other than munitions.

Manatees occur in limited areas where training activities would expend non-munition military items and the number of items expended within inshore waters where manatees feed is low compared to the total number of items expended throughout the AFTT Study Area. Therefore, the Navy does not anticipate that manatees would ingest non-munition military expended materials. Training activities that expend non-munition military expended materials would occur within West Indian manatee designated critical habitat, specifically within inshore waters near Port Canaveral, Florida. The current critical habitat designation for the West Indian manatee does not identify specific physical and biological features essential for species conservation, but essential habitat features have been reported to include warm water refuges, various food sources (seagrasses and freshwater vegetation), travel corridors, and shelter for calving (75 *Federal Register* 1574–1581, January 12, 2010). These habitat features would not be impacted by military expended materials other than munitions.

Training activities involving military expended materials other than munitions as described under Alternative 1 will not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

Training activities involving military expended materials other than munitions as described under Alternative 1 would have no effect on North Atlantic right whale and West Indian manatee critical habitats. Training activities involving military expended materials other than munitions would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA. The Navy has consulted with NMFS and the USFWS as required by section 7(a)(2) of the ESA in that regard.

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

As presented in Section 3.0.3.3.6 (Ingestion Stressors) military expended materials other than munitions would be expended during testing activities within the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Gulf of Mexico, and Key West Range Complexes, as well as the Naval Undersea Warfare Center, Division Newport Testing Rage; South Florida Ocean Measurement Facility Testing Range; and Naval Surface Warfare Center, Panama City Division Testing Ranges. Species that do not occur in these areas, including the bowhead whale, narwhal, beluga whale, ringed seal, bearded seal, harp seal, walrus, and polar bear, would not encounter military expended materials other than munitions and are not further analyzed in this section.

Target-related material, chaff, flares, decelerators/parachutes, biodegradable polymers, and their subcomponents have the potential to be ingested by a marine mammal, although most of these materials would quickly drop through the water column and settle on the seafloor. Some Styrofoam, plastic endcaps, and other small items may float for some time before sinking. In addition, biodegradable polymer fragments would only be temporarily available within the water column as they tend to disintegrate fairly quickly.

While the smaller items discussed here may pose a hazard to marine mammals, as discussed for non-explosive practice munitions ingestion, the impacts of ingesting these forms of expended materials on marine mammals would be minor because of the following factors:

- the limited geographic area where materials other than munitions are expended during a given event
- the limited period of time these military expended materials would remain in the water column
- the unlikely chance that a marine mammal might encounter and swallow these items on the seafloor, particularly given that many of these items would be expended over deep, offshore waters

The impacts of ingesting military expended materials other than munitions would be limited to cases where an individual marine mammal might eat an indigestible item too large to be passed through the gut. The marine mammals would not be preferentially attracted to these military expended materials, with the possible exception of decelerators/parachutes that may appear similar to the prey of some species such as sperm whales and beaked whales. For the most part, these military expended materials would most likely only be incidentally ingested by individuals feeding on the bottom in the precise location where these items were deposited. Military expended materials other than munitions that would remain floating on the surface are too small to pose a risk of intestinal blockage to any marine mammal that happened to encounter it.

Marine mammals resident to, or engaging in migratory, reproductive, and feeding behaviors within the range complexes and testing ranges listed above need to be evaluated based on their feeding habits and potential to encounter military expended materials other than munitions. Aside from humpback whales, most mysticete species that occur where testing activities take place are not expected to encounter non-munition military items because they feed near the surface or within the water column. Odontocete and pinniped species that occur in these areas and forage on the bottom may encounter non-munition military expended materials, but as previously stated, the possibility is considered low. Therefore, the Navy does not anticipate that any marine mammals would experience adverse ingestion impacts from target-related material, chaff, flares, decelerators/parachutes, and biodegradable polymers associated with testing activities under Alternative 1.

Navy testing activities that expend non-munition military expended materials would occur within the North Atlantic right whale's designated critical habitat year-round. Since North Atlantic right whales occur within the southeast critical habitat area primarily in winter months and occur within the northeast critical habitat area during summer months, any potential overlap with Navy testing activities in these areas would also be seasonal. As previously described, the Navy does not anticipate that North Atlantic right whales would ingest non-munition military expended materials. Physical and biological features identified for North Atlantic right whale conservation and considered in the critical habitat designation include oceanic conditions that distribute and aggregate dense concentrations of copepods within the northern foraging habitats and water temperatures, depths, and sea surface conditions that are suitable for the southern calving habitats (National Marine Fisheries Service, 2015a). These habitat features would not be impacted by military expended materials other than munitions.

