
3.9 Birds

Gulf of Alaska Navy Training Activities
Draft Supplemental Environmental Impact Statement/
Overseas Environmental Impact Statement

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3.9 Birds

3.9.1 Introduction

As presented in Chapter 1 (Purpose and Need), the United States (U.S.) Department of the Navy (Navy) analysis presented in this document supplements both the 2011 Gulf of Alaska (GOA) Final Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) (U.S. Department of the Navy, 2011b) and the 2016 GOA Final Supplemental EIS (SEIS)/OEIS (U.S. Department of the Navy, 2016). The Proposed Action would occur over a maximum time period of up to 21 consecutive days during the months of April–October. Though the types of activities and number of events in the Proposed Action are the same as in the previous documents (Alternative 1 in both the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS), there have been changes in the platforms and systems used as part of those activities. Consistent with the previous analysis for Alternative 1, the sinking exercise activity will not be part of the Proposed Action for this SEIS/OEIS.

The purpose of the birds section in this SEIS/OEIS is to provide any new or changed information since the 2016 GOA Final SEIS/OEIS that are relevant to an analysis of potential impacts on birds associated with the continuation of Navy training activities in the Temporary Maritime Activities Area (TMAA) beyond May 2022 as a result of the Proposed Action. The TMAA is 12 nautical miles (NM) or greater from shore, outside of the U.S. Territorial Sea.

This section also documents the Navy's continued consultation with the U.S. Fish and Wildlife Service (USFWS), pursuant to the Endangered Species Act (ESA). On March 24, 2010, the USFWS sent the Navy a letter of concurrence (consultation # 2010-0075) with the Navy's determination that the proposed training activities would not likely adversely affect the ESA-listed short-tailed albatross. In the March 24, 2010, letter of concurrence, the USFWS recognized the potential for adverse effects of the proposed training activities on the marine species, and that the Navy intended to use a watch-stander and pre-event target area clearing procedure to reduce the probability that a short-tailed albatross would be harmed by an explosion or other type of activity. On July 23, 2014, the USFWS sent an email to the Navy stating that reinitiation of consultation for the 2016 GOA Final SEIS/OEIS was not necessary as there were no changes to the actual activities, geographic parameters, or levels of activities occurring in the areas previously subject to consultation with the USFWS. In support of this SEIS/OEIS, the Navy is requesting consultation with USFWS based on new distribution information for the short-tailed albatross described in Section 3.9.2.2.3 (Distribution).

Marine birds in the TMAA include those listed under the Migratory Bird Treaty Act (MBTA) of 1918 (16 United States Code 703–712; Ch. 128; 13 July 1918; 40 Stat. 755 as amended) (U.S. Department of Defense & U.S. Fish and Wildlife Service, 2006). A migratory bird is any species or family of birds that live or reproduce in or migrate across international borders at some point during their annual life cycle. The MBTA established federal responsibilities for the protection of nearly all species of birds, eggs, and nests. In 2006, the USFWS and U.S. Department of Defense signed a Memorandum of Understanding to promote conservation of migratory birds (U.S. Department of Defense & U.S. Fish and Wildlife Service, 2006).

Through the National Defense Authorization Act, Congress determined that allowing incidental take of migratory birds as a result of military readiness activities is consistent with the MBTA. The Final Rule was published in the Federal Register (FR) on February 28, 2007 (FR Volume 72, No. 29, 28 February 2007), and may be found at 50 Code of Federal Regulations (CFR) Part 21.15. Congress defined military readiness activities as all training and operations of the Armed Forces that relate to combat and the

adequate and realistic testing of military equipment, vehicles, weapons, and sensors for the proper operation and suitability for combat use. The measure directs the Armed Forces to assess the effects of military readiness activities on migratory birds, in accordance with the National Environmental Policy Act (NEPA). It also requires the Armed Forces to develop and implement appropriate conservation measures if a proposed action may have a significant adverse effect on a migratory bird population. Specifically, 50 CFR Part 21.15 specifies a requirement to confer with the USFWS when the military readiness activities in question will have a significant adverse effect on a population of migratory bird species. An activity has a significant adverse effect if, over a reasonable period of time, it diminishes the capacity of a population of migratory bird species to maintain genetic diversity, to reproduce, and to function effectively in its native ecosystem. A population, as used in 50 CFR Part 21.3 (definitions), is defined as “a group of distinct, coexisting, same species, whose breeding site fidelity, migration routes, and wintering areas are temporally and spatially stable, sufficiently distinct geographically (at some point of the year), and adequately described so that the population can be effectively monitored to discern changes in its status.”

Recent administrative actions and court decisions are further clarifying the scope of the MBTA and the Department of Interior’s (DOI’s) mandate to enforce and administer the MBTA. In December 2017, the DOI issued its Solicitor’s Opinion, which clarified that otherwise lawful activity that results in an incidental take of a protected bird does not violate the MBTA (U.S. Department of the Interior, 2017). In February 2018, the Deputy Assistant Secretary of Defense memo clarified that DoD actions should continue current practices to minimize take of migratory birds (U.S. Department of Defense, 2018). On July 31, 2020, the United States District Court, Southern District New York, vacated the DOI Opinion (M-37050) regarding incidental take and remanded the Opinion back to the agency for further proceedings consistent with the Opinion. The vacated DOI Opinion does not change the analysis in this SEIS/OEIS regarding potential effects to migratory birds, due to the Navy’s continued efforts to follow the conservative and protective policies of the Assistant Secretary of Defense.

Background information in the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS for the marine bird species that occur in the TMAA will not be repeated in this section unless necessary for context in support of new information and emergent relevant best available science. This SEIS/OEIS includes marine bird species status updates, recent available literature, new distribution data for seabird species within the TMAA, and new bycatch information for seabirds since the 2016 GOA Final SEIS/OEIS. This information is presented in the subsections that follow.

3.9.2 Affected Environment

Descriptions of the TMAA ecosystem, climate, productivity, and oceanographic conditions were presented in the 2011 GOA Final EIS/OEIS and referenced in the 2016 GOA Final SEIS/OEIS. The TMAA continues to be one of the world’s most productive ocean regions, and the habitats associated with these cold and turbulent waters contain identifiable collections of microhabitats that sustain resident and migratory species of birds. The waters of the TMAA provide nutrient-rich offshore areas for seabirds that rely on upwelling zones and shelf currents to transport prey to the surface.

3.9.2.1 General Background

Descriptions of the TMAA ecosystem, climate, productivity, and oceanographic conditions were presented in the 2011 GOA Final EIS/OEIS and referenced in the 2016 GOA Final SEIS/OEIS. The TMAA continues to be one of the world’s most productive ocean regions, and the habitats associated with these cold and turbulent waters contain identifiable collections of microhabitats that sustain resident

and migratory species of birds. The waters of the TMAA provide nutrient-rich offshore areas for seabirds that rely on upwelling zones and shelf currents to transport prey to the surface.

Similar to the Navy's 2011 GOA Final EIS/OEIS and referenced in the 2016 GOA Final SEIS/OEIS, this section provides an overview of the species, distribution, and occurrence of birds that are either resident or migratory through the TMAA, with any relevant updates to the affected environment since the completion of the Navy's 2016 GOA Final SEIS/OEIS. Table 3.9-1 contains representative bird species in the TMAA.

Table 3.9-1: Representative Bird Species Within the TMAA

Family/Subfamily	Common Name	Scientific Name
Family Diomedidae	Black-footed Albatross ^{1,5}	<i>Phoebastria nigripes</i>
	Laysan Albatross ⁵	<i>Phoebastria immutabilis</i>
	Short-tailed Albatross ^{2,3}	<i>Phoebastria albatrus</i>
Family Procellariidae	Short-tailed Shearwater ¹	<i>Puffinus tenuirostris</i>
	Northern Fulmar ¹	<i>Fulmarus glacialis</i>
	Sooty Shearwater	<i>Ardenna grisea</i>
	Buller's Shearwater	<i>Ardenna bulleri</i>
	Pink-footed shearwater ^{2,5}	<i>Ardenna creatopus</i>
Family Phalacrocoracidae	Double-crested Cormorant ²	<i>Phalacrocorax auritus</i>
	Pelagic Cormorant ²	<i>Phalacrocorax pelagicus</i>
Family Hydrobatidae	Fork-tailed Storm-Petrel	<i>Oceanodroma furcata</i>
	Leach's Storm-Petrel	<i>Oceanodroma leucorhoa</i>
	Mottled Petrel ²	<i>Pterodroma inexpectata</i>
	Murphy's Petrel ^{2,5}	<i>Pterodroma ultima</i>
Family Laridae	Black-legged Kittiwake	<i>Rissa tridactyla</i>
	Red-legged Kittiwake ^{2,5}	<i>Rissa brevirostris</i>
	Glaucous-winged Gull	<i>Larus glaucescens</i>
	Arctic Tern ⁵	<i>Sterna paradisaea</i>
	Surf Scoter	<i>Melanitta perspicillata</i>
	Sabine's Gull ⁵	<i>Xema sabini</i>
	Red Phalarope ²	<i>Phalaropus fulicarius</i>
	Herring Gull ²	<i>Larus argentatus</i>
	Red-necked Phalarope ²	<i>Phalaropus lobatus</i>
Family Stercorariidae	Long-tailed Jaeger	<i>Stercorarius longicaudus</i>
	Pomarine Jaeger ²	<i>Stercorarius pomarinus</i>
	Parasitic Jaeger ²	<i>Stercorarius parasiticus</i>

Table 3.9-1: Representative Bird Species Within the TMAA (continued)

Family/Subfamily	Common Name	Scientific Name
Family Alcidae	Common Murre	<i>Uria aalge</i>
	Thick-billed murre ²	<i>Uria lomvia</i>
	Tufted Puffin	<i>Fratercula cirrhata</i>
	Parakeet Auklet	<i>Aethia psittacula</i>
	Horned Puffin	<i>Fratercula corniculata</i>
	Marbled Murrelet ^{2,4}	<i>Brachyramphus marmoratus</i>
	Cassin's Auklet ²	<i>Ptychoramphus aleuticus</i>
	Rhinoceros Auklet ²	<i>Cerorhinca monocerata</i>
	Ancient Murrelet ²	<i>Synthliboramphus antiquus</i>
Family Anatidae	Northern pintail	<i>Anas acuta</i>
	Northern Shoveler ²	<i>Spatula clypeata</i>
	Black Brant ²	<i>Branta bernicla</i>
	Green-winged Teal ²	<i>Anas carolinensis</i>
Family Gaviidae	Yellow-billed loon ^{2,5}	<i>Gavia adamsii</i>

¹ Species appear in the North Pacific Pelagic Seabird Database (Drew & Piatt, 2015) at the highest frequency and together represent greater than 66 percent of all observations. The short-tailed shearwater accounts for 32.3 percent, followed by the fork-tailed albatross (16.0 percent of all observations), northern fulmar (10.9 percent), and the black-footed albatross (7.8 percent).