Manatees occur in limited portions of the Study Area, generally outside areas where testing activities would expend non-munition military items, therefore, the Navy does not anticipate that a West Indian manatee would ingest non-munition military expended materials associated with testing activities under Alternative 1. In addition, testing activities that expend non-munition military expended materials would not be conducted within West Indian manatee critical habitat.

Testing activities involving military expended materials other than munitions as described under Alternative 1 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

Testing activities involving military expended materials other than munitions as described under Alternative 1 would have no effect on North Atlantic right whale and West Indian manatee critical habitats. Testing activities involving military expended materials other than munitions would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA. The Navy has consulted with NMFS and the USFWS as required by section 7(a)(2) of the ESA in that regard.

3.7.3.6.2.2 Impacts from Military Expended Materials Other Than Munitions Under Alternative 2

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

As presented in Section 3.0.3.3.6 (Ingestion Stressors), military expended materials other than munitions used and expended during training activities are identical under Alternatives 1 and 2. Therefore, the analysis presented in Section 3.7.3.6.2.1 (Impacts from Military Expended Materials Other Than Munitions Under Alternative 1) for training activities would also apply to training activities proposed under Alternative 2.

Training activities involving military expended materials other than munitions as described under Alternative 2 will not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

Training activities involving military expended materials other than munitions as described under Alternative 2 would have no effect on North Atlantic right whale and West Indian manatee critical habitats. Training activities involving military expended materials other than munitions would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA.

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

As presented in Section 3.0.3.3.6 (Ingestion Stressors) military expended materials other than munitions used and expended during testing activities are identical under Alternatives 1 and 2. Therefore, the analysis presented in Section 3.7.3.6.2.1 (Impacts from Military Expended Materials Other Than Munitions Under Alternative 1) for testing activities would also apply to testing activities proposed under Alternative 2.

Testing activities involving military expended materials other than munitions as described under Alternative 2 would not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

Testing activities involving military expended materials other than munitions as described under Alternative 2 would have no effect on North Atlantic right whale and West Indian manatee critical habitats. Testing activities involving military expended materials other than munitions would have no effect on the bowhead whale and ringed seal and may affect the blue whale, Gulf of Mexico subspecies of Bryde's whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and West Indian manatee, as defined by the ESA.

3.7.3.6.2.3 Impacts from Military Expended Materials Other Than Munitions Under the No Action Alternative

Impacts from Military Expended Materials Other Than Munitions Under the No Action Alternative for Training and Testing Activities

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

3.7.3.7 Secondary Stressors

This section analyzes potential impacts on marine mammals exposed to stressors indirectly through impacts on their habitat (sediment or water quality) or prey. For the purposes of this analysis, indirect impacts on marine mammals via sediment or water quality that do not require trophic transfer (e.g., bioaccumulation) in order to be observed are considered here. Bioaccumulation considered previously in this document in the analysis of fish (Section 3.6), invertebrates (Section 3.4), and marine habitats (Section 3.5) indicated minimal to no impacts on potential prey species of marine mammals. It is important to note that the terms "indirect" and "secondary" do not imply reduced severity of environmental consequences but instead describe how the impact may occur in an organism. Bioaccumulation is considered in the *Ecosystem Technical Report for the Atlantic Fleet Training and Testing (AFTT) Final Environmental Impact Statement* (U.S. Department of the Navy, 2012). Additionally, the transportation of marine mammals (the Navy's marine mammal system) in association with force protection and mine warfare exercises is presented to detail the lack of potential for the introduction of disease or parasites from those marine mammals to the Study Area. The potential for impacts from all of these secondary stressors are discussed below.

Stressors from Navy training and testing activities that could pose indirect impacts on marine mammals via habitat or prey include: (1) explosives, (2) explosive byproducts and unexploded munitions, (3) metals, (4) chemicals, and (5) transmission of disease and parasites. Analyses of the potential impacts on sediment and water quality are discussed in Section 3.2 (Sediments and Water Quality).

Explosives

As it pertains to marine mammals, 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 on the type of prey species in the area of the blast. As described in Chapter 2 (Description of Proposed Action and Alternatives) and Table 2.6-1 (Proposed Training Activities per Alternative) through Table 2.6-4 (Office of Naval Research Proposed Testing Activities per Alternative), training and testing activities resulting in underwater explosions will occur in the Study Area.

In addition to physical effects of an underwater blast, prey might have behavioral reactions to underwater sound. For instance, prey species might exhibit a strong startle reaction to explosions that might include swimming to the surface or scattering away from the source. This startle and flight response is the most common secondary defense among animals (Hanlon & Messenger, 1996; Mather, 2004). The abundances of prey species near the detonation point could be diminished for a short period of time before being repopulated by animals from adjacent waters. Alternatively, any prey species that would be directly injured or killed by the blast could draw in scavengers from the surrounding waters that would feed on those organisms, and in turn could be susceptible to becoming directly injured or killed by subsequent explosions. Any of these scenarios would be temporary, only occurring during activities involving explosives, and no lasting effect on prey availability or the pelagic food web would be expected.

The Navy will implement mitigation (e.g., not conducting gunnery activities within a specified distance of shallow-water coral reefs) to avoid or reduce potential impacts from explosives and physical disturbance and strike stressors on seafloor resources in mitigation areas throughout the Study Area (see Section 5.4.1, Mitigation Areas for Seafloor Resources). This mitigation will consequently help avoid potential impacts from explosives on marine mammal prey species that inhabit shallow-water coral reefs, live hard bottom, artificial reefs, and shipwrecks.

Explosion Byproducts and Unexploded Munitions

High-order explosions consume most of the explosive material, creating typical combustion byproducts. In the case of Royal Demolition Explosive, also known as cyclonite and hexogen, 98 percent of the products are common seawater constituents, and the remainder is rapidly diluted below threshold effect level (see Section 3.2, Sediments and Water Quality, Table 3.2-6, Water Solubility of Common Explosives and Explosive Degradation Products) Explosion byproducts associated with high order detonations present no indirect stressors to marine mammals through sediment or water. However, low order detonations and unexploded munitions present elevated likelihood of impacts on marine mammals. Furthermore, most explosions occur in depths exceeding that which normally support seagrass beds, an area that is commonly occupied by manatees. However, low-order detonations and unexploded munitions present elevated likelihood of secondary impacts on marine mammals.

Deposition of undetonated explosive materials into the marine environment can be reasonably well estimated by the known failure and low-order detonation rates of high-explosives (Section 3.2, Sediments and Water Quality, Table 3.2-7, Failure and Low-Order Detonation Rates of Military Munitions). While it is remotely possible for marine mammals to come into contact with an undetonated explosive, to have contact with unexploded materials in the sediment or water, and or to ingest unexploded materials in sediments, it is very unlikely.

Indirect impacts of explosives and unexploded munitions to marine mammals via sediment contamination are possible only if a marine mammal ingested the sediment. Degradation of explosives proceeds through several pathways, as discussed in Section 3.2.3.1 (Explosives and Explosion Byproducts). Degradation products of Royal Demolition Explosive are not toxic to marine organisms at realistic exposure levels (Rosen & Lotufo, 2010). Relatively low solubility of most explosives and their degradation products means that concentrations of these contaminants in the marine environment are relatively low and readily diluted. Furthermore, while explosives and their degradation products were detectable in marine sediment approximately 6 to 12 in. away from degrading munitions, the concentrations of these compounds were not statistically distinguishable from background beyond 3 to 6 ft. from the degrading munitions (Section 3.2.3.1, Explosives and Explosion Byproducts). Taken together, it is possible that marine mammals could be exposed to degrading explosives, but it would be within a very small radius of the explosive (1 to 6 ft.). Humpback whales, odontocetes, pinnipeds, and manatees are the only species in the AFTT Study Area that might routinely ingest sediments while feeding in shallow water, however this feeding does not occur in the deep water areas where unexploded materials are more likely to occur.

A series of research efforts that focused on World War II underwater munitions disposal sites in Hawaii (Briggs et al., 2016; Edwards et al., 2016; Kelley et al., 2016; Koide et al., 2016; University of Hawaii, 2010) and an intensively used live fire range in the Mariana Islands (Smith & Marx, 2016) provide information in regard to the impacts of undetonated materials and unexploded munitions on marine life. Section 3.2.3.1 (Explosives and Explosion Byproducts) and Section 3.2.3.3 (Metals) contains a summary of this literature which investigated water and sediment quality impacts, on a localized scale, from munitions ocean disposal sites and ocean disposed dredge spoils sites. Findings from these studies indicate that there were no adverse impacts on the local ecology from the presence of degrading munitions and there was no bioaccumulation of munitions-related chemicals in local marine species.