² Indicates species that are represented in the North Pacific Pelagic Seabird Database less than 0.5 percent of all observations.

³ Short-tailed albatross is an ESA-listed species, but accounts for less than 0.05 percent of total observations in the North Pacific Pelagic Seabird Database

⁴ Marbled murrelets occurring within the TMAA are likely from Alaska breeding populations. These populations are not protected under the ESA. This species is listed as threatened by the USFWS for populations in Washington, Oregon, and California.

⁵ These species are considered birds of conservation concern by the USFWS (U.S. Fish and Wildlife Service, 2008a, 2015).

As presented in the 2011 GOA Final EIS/OEIS, the habitat found within the TMAA supports a wide diversity of resident and migratory seabirds and waterfowl. Birds that are year-round residents or that migrate from northern waters frozen over in the winter use the protected embayments of Kodiak Island and the mainland shoreline to avoid harsh winter storms. Seabirds, such as alcids, shearwaters, and gulls, typically feed in open waters ranging from the shoreline and estuaries to the open ocean. Waterfowl, such as ducks and geese, are typically found near shore on the open coast and in estuaries, but some also use inland freshwater habitats. In general, seabird activity is most concentrated along the GOA coastline, while waterfowl are found primarily in the bays and shallow waters. Since the TMAA occurs mostly over the outer shelf slope and deeper ocean waters, this area is dominated by species that utilize the region seasonally and are not land-based outside the nesting season.

Since the previous analyses conducted in 2011 and 2016, the USFWS has released an updated list of Birds of Conservation Concern (BCC), with additional information specific to the GOA region that was not included in previous lists from the USFWS released in 2008 (U.S. Fish and Wildlife Service, 2008a). The USFWS maintains this list to implement and promote proactive management for species that do not warrant ESA listing status. Bird taxa considered for the BCC 2019 lists include nongame birds, gamebirds without hunting seasons or where harvest is minimal, and subsistence-hunted nongame birds in Alaska, while excluding from consideration bird species not protected under the MBTA; taxa already listed as threatened or endangered under the ESA; or taxa that only occur irregularly or peripherally in territorial seas, contiguous zones, and exclusive economic zones of the United States.

The 2019 BCC list includes 11 species of seabirds for the GOA Region (U.S. Fish and Wildlife Service, 2019). These species include marbled murrelet (*Brachyramphus marmoratus*),¹ Kittlitz's murrelet (*Brachyramphus brevirostris*), ancient murrelet (*Synthliboramphus antiquus*), red-legged kittiwake (*Rissa brevirostris*), yellow-billed loon (*Gavia adamsii*), Laysan albatross (*Phoebastria immutabilis*), Black-footed albatross (*Phoebastria nigripes*), Murphy's petrel (*Pterodroma ultima*), mottled petrel (*Pterodroma inexpectata*), Buller's shearwater (*Ardenna bulleri*), and pink-footed shearwater (*Ardenna creatopus*).

The 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS analyzed potential impacts four species protected under the authority of the ESA believed to occur within the TMAA (short-tailed albatross [*Phoebastria albatrus*], eskimo curlew [*Numenius borealis*], Steller's eider [*Polysticta stelleri*], and spectacled eider [*Somateria fischeri*]). As part of the Navy's approach to analyze potential impacts on ESA-listed bird species, the Navy conducted a literature review to include any updated information regarding these species, in particular their current regulatory status and updated information regarding their potential occurrence within the TMAA.

One important source for determining long-term trends and occurrence information included the North Pacific Pelagic Seabird Database (NPPSD), a database maintained by the U.S. Geological Survey (USGS) and includes more than 460,000 survey transects that were designed and conducted by numerous partners primarily to census seabirds at sea. The current database contains abundance and distribution information on over 20 million birds comprising 160 species observed over 40 years in a region of the North Pacific exceeding 25 million square kilometers. Survey efforts include international cooperation between the United States, Canada, Russia, and Japan. Based on this review, the Steller's eider and spectacled eider were determined to not occur within the TMAA, and are not analyzed in detail in this SEIS/OEIS. As part of the Navy's literature review, the status of the eskimo curlew was reconfirmed (extinct). In addition, the yellow-billed loon (*Gavia adamsii*) was determined to be not warranted for listing by the USFWS. Therefore, only the short-tailed albatross is analyzed in detail in accordance with the Navy's obligations under the ESA (see Section 3.9.2.2, Short-Tailed Albatross, for a summary of this species' life history and status, and Figure 3.9-1 for known occurrences within the TMAA).

3.9.2.1.1 Species Unlikely to Occur within the Temporary Maritime Activities Area

Previous Navy NEPA documents concerning activities within the Gulf of Alaska addressed potential impacts on the Steller's eider (*Polysticta stelleri*) and spectacled eider (*Somateria fischeri*). Because this SEIS addresses training activities within the TMAA, the Navy conducted a literature review for these species' occurrences in relation to the spatial extent of the TMAA and the potential for seasonal

¹ Marbled murrelets in inland waters of Alaska and pelagic environments in the Gulf of Alaska are not ESA listed.

occurrence within the TMAA during the months when training activities within the TMAA would be scheduled. The following sections provide a general background on the species previously analyzed and the Navy's justification for not analyzing them for potential impacts from training activities within the TMAA.

Steller's Eider

The Alaska breeding population of Steller's eiders was listed as threatened under the ESA in 1997 (62 FR 31748). For this SEIS/OEIS, the Navy conducted a literature search for additional information pertaining to the Steller's eider. In 2018, the USFWS announced work on a five-year status review for this species (U.S. Fish & Wildlife Service, 2018). This document does not provide any information that would warrant changes to the conclusions reached in the 2011 GOA Final EIS/OEIS or 2016 GOA Final SEIS/OEIS. During the months of April to October, when training activities are planned to occur, Steller's eiders can be found in nearshore areas, and in particular protected lagoons with tidal flats located hundreds of miles to the northwest and west of the TMAA. Critical habitat has been designated for this species in some important breeding areas on the Yukon-Kuskokwim River Delta and Kuskokwim Shoals, Sea Islands, Nelson Lagoon, and Izembek Lagoon in western Alaska (66 FR 8850). These locations are outside of the TMAA.

Outside of the breeding season (generally October through April), the distribution of Steller's eiders includes the nearshore areas around Kodiak Island, Cook Inlet, the southern side of the Alaska Peninsula, and the eastern Aleutian Islands. In support of this SEIS/OEIS, the Navy examined records of the USGS Alaska Science Center to determine which pelagic species overlap with the TMAA. Based on this review of records, no Steller's eider observations are reported within the TMAA, although approximately 120 observations are reported on Kodiak Island and along the Kenai Peninsula. Most of these observations (over 95 percent) are reported between November and March (Figure 3.9-1).

As stated in the 2011 GOA Final EIS/OEIS, there are no proposed activities in the TMAA during the winter, and there is no new information or circumstances that would alter analysis of the 2011 GOA Final EIS/OEIS. Therefore, the statement indicating that Steller's eiders are not likely to be present in the TMAA or be affected by any of the proposed activities remains valid. For this reason, the Navy has determined no potential impact to the Steller's eider, and the species will not be carried forward for analysis in this SEIS/OEIS.

Spectacled Eider

The spectacled eider was designated as threatened throughout its range in May 1993 (58 FR 27474). Critical habitat for the spectacled eider was designated in 2001 (66 FR 9146). However, none of the critical habitat designation overlaps with the TMAA.

Spectacled eiders are not expected to occur in the TMAA during the time period of training activities. Three primary nesting areas are known for the spectacled eider: the central coast of the Yukon-Kuskokwim Delta, the arctic coastal plain of Alaska, and the arctic coastal plain of Russia. Important late summer and fall molting areas have been identified in eastern Norton Sound and Ledyard Bay in Alaska, and in Mechigmenskiy Bay and an area offshore between the Kolyma and Indigirka River Deltas in Russia. Wintering flocks of spectacled eiders have been observed in openings in sea ice in the Bering Sea between St. Lawrence and St. Matthew Islands (U.S. Fish & Wildlife Service, 2018).

In support of this SEIS/OEIS, the Navy examined records of the USGS Alaska Science Center to determine which pelagic species overlap with the TMAA (see Figure 3.9-1). Based on this review of records, no

spectacled eider observations are reported within the TMAA. One record is reported from the NPPSD on Kodiak Island from 1977, with no recent records within the last 40 years of observations on Kodiak Island or the Kenai Peninsula.