The island of Farallon De Medinilla (in the Mariana Islands) has been used as a target area since 1971. Between 1997 and 2012, there were 14 underwater scientific survey investigations around the island providing a long-term look at potential impacts on the marine life from training and testing involving the use of munitions (Smith and Marx, 2016). Munitions use has included high-explosive rounds from gunfire, high-explosives bombs by Navy aircraft and U.S. Air Force B-52s, in addition to the expenditure of inert rounds and non-explosive practice bombs. Marine life assessed during these surveys included algae, corals, benthic invertebrates, sharks, rays, and bony fishes, and sea turtles. The investigators found no evidence over the 16-year period, that the condition of the biological resources had been adversely impacted to a significant degree by the training activities (Smith and Marx, 2016). Furthermore, they found that the health, abundance, and biomass of fishes, corals and other marine resources were comparable to or superior to those in similar habitats at other locations within the Mariana Archipelago.

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

The concentration of munitions/explosions, expended material, or devices in any one location in the AFTT Study Area would be a small fraction of that from a World War II dump site, or a target island used for 45 years, or a water range in a river used for almost 100 years. Based on findings from much more intensively used locations, the water quality effects from the use of munitions, expended material, or devices resulting from any of the proposed actions would be negligible by comparison. As a result, explosion by-products and unexploded munitions would have no meaningful effect on water quality and would therefore not constitute a secondary indirect stressor for marine mammals.

Metals

Metals are introduced into seawater and sediments as a result of training and testing activities involving ship hulks, targets, munitions, and other military expended materials (Section 3.2.3.3, Metals) (Environmental Sciences Group, 2005). Some metals bioaccumulate and physiological impacts begin to occur only after several trophic transfers concentrate the toxic metals (Section 3.5, Habitats, and Chapter 4, Cumulative Impacts). Evidence from a number of studies (Briggs et al., 2016; Kelley et al., 2016; Koide et al., 2016; U.S. Department of the Navy, 2013a; University of Hawaii, 2010) indicate metal contamination is very localized and that bioaccumulation resulting from munitions cannot be demonstrated. Specifically in sampled marine life living on or around munitions on the seafloor, metal concentrations could not be definitively linked to the munitions since comparison of metals in sediment next to munitions show relatively little difference in comparison to other "clean" marine sediments used as a control/reference (Koide et al., 2016). Research has demonstrated that some smaller marine organisms are attracted to metal munitions as a hard substrate for colonization or as shelter (Kelley et al., 2016; Smith & Marx, 2016) but this is unlikely to substantively impact marine mammal prey availability.

Chemicals

Several Navy training and testing activities introduce chemicals into the marine environment that are potentially harmful in higher concentrations, however rapid dilution would occur and toxic concentrations are unlikely to be encountered. Chemicals introduced are principally from flares and propellants for missiles and torpedoes. Properly functioning flares, missiles, and torpedoes combust most of their propellants, leaving benign or readily diluted soluble combustion byproducts (e.g., hydrogen cyanide). Operational failures may allow propellants and their degradation products to be released into the marine environment. Flares and missiles that operationally fail may release perchlorate, which is highly soluble in water, persistent, and impacts metabolic processes in many plants and animals if in sufficient concentration. Such concentrations are not likely to persist in the ocean. Research has demonstrated that perchlorate did not bioconcentrate or bioaccumulate, which was consistent with the expectations for a water soluble compound (Furin et al., 2013). Perchlorate from failed expendable items is therefore unlikely to compromise water quality to that point that it would act as a secondary stressor to marine mammals. It should also be noted that chemicals in the marine environment as a result of Navy training and testing activities would not occur in isolation and are typically associated with military expended materials that release the chemicals while in operation. Because marine mammal avoidance of an expended flare, missile, or torpedo in the water is almost certain, it would further reduce the potential for introduced chemicals to act as a secondary stressor.

Transmission of Marine Mammal Diseases and Parasites

The U.S. Navy deploys trained common bottlenose dolphins (*Tursiops truncatus*) and California sea lions (*Zalophus californianus*) for integrated training involving two primary mission areas: to find objects such as inert mine shapes, and to detect swimmers or other intruders around Navy facilities such as piers. When deployed, the animals are part of what the Navy refers to as Marine Mammal Systems. These Marine Mammal Systems include one or more motorized small boats, several crew members, and a trained marine mammal. Based on the standard procedures with which these systems are deployed, it is not reasonably foreseeable that use of these marine mammals systems would result in the transmission of disease or parasites to cetaceans or pinnipeds in the Study Area based on the following.

Each trained animal is deployed under behavioral control to find the intruding swimmer or submerged object. Upon finding the target of the search, the animal returns to the boat and alerts the animal handlers that an object or swimmer has been detected. In the case of a detected object, the human handlers give the animal a marker that the animal can bite onto and carry down to place near the detected object. In the case of a detected swimmer, animals are given a localization marker or leg cuff that they are trained to deploy via a pressure trigger. After deploying the localization marker or leg cuff, the animal swims free of the area to return to the animal support boat. For detected objects, human divers or remote vehicles are deployed to recover the item. Swimmers that have been marked with a leg cuff are reeled in by security support boat personnel via a line attached to the cuff.

Marine Mammal Systems deploy approximately 1 to 2 weeks before the beginning of a training exercise to allow the animals to acclimate to the local environment. Four to 12 marine mammals are involved per exercise. Marine Mammal Systems typically participate in object detection and recovery, both participating in mine warfare exercises and assisting with the recovery of non-explosive mine shapes at the conclusion of an exercise. Marine Mammal Systems may also participate in port security and anti-terrorism/force protection exercises.

During the past 40 years, the Navy Marine Mammal Program has deployed globally. To date, there have been no known instances of deployment-associated disease transfer to or from Navy marine mammals. Navy animals are maintained under the control of animal handlers and are prevented from having sustained contact with indigenous animals.

When not engaged in the training event, Navy marine mammals are either housed in temporary enclosures or aboard ships involved in training exercises. All marine mammal waste is disposed of in a manner approved for the specific holding facilities. When working, sea lions are transported in boats, and dolphins are transferred in boats or by swimming alongside the boat under the handler's control. Their open-ocean time is under stimulus control and is monitored by their trainers.

Navy marine mammals receive excellent veterinarian care (per Secretary of the Navy Instruction 3900.41E). Appendix A, Section 8, of the Swimmer Interdiction Security System Final EIS (U.S. Department of the Navy, 2009) presents an overview of the veterinary care provided for the Navy's marine mammals. Appendix B (Activity Stressor Matrices), Section 2, of the Swimmer Interdiction Security System Final EIS presents detailed information on the health screening process for communicable diseases. The following is a brief summary of the care received by all of the Navy's marine mammals:

- Qualified veterinarians conduct routine and predeployment health examinations on the Navy's marine mammals; only animals determined as healthy are allowed to deploy.
- Restaurant-quality frozen fish are fed to prevent diseases that can be caused by ingesting fresh fish (e.g., parasitic diseases).
- Navy animals are routinely dewormed to prevent parasitic and protozoal diseases.
- If a valid and reliable screening test is available for a regionally relevant pathogen (e.g., polymerase chain reaction assays for morbillivirus), such tests are run on appropriate animal samples to ensure that animals are not shedding these pathogens.

The Navy Marine Mammal Program routinely does the following to further mitigate the low risk of disease transmission from captive to wild marine mammals during training exercises:

- Marine mammal waste is disposed of in an approved system dependent upon the animal's specific housing enclosure and location.
- Onsite personnel are made aware of the potential for disease transfer, and report any sightings of wild marine mammals so that all personnel are alert to the presence of the animal.
- Marine mammal handlers visually scan for indigenous marine animals for at least 5 minutes before animals are deployed and maintain a vigilant watch while the animal is working in the water. If a wild marine mammal is seen approaching or within 100 m, the animal handler will hold the marine mammal in the boat or recall the animal immediately if the animal has already been sent on the mission.
- The Navy obtains appropriate state agriculture and other necessary permits and strictly adheres to the conditions of the permit.

Due to the limited amount of time that the Navy marine mammals spend in the open ocean, the control that the trainers have over the animals, the collection and proper disposal of marine mammal waste, the exceptional screening and veterinarian care given to the Navy's animals, the visual monitoring for indigenous marine mammals, and more than 40 years with zero known incidents, there is no scientific basis to conclude that the use of Navy marine mammals during training activities will have an impact on wild marine mammals.

3.7.3.7.1 Impacts on Habitat

As presented above in Section 3.7.3.7 (Secondary Stressors), Navy activities that introduce explosive byproducts and unexploded munitions, metals, and chemicals into the marine environment have not demonstrated long-term impacts on sediment and water quality. Explosive byproducts and unexploded munitions from ongoing Navy activities have not resulted in water quality impacts, and the likelihood of marine mammals being in contact with sediments contaminated from degrading explosives is low, given the small radius of impact around the location of the explosive. Furthermore, there is no evidence of bioconcentration or bioaccumulation of chemicals introduced by Navy activities that would alter water quality to an extent that would result in overall habitat degradation for marine mammals.