As there are no proposed activities in the TMAA during the winter, and there is no new information or circumstances that would alter analysis of the 2011 GOA Final EIS/OEIS or 2016 GOA Final SEIS/OEIS, spectacled eiders are not likely to be affected by any of the proposed activities. For this reason, the Navy has determined no potential impact to the spectacled eider, and the species will not be carried forward for analysis in this SEIS/OEIS.

3.9.2.1.2 Habitat Use

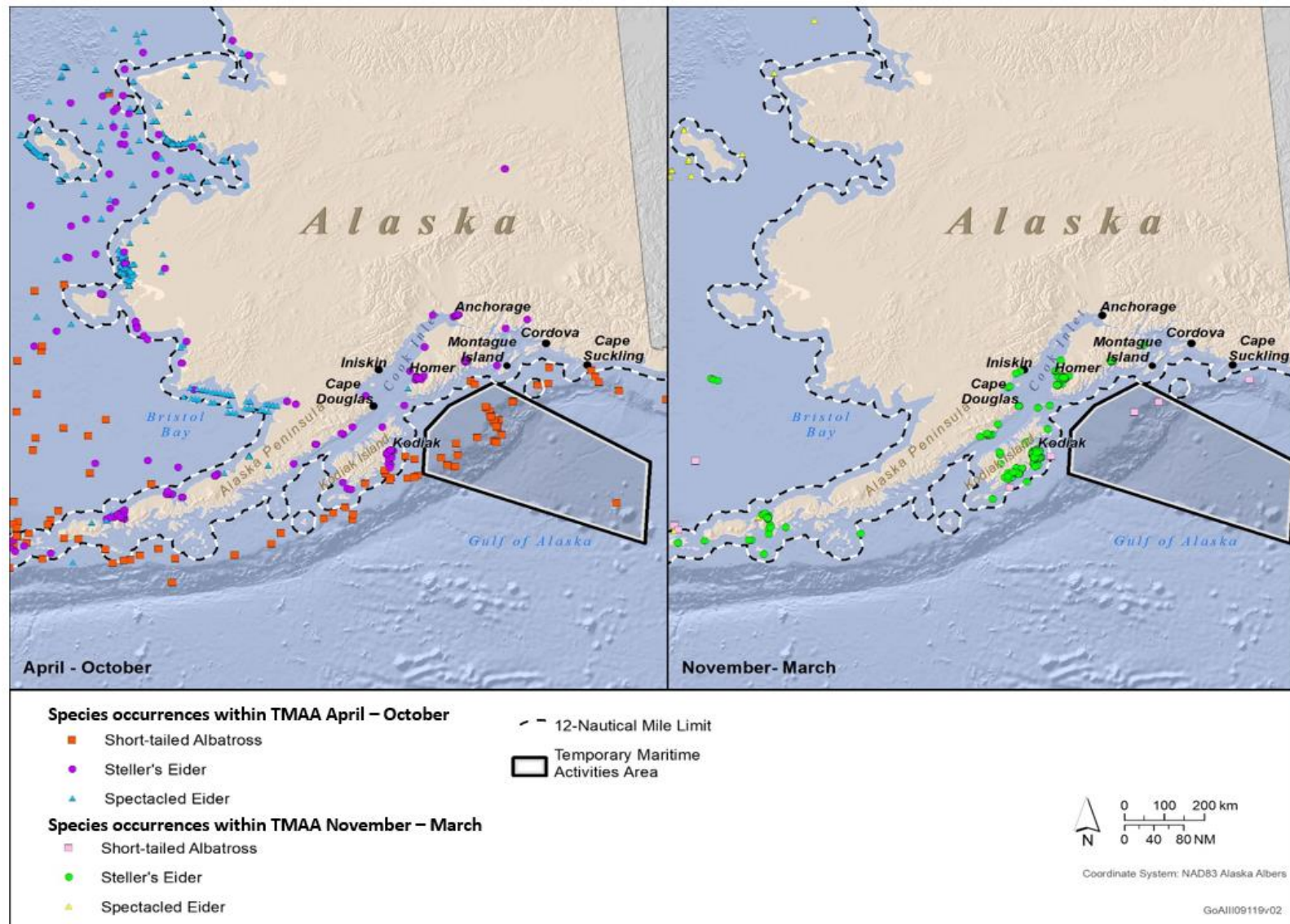
Pelagic ranges, as a function of distance from shore, can range widely for different species. Much of the recent research regarding abundance and distribution as a function of distance from shore for marine birds was conducted to better understand potential impacts on marine birds from offshore energy development.

3.9.2.1.3 Flight Altitudes

While foraging birds will be present near the water surface, migrating birds may fly at various altitudes. Flight altitudes for birds have traditionally been estimated from on the ground (or boat) observations, or from planes; however, flight altitude information increasingly relies on radar studies and telemetry techniques, where the bird's measured altitude is subtracted from the ground elevation (Poessel et al., 2018). Jongbloed (2016) completed a literature review to determine flight height of marine birds to assess potential risks from wind turbine collisions. This review found that most seabird species fly beneath the rotor blade altitudes of offshore wind turbines, which reduces the risk for collision. Some species such as sea ducks and loons may be commonly seen flying just above the water's surface, but the same species can also be spotted flying high enough (5,800 feet [ft.]) that they are barely visible through binoculars (Lincoln et al., 1998). While there is considerable variation, the favored altitude for most small birds appears to be between 500 ft. (152 meters [m]) and 1,000 ft. (305 m). Radar studies have demonstrated that 95 percent of the migratory movements occur at less than 10,000 ft. (3,050 m), with the bulk of the movements occurring under 3,000 ft. (914 m) (Lincoln et al., 1998). Weather factors may also influence flight heights. Tarroux et al. (2016) examined the flying tactics of Antarctic petrels, *Thalassoica antarctica*, in Antarctica revealing the flexibility of flight strategies. Birds tend to fly higher with favorable wind conditions and fly near ground level during strong winds. Birds were found to adjust their speed and heading during stronger winds to limit drift, however, they were able to tolerate a limited amount of drift (Tarroux et al., 2016). In summary, most marine birds can be expected to fly relatively close to the surface, but may range upwards in altitude depending on a number of factors such as wind speed and direction, precipitation avoidance, time of day or night, foraging behaviors, migration, and distance to coast.

3.9.2.1.4 Diving Information

Since the publication of the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS, the Navy conducted a literature search for new information on dive behavior that may change the analysis of potential impacts on birds. No new information is available on dive behavior that would alter the analysis from the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS. As such, the additional description regarding dive behavior presented in the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS remains valid. A summary of diving information for bird groups and specific species is included below.



Sources: North Pacific Pelagic Seabird Database (Drew & Piatt, 2015) and eBird (2020)

Figure 3.9-1: ESA-listed Bird Species Seasonal Distributions

There are four general feeding strategies for seabirds—surface feeding, pursuit diving, and plunge diving. Many of the seabird species found in the TMAA will dive, skim, or grasp prey at the water’s surface or within the upper portion (1–2 m) of the water column (Cook et al., 2011; Jiménez et al., 2012; Sibley, 2014). Surface feeding is exhibited by some tern species within the TMAA, while specialized bills in albatrosses and petrels allow for snatching prey from the surface. Birds able to pursuit dive use their wings and feet for propulsion through the water, exhibited by shearwaters, some petrels, murrelets, and cormorants that occur within the TMAA. Using this strategy, pursuit divers usually float on the water and dive under to pursue fish and other prey (Burger et al., 2004). The short-tailed shearwater, the most frequently reported bird species in the North Pacific Pelagic Database (Drew & Piatt, 2015), is known to dive to depths greater than 70 m (Onley & Scofield, 2007). Plunge diving, as used by some terns within the TMAA, is a foraging strategy in which the bird hovers over the surface and dives into the water to pursue prey (Hansen et al., 2017). Dive durations are correlated with depth and range from a few seconds in shallow divers to several minutes in alcids (Ponganis, 2015). The short-tailed albatross is a surface feeder and scavenger, and predominately takes prey by surface-seizing, not diving (U.S. Fish and Wildlife Service, 2008b).

3.9.2.1.5 Hearing and Vocalization

The Navy conducted a literature search for new information since the publication of the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS on bird hearing and vocalizations. New information regarding hearing sensitivities of waterbirds, including various duck species and lesser scaups, is summarized below, along with recent publications that show differences in hearing sensitivities between freshwater divers and pelagic birds. This information is summarized below with an overview of the most current best available science regarding bird hearing and vocalization.

3.9.2.1.5.1 Airborne Hearing and Vocalization in Seabirds

Although hearing range and sensitivity has been measured for many land birds, little is known of seabird hearing. The majority of published literature on bird hearing focuses on terrestrial birds and their ability to hear in air. A review of 32 terrestrial and marine species indicates that birds generally have greatest hearing sensitivity between 1 and 4 kilohertz (kHz) (Beason, 2004). Very few birds can hear below 20 Hertz, most have an upper frequency hearing limit of 10 kHz, and none exhibit hearing at frequencies higher than 15 kHz (Dooling & Popper, 2000). Since 2011, new scientific literature has been published on the hearing abilities of birds. Hearing capabilities have been studied for only a few seabirds (Beason, 2004; Beuter et al., 1986; Crowell et al., 2015; Johansen et al., 2016; Maxwell et al., 2017; Mooney et al., 2019; Thiessen, 1958; Wever et al., 1969); these studies show that seabird hearing ranges and sensitivity in air are consistent with what is known about bird hearing in general.

In-air auditory abilities have been measured in 10 diving bird species using electrophysiological techniques (Crowell et al., 2015; Maxwell et al., 2017). All species tested had the best in-air hearing sensitivity from 1 to 3 kHz. The red-throated loon (*Gavia stellata*) and northern gannet (*Morus bassanus*) (both non-duck species) had the highest thresholds, while the lesser scaup (*Aythya affinis*) and ruddy duck (*Oxyura jamaicensis*) (both duck species) had the lowest thresholds (Crowell et al., 2015). Auditory sensitivity varied amongst the species tested, spanning over 30 decibels (dB) in the frequency range of best hearing. While electrophysiological techniques provide insight into hearing abilities, auditory sensitivity is more accurately obtained using behavioral techniques. Crowell et al. (2016) used behavioral methods to obtain an in-air audiogram of the lesser scaup. Hearing frequency range in air was similar to other birds, with best sensitivity at 2.86 kHz with a threshold of 14 dB referenced to 20 micropascals

(dB re 20 μ Pa). Maxwell et al. (2017) obtained the behavioral in-air audiogram of a great cormorant (*Phalacrocorax carbo*), and the most sensitive hearing was 18 dB re 20 μ Pa at 2 kHz.

Crowell et al. (2015) also compared the vocalizations of the same 10 diving bird species to the region of highest sensitivity of in-air hearing. Of the birds studied, vocalizations of only eight species were obtained due to the relatively silent nature of two species. The peak frequency of the vocalizations of seven of the eight species fell within the range of highest sensitivity of in-air hearing. Crowell et al. (2015) suggested that the colonial nesters tested had relatively reduced hearing sensitivity because they relied on individually distinctive vocalizations over short ranges. Additionally, they observed that the species with more sensitive hearing were those associated with freshwater habitats, which are relatively quieter compared to marine habitats with wind and wave noise.

Maxwell et al. (2017) obtained the behavioral in-air audiogram of a great cormorant (*Phalacrocorax carbo*), and the most sensitive hearing was 18 dB re 20 μ Pa at 2 kHz. Mooney et al. (2019) measured auditory brainstem responses from one anesthetized, wild-caught Atlantic puffin (*Fratercula arctica*) and found a hearing range of 0.5–6 kHz, with the best sensitivity in the 1–2 kHz range. That study also measured auditory brainstem responses from one common murre (*Uria aalge*), and found a hearing range of 1–4 kHz, with the best sensitivity at 1 kHz. However, Mooney et al. (2019) were unable to measure auditory brainstem responses at 3 kHz for the common murre. Recently, Mooney et al. (2020) used auditory-evoked potentials (AEPs) to measure in-air hearing for 9 wild Atlantic puffins (*Fratercula arctica*) and found especially sensitive hearing from 0.5 to 2.5 kHz. The authors suggest that adept hearing at these low frequencies may benefit this species by aiding in detecting predators from their underground burrows.

Data on short-tailed albatross hearing or vocalization does not exist. Vocalizations recorded from the Laysan albatross (*Phoebastria immutabilis*) and black-footed albatross (*Phoebastria nigripes*) contain frequencies in the range of 85 Hertz (Hz)–28 kHz (Sparling, 1977). The fundamental frequency present in these vocalizations ranged from 85 Hz to 3.48 kHz.

No audiogram data exists for any species of albatross, including the short-tailed albatross. It is likely that the range of best sensitivity in albatross is approximately 1–4 kHz, similar to other birds of the same size. Albatross species make relatively shallow dives while foraging. Due to plunge diving behavior, it is not clear that underwater hearing plays a dominant role in foraging or that albatross species would be exposed to underwater sounds except for brief periods. Accordingly, it is assumed that albatross likely do not specialize in underwater hearing and, for purposes of this analysis, could have underwater hearing capabilities similar to other diving birds, with best hearing capability from 1 to 4 kHz.

3.9.2.1.5.2 Underwater Hearing in Seabirds

Little is known about the hearing abilities of birds underwater (Dooling & Therrien, 2012). In air, the size of the bird is usually correlated with the sensitivity to sound (Johansen et al., 2016); for example, songbirds tend to be more sensitive to higher frequencies and larger non-songbirds tend to be more sensitive to lower frequencies (Dooling & Popper, 2000). Two studies have tested the ability of a single individual diving bird, a great cormorant (*Phalacrocorax carbo sinensis*), to respond to underwater sounds (Hansen et al., 2017; Johansen et al., 2016). These studies suggest that the cormorant's hearing in air is less sensitive than birds of similar size; however, the hearing capabilities in water are better than what would be expected for a purely in-air adapted ear (Johansen et al., 2016). The frequency range of best hearing underwater was observed to be narrower than the frequency range of best hearing in air, with greatest sensitivity underwater observed around 2 kHz (about 71 dB re 1 μ Pa), based on behavioral

responses. Although results were not sufficient to be used to generate an audiogram, Therrien (2014) also examined underwater hearing sensitivity of long-tailed ducks (*Clangula hyemalis*) by measuring behavioral responses. The research showed that auditory thresholds at frequencies within the expected range of best sensitivity (1, 2, and 2.86 kHz) are expected to be between 77 and 127 dB re 1 μ Pa.

Recently, Larsen et al. (2020) measured auditory evoked potentials and eardrum movement in anesthetized, wild-caught, fledgling great cormorants both in air and underwater. The best average sensitivity was at 1 kHz in both media, where the thresholds were 53 dB re 20 μ Pa (air) and 84 dB re 1 μ Pa (water). Statistical analysis showed no difference between sound pressure thresholds in air and underwater, as well as no frequency-medium interaction. The authors suggest that cormorants have anatomical adaptations for underwater hearing, however, the average underwater audiogram obtained in this study does not necessarily support well-developed aquatic hearing. Furthermore, a behavioral audiogram of a single adult great cormorant (Hansen et al., 2017) suggests that absolute thresholds are lower than found by Larsen and colleagues, and shows a best frequency of 2 kHz. The differences in audiogram methodology (behavioral vs. auditory evoked potential), life stage (adult vs. fledgling), and arousal state (anesthetized vs. awake), obscure the source of discrepancy between these two studies. The authors suggest additional behavioral (psychophysical) measurements in more individuals.

Diving birds may not hear as well underwater, compared to non-avian species, based on adaptations to protect their ears from pressure changes (Dooling & Therrien, 2012). Because reproduction and communication with conspecifics occurs in air, adaptations for diving may have evolved to protect in-air hearing ability and may contribute to reduced sensitivity underwater (Hetherington, 2008). There are many anatomical adaptations in diving birds that may reduce sensitivity both in air and underwater. Anatomical ear adaptations are not well investigated, but include cavernous tissue in the meatus and middle ear that may fill with blood during dives to compensate for increased pressure on the tympanum, active muscular control of the meatus to prevent water entering the ear, and interlocking feathers to create a waterproof outer covering (Crowell et al., 2015; Rijke, 1970; Sade et al., 2008). The northern gannet, a plunge diver, has unique adaptations to hitting the water at high speeds, including additional air spaces in the head and neck to cushion the impact and a thicker tympanic membrane than similar-sized birds (Crowell et al., 2015). All of these adaptations could explain the measured higher hearing thresholds of diving birds.

Although important to seabirds in air, it is unknown if seabirds use hearing or vocalizations underwater for foraging, communication, predator avoidance, or navigation (Crowell, 2016; Dooling & Therrien, 2012). Some scientists suggest that birds must rely on vision rather than hearing while underwater (Hetherington, 2008), while others suggest birds must rely on an alternative sense in order to coordinate cooperative foraging and foraging in low light conditions (e.g., night, depth) (Dooling & Therrien, 2012).

The Navy's Living Marine Resources Program is sponsoring an ongoing study on hearing and estimated acoustic impacts in three species of auk, which will help the Navy refine its assessment of potential impacts from its activities on seabirds.

The additional published scientific information since 2011 supplements and reinforces the information presented for birds in the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS, and there is no new information or circumstances that would alter the analysis of those documents. As such, the description regarding bird hearing capabilities presented in the 2016 GOA Final SEIS/OEIS remain valid.

3.9.2.1.6 General Threats

Climate Change

Since the publication of the Navy's 2016 GOA Final SEIS/OEIS, new information is available describing the ecosystem, climate, productivity, and oceanographic conditions within the TMAA. Recent literature is available that improves understanding of climate change and potential impacts in the GOA and surrounding areas. In particular, these updates relate to anticipated climate change impacts that are projected to result in lengthened growing seasons in Alaska and northwestern Canada, with further warming continuing the trend of northward movement of some Arctic, cold-adapted organisms, with replacement by other sub-Arctic, warmer-water organisms (Smith et al., 2019; Tingley & Huybers, 2013). Much of this information is derived from nearly four decades of marine bird monitoring in Alaska and recently available climate models that overlap with the TMAA. These sources are summarized below and are considered in the Navy's analysis of potential impacts on birds from the Proposed Action described in Section 3.9.3 (Environmental Consequences).

Goyert et al. (2018) analyzed the population dynamics of five species of marine birds (black-legged kittiwake [*Rissa tridactyla*], red-legged kittiwake [*Rissa brevirostris*], common murre [*Uria aalge*], thick-billed murre [*Uria lomvia*], and tufted puffin [*Fratercula cirrhata*]), and found that some species may be more sensitive to environmental changes. For example, kittiwake species showed the greatest sensitivity to decreases in zooplankton (e.g., krill) and changes in sea surface temperature, while murre species appear to be more resilient, with carrying capacity increasing in waters surrounding Alaska in response to sea surface temperature increases.