North Atlantic right whales and West Indian manatees are the only species with critical habitat located in the Study Area. Physical and biological features identified for North Atlantic right whale conservation and considered in the critical habitat designation include oceanic conditions that distribute and aggregate dense concentrations of copepods within the northern foraging habitats and water temperatures, depths, and sea surface conditions that are suitable for the southern calving habitats (National Marine Fisheries Service, 2015a). The current critical habitat designation for the West Indian manatee does not identify specific physical and biological features essential for species conservation, but essential habitat features have been reported to include warm water refuges, various food sources (seagrasses and freshwater vegetation), travel corridors, and shelter for calving (75 *Federal Register* 1574–1581, January 12, 2010). These habitat features are not expected to be impacted by secondary stressors associated with the proposed Navy activities.

Impacts on habitat from secondary stressors associated with training and testing activities as described under Alternative 1 will not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

Impacts on habitat from secondary stressors associated with training and testing activities as described under Alternative 1 will have no effect on North Atlantic right whale and West Indian manatee critical habitat and may affect ESA-listed and proposed ESA-listed marine mammals, as defined by the ESA. The Navy has consulted with NMFS and the USFWS as required by section 7(a)(2) of the ESA in that regard.

3.7.3.7.2 Impacts on Prey Availability

As presented above in Section 3.7.3.7 (Secondary Stressors), Navy activities that introduce explosives, metals, and chemicals into the marine environment have not demonstrated long-term impacts on prey availability for marine mammals. The Navy's use of explosives has not demonstrated any lasting effects on prey availability for cetaceans. Activities that involve the use of explosives typically occur at depths that exceed areas that support seagrass beds for foraging manatees. Bioaccumulation of metals from munitions in prey species has not been demonstrated and no effects to prey availability from metals and chemicals are known to occur.

North Atlantic right whales and West Indian manatees are the only species with critical habitat within the Study Area. Physical and biological features identified for North Atlantic right whale conservation and considered in the critical habitat designation include oceanic conditions that distribute and aggregate dense concentrations of copepods within the northern foraging habitats (National Marine Fisheries Service, 2015a). The current critical habitat designation for the West Indian manatee does not identify specific physical and biological features essential for species conservation, but essential habitat features have been reported to include various food sources (seagrasses and freshwater vegetation) in proximity to warm water refugia (75 *Federal Register* 1574–1581, January 12, 2010). These habitat features for feeding requirements are not expected to be impacted by secondary stressors associated with the proposed Navy activities.

Impacts on prey availability from secondary stressors associated with training and testing activities as described under Alternative 1 will not result in the unintentional taking of marine mammals incidental to those activities, as defined by the MMPA.

Impacts on prey availability from secondary stressors associated with training and testing activities as described under Alternative 1 will have no effect on North Atlantic right whale and West Indian manatee critical habitat and may affect ESA-listed and proposed ESA-listed marine mammals, as defined by the ESA. The Navy has consulted with NMFS and the USFWS as required by section 7(a)(2) of the ESA in that regard.

3.7.4 Summary of Potential Impacts on Marine Mammals

3.7.4.1 Combined Impacts of All Stressors Under Alternative 1

As described in Section 3.0.3.5 (Resource-Specific Impacts Analysis for Multiple Stressors), this section evaluates the potential for combined impacts of all the stressors from the proposed action. The analysis and conclusions for the potential impacts from each of the individual stressors are discussed in Sections 3.7.3.1 (Acoustic Stressors) through 3.7.3.6 (Ingestion Stressors) and, for ESA listed species, summarized in Section 3.7.5 (Endangered Species Act Determinations). Stressors associated with Navy training and testing activities do not typically occur in isolation but rather occur in some combination. For example, mine neutralization activities include elements of acoustic, physical disturbance and strike, entanglement, ingestion, and secondary stressors that are all coincident in space and time. An analysis of the combined impacts of all stressors considers the potential consequences of additive stressors and synergistic stressors, as described below. This analysis makes the reasonable assumption that the majority of exposures to stressors are non-lethal, and instead focuses on consequences potentially impacting 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 testing or training 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, 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 training and testing 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 exercises. Exposure to multiple stressors is more likely to occur at an instrumented range where training and testing using multiple platforms may be concentrated during a particular event. 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 training and small testing activities which are conducted in the open ocean. Unit level exercises occur over a small spatial scale (one to a few square miles) and with few participants (usually one or two) or short duration (the order of a few hours or less).

Secondly, a marine mammal could be exposed to multiple training and testing activities over the course of its life, however, training and testing activities are generally separated in space and time in such a way that it would be unlikely that any individual 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 (National Oceanic and Atmospheric Administration, 2013, 2015) are that majority of impacts from Navy training and testing activities are not expected to have deleterious impacts on the fitness of any individuals or long-term consequences to populations of marine mammals.

Although potential impacts on certain marine mammal species from training and testing 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 3.7.5 (Endangered Species Act Determinations) and Section 3.7.6 (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).

3.7.4.2 Combined Impacts of All Stressors Under Alternative 2

Training and testing activities proposed under Alternative 2 would be an increase over what is proposed for Alternative 1. However, this increase is not expected to substantially increase the potential for impacts over what is analyzed for Alternative 1. The analysis presented in Section 3.7.4.1 (Combined Impacts of All Stressors Under Alternative 1) would similarly apply to Alternative 2. The combined impacts of all stressors for training and testing activities under Alternative 2 are not expected to have deleterious impacts on the fitness of any individuals or long-term consequences to populations of marine mammals.

3.7.4.3 Combined Impacts of All Stressors Under the No Action Alternative

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

3.7.5 Endangered Species Act Determinations

Pursuant to the ESA, the Navy has concluded that training and testing activities may affect the blue whale, bowhead whale, Bryde's whale, fin whale, North Atlantic right whale, ringed seal, sei whale, sperm whale, and West Indian manatee. The Navy has also concluded that training and testing activities would have no effect on designated critical habitat for the North Atlantic right whale and West Indian manatee. The Navy has consulted with NMFS and the USFWS as required by section 7(a)(2) of the ESA in that regard. The Navy's summary of effects determinations for each ESA-listed species is provided in Table 3.7-109. Where the effects determinations reached by NMFS (for species under their jurisdiction) in their Biological Opinion differed from the Navy's, those differences are noted in a footnote to Table 3.7-109. NMFS determinations are made on the overall Proposed Action and are not separated by training and testing activities. The USFWS concurred with all Navy determinations on the West Indian manatee.

Table 3.7-109: Marine Mammal Effect Determinations for Training and Testing Activities Under Alternative 1 (Preferred Alternative)

Species	*Designation Unit*	*Effect Determinations by Stressor*																	
		Acoustic						*Explo-sives*	*Energy*		*Physical Disturbance and Strike*				*Entanglement*			*Ingestion*	
		Sonar and Other Transducers	*Air Guns*	*Pile Driving*	*Vessel Noise*	*Aircraft Noise*	*Weapons Noise*	*Explosives*	*In-water Electromagnetic Devices*	*High-energy Lasers*	*Vessels*	*In-water Devices*	*Military Expended Materials*	*Seafloor Devices*	*Wires and Cables*	*Decelerators/Parachutes*	*Biodegradable Polymer*	*Military Expended Materials - Munitions*	*Military Expended Materials - Other Than Munitions*
Training Activities																			
Blue whale	Throughout range	LAA	N/A	NE	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	LAA[1]	NLAA	NLAA	NLAA	NLAA	NLAA	N/A	NLAA	NLAA
Bowhead whale	Throughout range	NE	N/A	NE	NE[1]	NE	NE	NE	NE	NE	NLAA	NE	NE	NE	NE	NE	N/A	NE	NE
Bryde's whale	Gulf of Mexico subspecies	NLAA	N/A	NE	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	N/A	NLAA	NLAA
Fin whale	Throughout range	LAA	N/A	NLAA	NLAA	NLAA	NLAA	LAA	NLAA	NLAA	LAA	NLAA	NLAA	NLAA	NLAA	LAA[1]	N/A	NLAA	NLAA
North Atlantic right whale	Throughout range	LAA	N/A	NLAA	NLAA	NLAA	NLAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	LAA[1]	N/A	NLAA	NLAA
	Critical habitat	NE	N/A	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	N/A	NE	NE
Ringed seal	Throughout range	NE	N/A	NE	NE[1]	NE	NE	NE	NE	NE	NLAA	NE	NE	NE	NE	NE	N/A	NE	NE
Sei whale	Throughout range	LAA	N/A	NE	NLAA	NLAA	NLAA	LAA	NLAA	NLAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	N/A	NLAA	NLAA
Sperm whale	Throughout range	LAA	N/A	NE	NLAA	NLAA	NLAA	LAA	NLAA	NLAA	LAA[1]	NLAA	NLAA	NLAA	NLAA	LAA[1]	N/A	NLAA	NLAA
West Indian manatee	Throughout range	NLAA	N/A	NLAA	NLAA	NLAA	NE	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NLAA	N/A	NLAA	NLAA
	Critical habitat	NE	NA	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	N/A	NE	NE