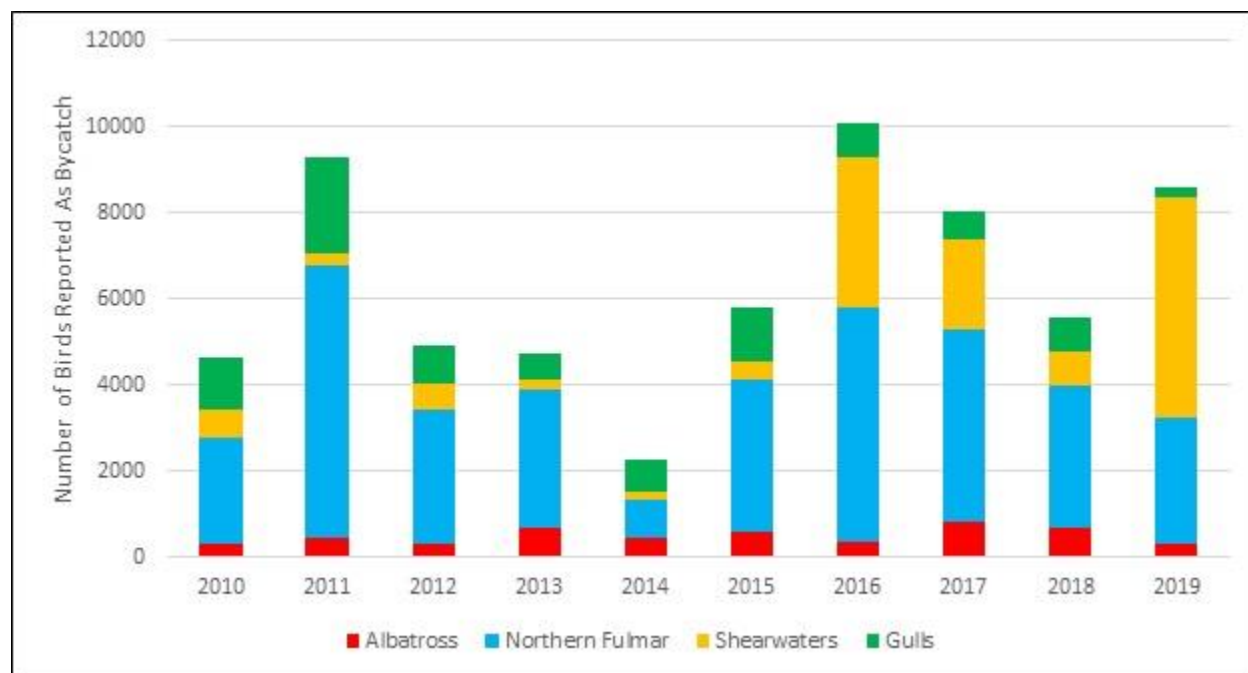
Smith et al. (2019) used recently made available climate models for the Bering Sea and Aleutian Arc to assess vulnerability of marine birds to changing climate variables considered in their analysis. Analyzing seasonal and annual spatial projections from three climate models for two physical climate variables (seawater temperature and sea ice) and three forage variables (large copepods, euphausiids, and benthic infauna), and comparing projected conditions from a recent time period (2003–2012) to a future time period (2030–2039), Smith et al. (2019) focused on core areas within areas designated as Important Bird Areas. Based on their analysis, fulmars, gulls, and auklets were affected by zooplankton declines, with the model predicting steeper declines, especially along the outer shelf and Aleutian Islands. Benthic biomass declines affected eiders along the inner shelf, and large copepod decline was significant for storm-petrels and auklets in the western Aleutians.

Recently reported bird die-offs are also notable for the description of the existing conditions in the TMAA and surrounding regions. For example, seabird mortality events in the Bering Sea and Gulf of Alaska appear to be due to starvation (Jones et al., 2019; Walsh et al., 2018). Thompson et al. (2019) analyzed size and condition of forage fish and determined that size and condition were negatively correlated to increasing sea surface temperatures and periodic Pacific Decadal Oscillation. Establishing that the condition of capelin and sand lance was among the lowest of their sample size, coinciding with fish die-offs in 2015–2016, the authors speculated that poor forage fish condition and the relatively small size of forage fish were responsible for marine bird die-offs.

Commercial Industries

The most significant commercial activity impacting seabirds within the TMAA and Gulf of Alaska region are commercial fisheries. Bycatch is defined by the National Marine Fisheries Service as discarded catch of any living marine resource plus unobserved mortality due to a direct encounter with fishing gear. Impacts from bycatch and bycatch mortality vary across fisheries and may have adverse biological,

economic, and social consequences (Benaka et al., 2019). Off Alaska, most seabird bycatch has historically occurred in fisheries using demersal longline (i.e., hook-and-line) gear. Total estimated seabird bycatch in the Alaska federal groundfish and halibut fisheries for all gear types and management plans for 2010–2019 for species of albatross, shearwaters, gulls, and the northern fulmar (a seabird species reported at the highest frequency in Alaska waters) are shown in Figure 3.9-2. The annual average bycatch for seabirds in Alaska waters from 2010–2019 is 6,378 birds, with the lowest numbers reported in 2014 (2,240 total birds) and the highest in 2016 (8,040 birds). Total annual bycatch in 2019 amounted to 8,585 birds.



Source: Krieger and Eich (2020)

Figure 3.9-2: Estimated Annual Bycatch of Albatross, Shearwaters, Gulls, and Northern Fulmar from 2010 Through 2019

Albatross. In 2019, 309 albatross (243 black-footed albatross, 52 Laysan albatross, 14 unidentified albatross) were estimated to have been caught in the fisheries off Alaska; a decrease of 39 percent compared to the 2010 through 2018 average (510 birds per year). For specific species of albatross, Laysan albatross bycatch in 2019 was one-sixth the bycatch estimated for this species in 2018 (289 birds), and was 70 percent lower than the 2010 through 2018 average (173 birds). Laysan albatross bycatch has ranged from less than 1 percent to 5 percent of total estimated seabird bycatch since 2010. Black-footed albatross bycatch was 30 percent lower in 2019 (243 birds) compared to 2018 (352 birds). The estimated bycatch of black-footed albatross in 2019 was 24 percent less than the 2010 through 2018 average (319 birds per year). There has been no reported short-tailed albatross bycatch in Alaska fisheries since 2014 (11 short-tailed albatross reported as bycatch in 2014).

Shearwaters. In 2019, shearwaters accounted for the majority (58 percent) of all bycatch in waters off of Alaska. Estimated shearwater bycatch (5,103 birds) is more than 5 times greater than the 2010 through 2018 average (957 birds per year). The 2019 increase in shearwater bycatch estimates likely corresponds to the shearwater mortality event observed throughout Alaska discussed above and reported by (Jones et al., 2019; Thompson et al., 2019; Walsh et al., 2018).

Gulls. Gulls also account for high numbers in bycatch estimates, and were the third most frequently occurring species group reported as bycatch. However, 2019 estimates are the lowest from the reporting period (2010–2019).

Northern Fulmar. Fulmar bycatch has ranged from an estimated 33 percent to 65 percent of the total seabird bycatch from 2010 through 2019, and has been the most commonly reported species in bycatch every year. In 2019, this species accounted for 33 percent of total seabird bycatch.

Marine Debris and Pollution

Plastic debris is abundant and pervasive in the world oceans and, because of its durability, is continuing to increase. The ingestion of plastics by seabirds such as albatrosses and shearwaters occurs with high frequency and is of particular concern. Potential impacts to birds and other wildlife from ingesting plastic and other debris include reduced food consumption due to lower available stomach volume and therefore poorer fat deposition and body condition, physical damage to the digestive tract, and obstruction of the digestive tract which may result in starvation. Additional risks of anthropogenic debris ingestion include the transfer of pollutants and bioaccumulation of plastic-derived chemicals in body tissues, toxicity via uptake of persistent organic pollutants absorbed by plastic particles, and the translocation of microscopic plastics to other organ systems (Roman et al., 2016). The rates of plastic ingestion by seabirds are closely related to the concentrations of plastics in different areas of the ocean due to waste discharges and ocean currents and are increasing (Kain et al., 2016; Wilcox et al., 2015).

The impacts from entanglement of marine species in marine debris are clearly profound and, in many cases, entanglements appear to be increasing despite efforts over four decades to reduce the threat. Many coastal states have undertaken certain efforts to reduce entanglement rates through marine debris clean-up measures and installed fishing line recycle centers at boat landings, in part due to entanglement of seabirds and other marine species. Fishing-related gear, balloons, and plastic bags were estimated to pose the greatest entanglement risk to marine fauna. In contrast, experts identified a broader suite of items of concern for ingestion, with plastic bags and plastic utensils ranked as the greatest threats. Entanglement and ingestion affected a similar range of taxa, although entanglement was rated as slightly worse because it is more likely to be lethal. Contamination was scored the lowest in terms of impact, affecting a smaller portion of the taxa and being rated as having solely non-lethal impacts (Wilcox et al., 2016).

3.9.2.2 Short-Tailed Albatross

3.9.2.2.1 Status and Management

As presented in the 2011 GOA Final EIS/OEIS, the short-tailed albatross (*Phoebastria albatrus*) was listed as endangered throughout its range under the ESA in 2000 (65 FR 46643). There is no designated critical habitat under ESA for the short-tailed albatross.

The human-induced threats to the short-tailed albatross are described in the 2011 GOA Final EIS/OEIS and referenced in the 2016 GOA Final SEIS/OEIS. In 2016, the Navy completed a literature review to update the description and understanding of threats within the TMAA for the short-tailed albatross. These threats (hooking and drowning on commercial long-line gear, entanglement in derelict fishing gear, ingestion of plastic debris, contamination from oil spills, and potential predation by introduced mammals on breeding islands) have remained persistent since the publication of the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS. There have been improvements in reducing bycatch for

albatrosses and other species in Alaska's longline fisheries (Melvin et al., 2019), which has likely contributed to increasing population trends for this species.

3.9.2.2.2 Abundance

Since the publication of the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS, the status of the short-tailed albatross has not changed under ESA. However, the current population estimate is approximately 3,000 birds (as compared to the 1,200 birds reported in the 2011 GOA Final EIS/OEIS) and is increasing at a rate of 5–8 percent per year (Suryan & Kuletz, 2018; U.S. Fish and Wildlife Service, 2014).

3.9.2.2.3 Distribution

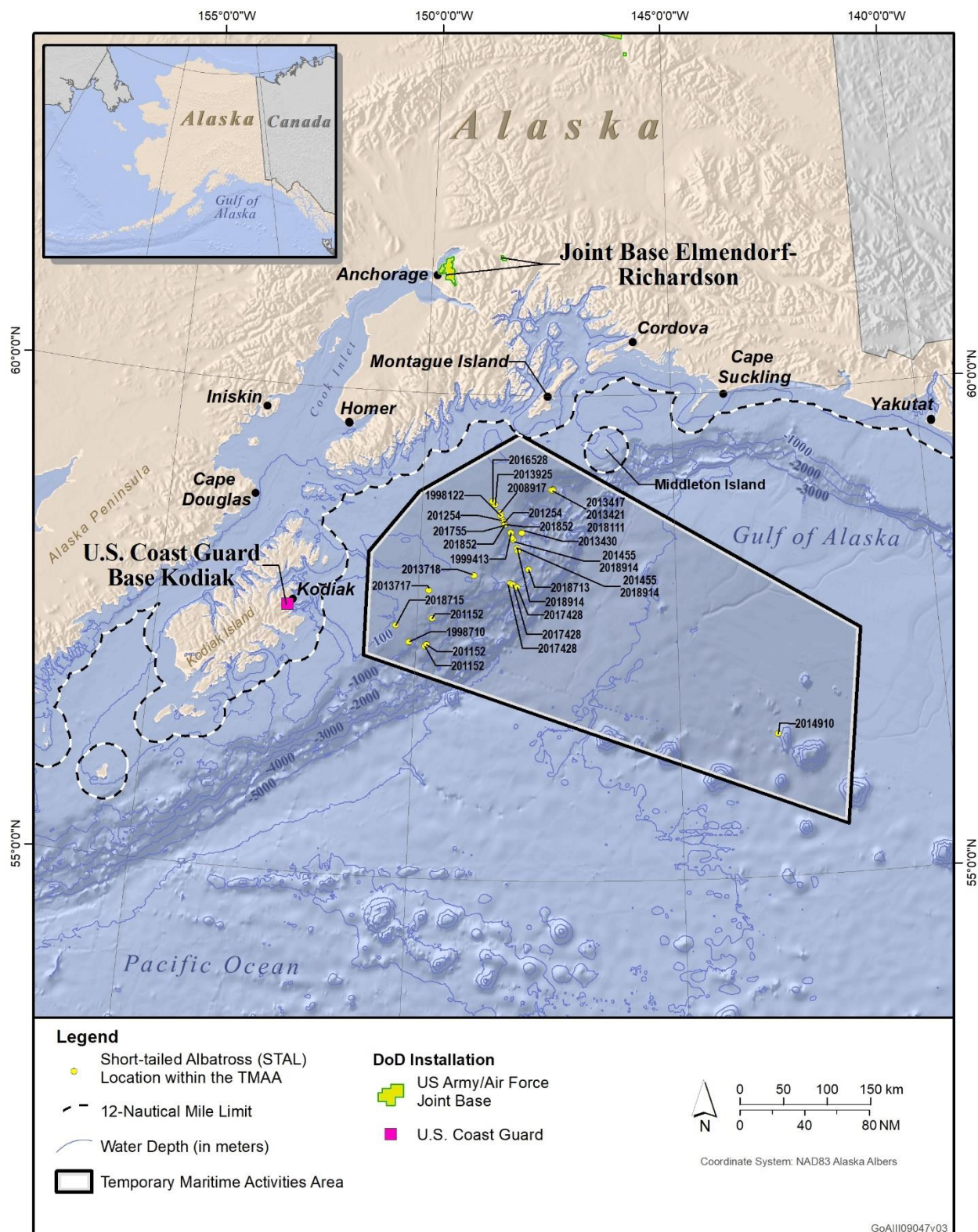
New information is available pertaining to the life history of short-tailed albatrosses (lifespan, nesting, foraging, distribution, and presence in the TMAA) since the publication of the Navy's 2016 GOA Final SEIS/OEIS. As part of the literature search supporting this SEIS/OEIS, the Navy has found additional information on juvenile foraging and distributions. Orben et al. (2018) suggest that juveniles show strong seasonal changes in distributions, traveling more in winter and occupying regions not typically used by adults. While adult short-tailed albatrosses forage over both oceanic and neritic habitats across the North Pacific, concentrating along biologically productive shelf-break areas, juveniles appear to use shelf-based habitats more, especially in the Sea of Okhotsk, Bering Sea, and along the U.S. West Coast (Orben et al., 2018). During their initial flight years, juvenile short-tailed albatrosses use a large portion of the North Pacific from tropical to arctic waters, including the transition zone, California Current system, sub-arctic gyres, and the marginal seas: the Bering Sea and Sea of Okhotsk (Orben et al., 2018). As juvenile albatrosses age, habitat use switches away from pelagic regions to shelf break and slope habitats, becoming more similar to adult distributions.

In support of this SEIS/OEIS, the Navy examined records of the USGS Alaska Science Center to determine which pelagic species overlap with the TMAA (see description of the NPPSD in Section 3.9.2.1, General Background). Based on this review of records, 30 short-tailed albatross observations were reported between 1998 and 2018 within the TMAA. Most of these observations were reported in spring and summer months (65 percent of observations within the TMAA for all short-tailed albatrosses occurred between April and May, and 95 percent occurring between April and September) (Figure 3.9-3).

3.9.2.2.4 Group Size

The Navy conducted a literature search for new information since the publication of the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS on group size that may change the analysis of potential impacts on birds. No new information is available on group size that would alter the analysis from the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS. A summary of group size information for bird groups and specific species is included below. A variety of group sizes and diversity may be encountered throughout the TMAA, ranging from migration of an individual bird to large concentrations of mixed-species flocks. Depending on season, location, and time of day, the number of birds observed (group size) will vary and will likely fluctuate from year to year. During spring and fall periods, diurnal and nocturnal migrants would likely occur in large groups as they migrate over open water.

Most seabird species nest in groups (colonies) on the ground of coastal areas or oceanic islands, where breeding colonies number from a few individuals to thousands (U.S. Geological Survey, 2016). Outside of the breeding season, most seabirds within the Order Procellariiformes are solitary, though they may join mixed-species flocks while foraging and can be associated with whales and dolphins (Onley & Scofield, 2007) or areas where prey density is high (U.S. Fish and Wildlife Service, 2005a, 2005b). During the



Source: North Pacific Pelagic Seabird Database (Drew & Piatt, 2015) and eBird (2020)

Figure 3.9-3: Observations of Short-Tailed Albatrosses Within the TMAA

breeding season, these seabirds usually form large nesting colonies. Similarly, birds within the Order Pelecaniformes are typically colonial. Foraging occurs either singly or in small groups. For example, foraging can range from singles or pairs (murrelets) (Lorenz et al., 2016; U.S. Fish and Wildlife Service, 2017) and can extend upward into larger groups (terns) in which juveniles accompany adults to post breeding foraging areas, where the water is calm and the food supply is good.

3.9.3 Environmental Consequences

The Navy conducted a review of existing federal and state regulations and standards, as well as a review of new literature (e.g., publications) pertaining to birds. Although additional information relating to existing environmental conditions was found, the new information does not indicate an appreciable change to the existing environmental conditions as described in the 2011 GOA Final EIS/OEIS or from updates provided in the 2016 GOA Final SEIS/OEIS. As presented in Section 1.3 (Proposed Action), the Proposed Action in this SEIS/OEIS is consistent with the Proposed Action from the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS. This SEIS/OEIS analyzes the impacts on birds under the No Action Alternative and Alternative 1 (the Proposed Action).