Table 3.7-109: Marine Mammal Effect Determinations for Training and Testing Activities Under Alternative 1 (Preferred Alternative) (continued)

Species	Designation Unit	*Effect Determinations by Stressor*																	
		Acoustic						*Explo-sives*	*Energy*		*Physical Disturbance and Strike*				*Entanglement*			*Ingestion*	
		Sonar and Other Transducers	*Air Guns*	*Pile Driving*	*Vessel Noise*	*Aircraft Noise*	*Weapons Noise*	*Explosives*	*In-water Electromagnetic Devices*	*High-energy Lasers*	*Vessels*	*In-water Devices*	*Military Expended Materials*	*Seafloor Devices*	*Wires and Cables*	*Decelerators/Parachutes*	*Biodegradable Polymer*	*Military Expended Materials - Munitions*	*Military Expended Materials - Other Than Munitions*
Testing Activities																			
Blue whale	Throughout range	LAA	NE[1]	N/A	NLAA	NLAA	NLAA	LAA	NLAA	NLAA	LAA[1]	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Bowhead whale	Throughout range	NE	NE	N/A	NE[1]	NE[1]	NE	NE	NE	NE	NLAA	NE	NE	NE	NE	NE	NE	NE	NE
Bryde's whale	Gulf of Mexico subspecies	LAA	NLAA	N/A	NLAA	NLAA	NLAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Fin whale	Throughout range	LAA	NLAA	N/A	NLAA	NLAA	NLAA	LAA	NLAA	NLAA	LAA	NLAA	NLAA	NLAA	NLAA	LAA[1]	NLAA	NLAA	NLAA
North Atlantic right whale	Throughout range	LAA	NE[1]	N/A	NLAA	NLAA	NLAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	LAA[1]	NLAA	NLAA	NLAA
	Critical habitat	NE	NE	N/A	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Ringed seal	Throughout range	NE	NE	N/A	NE[1]	NE[1]	NE	NE	NE	NE	NLAA	NE	NE	NE	NE	NE	NE	NE	NE
Sei whale	Throughout range	LAA	NE[1]	N/A	NLAA	NLAA	NLAA	LAA	NLAA	NLAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Sperm whale	Throughout range	LAA	NE[1]	N/A	NLAA	NLAA	NLAA	LAA	NLAA	NLAA	LAA[1]	NLAA	NLAA	NLAA	NLAA	LAA[1]	NLAA	NLAA	NLAA
West Indian manatee	Throughout range	NLAA	NLAA	N/A	NLAA	NLAA	NE	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NLAA	NLAA
	Critical habitat	NE	NE	N/A	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Note: LAA = may effect, likely to adversely affect; N/A = not applicable, activity related to the stressor does not occur during specified training or testing events (e.g., there are no testing activities that involve the use of pile driving); NE = no effect; NLAA = may effect, not likely to adversely affect.
[1] Based on the analysis conducted in the Biological Opinion, the NMFS reached the determination of NLAA.

3.7.6 Marine Mammal Protection Act Determinations

The Navy is seeking Letters of Authorization in accordance with the MMPA from NMFS for certain training and testing activities (the use of sonar and other transducers, air guns, pile driving, vessels, and explosives), 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 air guns and pile driving may result in Level B harassment of certain marine mammal species. The use of explosives may result in Level A harassment, Level B harassment, and mortality of certain marine mammals. The use of vessels may result in Level A harassment due to physical strike. Refer to Section 3.7.3.1.2 (Impacts from Sonar and Other Transducers) for details on the estimated impacts from sonar and other transducers, Section 3.7.3.1.3 (Impacts from Air Guns) for details on the estimated impacts from air guns, Section 3.7.3.1.4 (Impacts from Pile Driving) for details on the estimated impacts from pile driving, Section 3.7.3.2.2 (Impacts from Explosives) for impacts from explosives, and Section 3.7.3.4.1 (Impacts from Vessels and In-Water Devices) for details on the estimated impacts from vessels.

Weapons noise, vessel noise, aircraft noise, the use of in-water 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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