Based on the information provided in Section 3.9.2 (Affected Environment), only the short-tailed albatross is carried forward for a species-specific analysis because new information is available that improves the understanding of short-tailed albatross occurrences within the TMAA. The stressors analyzed for potential impacts on seabirds within the TMAA include the following:

- Acoustic (sonar and other transducers, vessel noise, aircraft noise, weapon noise)
- Explosives (explosive shock wave and sound, explosive fragments)

In addition to acoustic and explosive stressors, the Navy also reviewed the proposed action's potential impacts on seabird species from other stressors analyzed in the 2011 GOA Final EIS/OEIS. These stressors include entanglement and ingestion from the release of military expended materials during training activities, along with vessel and aircraft noise, and the potential for vessel and aircraft strike on seabirds. The analysis of potential impacts of stressors on seabirds within the TMAA includes consideration of the standard operating procedures and mitigation measures that the Navy will implement under Alternative 1 of the Proposed Action. Standard operating procedures are designed to provide for safety and mission success, and many also benefit birds. As described in Section 5.1.3 (Aircraft Safety) of the 2016 GOA Final SEIS/OEIS, bird strikes present an aviation safety risk for aircrews and aircraft. Pilots of Navy aircraft make every attempt to avoid large flocks of birds in order to reduce the safety risk involved with a potential bird strike. As described in Section 2.3.2.2 (Target Deployment and Retrieval Safety) of this SEIS/OEIS, standard operating procedures for target deployment and retrieval safety include conducting applicable weapons firing activities in daylight hours in Beaufort Sea state number 4 conditions or better to ensure safe operating conditions. This benefits birds by increasing the effectiveness of visual observations for mitigation, thereby reducing the potential for interactions with the weapons firing activities associated with the use of applicable deployed targets. During activities that involve recoverable targets (e.g., aerial drones), the military recovers the target and any associated decelerators/parachutes to the maximum extent practicable consistent with personnel and equipment safety. Recovery of these items helps minimize the amount of materials that remain on the surface or on the seafloor, which could potentially alert enemy forces to the presence of military assets during military missions and combat operations. This standard operating procedure benefits birds by reducing the potential for physical disturbance and strike, entanglement, or ingestion of applicable targets and any associated decelerators/parachutes. In addition to standard operating

procedures, the Navy developed mitigation measures for the purpose of avoiding or reducing potential impacts from weapons firing noise, explosive medium-caliber gunnery exercises, and small- and medium-caliber non-explosive gunnery exercises on ESA-listed short-tailed albatross in the TMAA. Additional information about mitigation for birds is presented in Chapter 5 (Mitigation) of this SEIS/OEIS.

The Navy has determined that the wide distribution of seabirds within the TMAA and the dispersed occurrence of Navy training activities does not present new risks to seabird species than what was analyzed previously. Accordingly, this SEIS/OEIS will analyze in detail acoustic stressors (sonar and other transducers, vessel noise, aircraft noise, weapon noise) and explosive stressors (explosive shock wave and sound, explosive fragments). Consistent with previous consultations and analyses of potential impacts on the short-tailed albatross within the TMAA, the Navy does not anticipate adverse effects on this species resulting from non-acoustic and non-explosive stressors.

3.9.3.1 Acoustic Stressors

The analysis of effects to birds follows the concepts outlined in Section 3.0.4.3 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities). This section begins with a summary of relevant data regarding acoustic impacts on birds in Section 3.9.3.1.1 (Background). This is followed by an analysis of estimated impacts on birds due to sonar and other transducers. The Navy will rely on the previous 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS analysis of vessel noise, aircraft noise, and weapons noise, as there has been no substantive or otherwise meaningful change in the action, although new applicable and emergent science in regard to these sub-stressors is presented in the sections that follow. Based on established criteria and thresholds for auditory injury and new impact modeling methods, the analysis provided in Section 3.9.3.1.2 (Impacts from Sonar and Other Transducers) of this SEIS/OEIS supplants the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS for birds. Additional explanations of the acoustic terms and sound energy concepts used in this section are found in Appendix B (Acoustic and Explosive Concepts).

3.9.3.1.1 Background

The sections below include a survey and synthesis of best-available science published in peer-reviewed journals, technical reports, and other scientific sources pertinent to impacts on birds potentially resulting from sound-producing Navy training activities. Impacts on birds depend on the sound source and context of exposure. Possible impacts include auditory or non-auditory trauma; hearing loss resulting in temporary or permanent hearing threshold shift (TTS or PTS, respectively); auditory masking; physiological stress; or changes in behavior, including changing habitat use and activity patterns, increasing stress response, decreasing immune response, reducing reproductive success, increasing predation risk, and degrading communication (Larkin et al., 1996). Numerous studies have documented that birds and other wild animals respond to human-made noise (Bowles et al., 1994; Larkin et al., 1996; National Park Service, 1994). The manner in which birds respond to noise could depend on species' physiology life stage, characteristics of the noise source, loudness, onset rate, distance from the noise source, presence/absence of associated visual stimuli, and previous exposure. Noise may cause physiological or behavioral responses that reduce the animals' fitness or ability to grow, survive, and reproduce successfully.

The types of birds exposed to sound-producing activities depend on where military readiness activities occur. Birds in the TMAA can be divided into three groups based on breeding and foraging habitat: (1) those species such as albatrosses, petrels, frigatebirds, alcids, jaegers, and some terns that forage over the ocean and nest on coastlines and oceanic islands; (2) species such as pelicans, cormorants,

gulls, and some terns that nest along the coast and forage in nearshore areas; and (3) those species such as jaegers, some gull and tern species, grebes, scoters, and ducks and loons that nest and forage along the coast and inland habitats and come to the coastal areas during non-breeding season. In addition, birds that are typically found inland, such as songbirds, may be present flying in large numbers over open ocean areas during annual spring and fall migration periods.

Birds could be exposed to sounds from a variety of sources. While above the water surface, birds may be exposed to airborne sources such as weapons noise and aircraft noise. While foraging and diving, birds may be exposed to underwater sources such as sonar and vessel noise. Exposures of birds that forage below the surface may be reduced by destructive interference of reflected sound waves near the water surface (see Appendix B, Acoustic and Explosive Concepts), although as previously stated, little is known about seabird hearing ability underwater. Birds that forage near the surface would be exposed to underwater sound for shorter periods of time than those that forage below the surface. Birds that plunge-dive or surface-dip are typically submerged for short durations, and any exposure to underwater sound would be very brief. Albatrosses exhibit shallow plunge-diving or surface-dipping behavior at or near the water surface to capture prey (see Section 3.9.2.1.4, Diving Information).

3.9.3.1.1.1 Injury

Both non-auditory and auditory injuries can occur as a result of intense sound exposure. Moderate- to low-level noise from vessels, aircraft, and weapons described in Section 3.9.3.1 (Acoustic Stressors) lacks the amplitude and energy to cause any direct injury. Section 3.0.4.3 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities) provides additional information on injury and the framework used to analyze this potential impact.

Auditory structures can be susceptible to direct mechanical injury due to high levels of impulsive sound. This could include tympanic membrane rupture, disarticulation of the middle ear ossicles, and trauma to the inner ear structures such as hair cells within the organ of Corti. Auditory trauma differs from auditory fatigue in that the latter involves the overstimulation (fatiguing) of the auditory system, rather than direct mechanical damage, which may result in hearing loss (see Section 3.9.3.1.1.2, Hearing Loss). There are no data on damage to the middle ear structures of birds due to acoustic exposures. Because birds are known to regenerate auditory hair cells, studies have been conducted to purposely expose birds to very high sound exposure levels (SELs) in order to induce hair cell damage in the inner ear. The effects of sound exposures on hair cells are discussed below in Section 3.9.3.1.1.2 (Hearing Loss).

Because there are no data on non-auditory injury to birds from intense non-explosive sound sources, it may be useful to consider information for other similar-sized vertebrates. The rapid large pressure changes near non-explosive impulsive underwater sound sources, such as some large air guns and pile driving, are thought to be potentially injurious to other small animals (fishes and sea turtles). Potential for injury is generally attributed to compression and expansion of body gas cavities, either due to rapid onset of pressure changes or resonance (enhanced oscillation of a cavity at its natural frequency). Because water is considered incompressible and animal tissue is generally of similar density as water, animals would be more susceptible to injury from a high-amplitude sound source in water than in air, since waves would pass directly through the body rather than being reflected. Proximal exposures to high-amplitude non-impulsive sounds underwater could be limited by a bird's surfacing response.

In air, the risk of barotrauma would be associated with high-amplitude impulses, such as from explosives (discussed in Section 3.9.3.2, Explosive Stressors). Unlike in water, most acoustic energy will reflect off the surface of an animal's body in air. Additionally, air is compressible whereas water is not, allowing

energy to dissipate more rapidly. For these reasons, in-air non-explosive sound sources in this analysis are considered to pose little risk of non-auditory injury.

3.9.3.1.1.2 Hearing Loss

Exposure to intense sound may result in hearing loss that persists after cessation of the noise exposure. Hearing loss may be temporary or permanent, depending on factors such as the exposure frequency, received sound pressure level (SPL), temporal pattern, and duration. Hearing loss could impair a bird's ability to hear biologically important sounds within the affected frequency range. Biologically important sounds come from social groups, potential mates, offspring, or parents; environmental sounds; prey; or predators.

Because in-air measures of hearing loss and recovery in birds due to an acoustic exposure are limited (e.g., quail, budgerigars, canaries, and zebra finches (Ryals et al., 1999); budgerigar (Hashino et al., 1988); parakeet (Saunders & Dooling, 1974); quail (Niemic et al., 1994)), and no studies exist of bird hearing loss due to underwater sound exposures, auditory threshold shift in birds is considered to be consistent with general knowledge about noise-induced hearing loss described in Section 3.0.4.3 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities). The frequencies affected by hearing loss would vary depending on the exposure frequency. The limited data on hearing loss in birds shows that the frequency of exposure is the hearing frequency most likely to be affected (Saunders & Dooling, 1974).

Hearing loss can be due to biochemical (fatiguing) processes or tissue damage. Tissue damage can include damage to the auditory hair cells and their underlying support cells. Hair cell damage has been observed in birds exposed to long-duration sounds that resulted in initial threshold shifts greater than 40 dB (Niemic et al., 1994; Ryals et al., 1999). Unlike many other animals, birds have the ability to regenerate hair cells in the ear, usually resulting in considerable anatomical, physiological, and behavioral recovery within several weeks (Rubel et al., 2013; Ryals et al., 1999). Still, intense exposures are not always fully recoverable, even over periods up to a year after exposure, and damage and subsequent recovery vary significantly by species (Ryals et al., 1999). Birds may be able to protect themselves against damage from sustained sound exposures by reducing middle ear pressure, an ability that may protect ears while in flight (Ryals et al., 1999) and from injury due to pressure changes during diving (Dooling & Therrien, 2012).

Hearing loss is typically quantified in terms of threshold shift, which is the amount (in dB) that hearing thresholds at one or more specified frequencies are elevated, compared to their pre-exposure values, at some specific time after the noise exposure. The amount of threshold shift measured usually decreases with increasing recovery time, which is the amount of time that has elapsed since a noise exposure. If the threshold shift eventually returns to zero (i.e., the hearing threshold returns to the pre-exposure value), the threshold shift is called a temporary threshold shift (TTS). If the threshold shift does not completely recover (the threshold remains elevated compared to the pre-exposure value), the remaining threshold shift is called a permanent threshold shift (PTS). By definition, TTS is a function of the recovery time; therefore, comparing the severity of noise exposures based on the amount of induced TTS can only be done if the recovery times are also considered. For example, a 20 dB TTS measured 24 hours post-exposure indicates a more hazardous exposure than one producing 20 dB of TTS measured only two minutes after exposure. If the TTS is 20 dB after 24 hours, the TTS measured after two minutes would be much higher. Conversely, if 20 dB of TTS is measured after two minutes, the TTS measured after 24 hours would likely be much smaller. Studies in mammals have revealed that noise exposures resulting in high levels of TTS (greater than 40 dB) may also result in neural injury

without any permanent hearing loss (Kujawa & Liberman, 2009; Lin et al., 2011). It is unknown if a similar effect would be observed in birds.

Hearing Loss due to Non-Impulsive Sound Sources

Behavioral studies of threshold shift in birds within their frequencies of best hearing (between 2 and 4 kHz) due to long duration (30 minutes to 72 hours) continuous, non-impulsive, high-level sound exposures in air have shown that susceptibility to hearing loss varies substantially by species, even in species with similar auditory sensitivities, hearing ranges, and body size (Niemic et al., 1994; Ryals et al., 1999; Saunders & Dooling, 1974). For example, Ryals et al. (1999) conducted the same exposure experiment on quail and budgerigars, which have very similar audiograms. A 12-hour exposure to a 2.86 kHz tone at 112 dB re 20 μ Pa SPL (cumulative SEL of 158 dB referenced to 20 micropascals squared seconds [dB re 20 μ Pa²s]) resulted in a 70 dB threshold shift measured after 24 hours in quail; and a PTS of approximately 20 dB persisted after one year. This same exposure in budgerigars produced a substantially lower TTS of 40 dB measured after 12 hours, which fully recovered after one month (Ryals et al., 1999). Although not directly comparable, this SPL would be perceived as extremely loud but just under the threshold of pain for humans per the American Speech-Language-Hearing Association. Whereas the 158 dB re 20 μ Pa²s SEL tonal exposure to quail discussed above caused 20 dB of PTS (Ryals et al., 1999), a shorter (four-hour) tonal exposure to quail with similar SEL (157 dB re 20 μ Pa²s) caused 65 dB of TTS that fully recovered within two weeks (Niemic et al., 1994).

Data on threshold shift in birds due to relatively short-duration sound exposures that could be used to estimate the onset of threshold shift is limited. Saunders and Dooling (1974) provide the only threshold shift growth data measured for birds. Saunders and Dooling (1974) exposed young budgerigars to four levels of continuous 1/3-octave band noise (76, 86, 96, and 106 dB re 20 μ Pa) centered at 2.0 kHz and measured the threshold shift at various time intervals during the 72-hour exposure. The earliest measurement found 7 dB of threshold shift after approximately 20 minutes of exposure to the 96 dB re 20 μ Pa SPL noise (127 dB re 20 μ Pa²s SEL). Generally, onset of TTS in other species has been considered 6 dB above measured threshold (Finneran, 2015), which accounts for natural variability in auditory thresholds. The Saunders and Dooling (1974) budgerigar data are the only bird data showing low levels of threshold shift. Because of the observed variability of threshold shift susceptibility between bird species and the relatively long duration of sound exposure in Saunders and Dooling (1974), the observed onset level cannot be assumed to represent the SEL that would cause onset of TTS for other bird species or for shorter duration exposures (i.e., a higher SEL may be required to induce threshold shift for shorter duration exposures).

Since the goal of most bird hearing studies has been to induce hair cell damage to study regeneration and recovery, exposure durations were purposely long. Studies with other non-avian species have shown that long-duration exposures tend to produce more threshold shift than short-duration exposures with the same SEL (e.g., see Finneran (2015)). The SELs that induced TTS and PTS in these studies likely over-estimate the potential for hearing loss due to any short-duration sound of comparable SEL that a bird could encounter outside of a controlled laboratory setting. In addition, these studies were not designed to determine the exposure levels associated with the onset of any threshold shift or to determine the lowest SEL that may result in PTS.

With insufficient data to determine PTS onset for birds due to a non-impulsive exposure, data from other taxa are considered. Studies of terrestrial mammals suggest that 40 dB of threshold shift is a reasonable estimate of where PTS onset may begin (Southall et al., 2007). Similar amounts of threshold shift have been observed in some bird studies with no subsequent PTS. Of the birds studied, the

budgerigars showed intermediate susceptibility to threshold shift; they exhibited shifts in the range of 40 dB–50 dB after 12-hour exposures to 112 dB and 118 dB re 20 μ Pa SPL tones at 2.86 kHz (158–164 dB re 20 μ Pa²s SEL), which recovered to within 10 dB of baseline after three days and fully recovered after one month (Ryals et al., 1999). These experimental SELs are a conservative estimate of the SEL above which PTS may be considered possible for birds.

All of the above studies were conducted in air. There are no studies of hearing loss in diving birds due to underwater sound exposures.

Hearing Loss due to Impulsive Sound Sources

The only measure of hearing loss in a bird due to an impulsive noise exposure was conducted by Hashino et al. (1988), in which budgerigars were exposed to the firing of a pistol with a received level of 169 dB re 20 μ Pa peak SPL (two gunshots per each ear); SELs were not provided. While the gunshot frequency power spectrum had its peak at 2.8 kHz, threshold shift was most extensive below 1 kHz. TTS recovered at frequencies above 1 kHz, while a 24 dB PTS was sustained at frequencies below 1 kHz. Studies of hearing loss in diving birds exposed to impulsive sounds underwater do not exist.

Because there is only one study of hearing loss in birds due to an impulsive exposure, the few studies of hearing loss in birds due to exposures to non-impulsive sound (discussed above) are the only other avian data upon which to assess bird susceptibility to hearing loss from an impulsive sound source. Data from other taxa (U.S. Department of the Navy, 2017a) indicate that, for the same SEL, impulsive exposures are more likely to result in hearing loss than non-impulsive exposures. This is due to the high peak pressures and rapid pressure rise times associated with impulsive exposures.

3.9.3.1.1.3 Masking

Masking occurs when one sound, distinguished as the “noise,” interferes with the detection or recognition of another sound. The quantitative definition of masking is the amount in decibels an auditory detection or discrimination threshold is raised in the presence of a masker (Erbe et al., 2016). As discussed in Section 3.0.4.3 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities), masking can effectively limit the distance over which an animal can communicate and detect biologically relevant sounds. Masking only occurs in the presence of the masking noise and does not persist after the cessation of the noise.

Critical ratios are the lowest ratio of signal-to-noise at which a signal can be detected. When expressed in decibels, critical ratios can easily be calculated by subtracting the noise level (in dB re 1 μ Pa² per hertz) from the signal level (in dB re 1 μ Pa) at detection threshold. A signal must be received above the critical ratio at a given frequency to be detectable by an animal. Critical ratios have been determined for a variety of bird species (e.g., Dooling (1980), Noirot et al. (2011), Dooling and Popper (2000), and Crowell (2016)), and inter-species variability is evident. Some birds exhibit low critical ratios at certain vocal frequencies, perhaps indicating that hearing evolved to detect signals in noisy environments or over long distances (Dooling & Popper, 2000).

The effect of masking is to limit the distance over which a signal can be perceived. An animal may attempt to compensate in several ways, such as by increasing the source level of vocalizations (the Lombard effect), changing the frequency of vocalizations, or changing behavior (e.g., moving to another location, increasing visual display). Birds have been shown to shift song frequencies in the presence of a tone at a similar frequency (Goodwin & Podos, 2013), and in continuously noisy urban habitats, populations have been shown to have altered song duration and shifted to higher frequencies

(Slabbekoorn & den Boer-Visser, 2006). Changes in vocalization may incur energetic costs and hinder communication with conspecifics, which, for example, could result in reduced mating opportunities. These effects are of long-term concern in constant noisy urban environments (Patricelli & Blickley, 2006) where masking conditions are prevalent.

3.9.3.1.1.4 Physiological Stress

Animals in the marine environment naturally experience stressors within their environment and as part of their life histories. Contributors to stress include changing weather and ocean conditions, exposure to diseases and naturally occurring toxins, lack of prey availability, social interactions with members of the same species, nesting, and interactions with predators. Anthropogenic sound-producing activities have the potential to provide additional stressors beyond those that naturally occur, as described in Section 3.0.4.3 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities).

Chronic stress due to disturbance may compromise the general health and reproductive success of birds (Kight et al., 2012), but a physiological stress response is not necessarily indicative of negative consequences to individual birds or to populations (Larkin et al., 1996; National Park Service, 1994). The reported behavioral and physiological responses of birds to noise exposure can fall within the range of normal adaptive responses to external stimuli, such as predation, that birds face on a regular basis. These responses can include activation of the neural and endocrine systems, which can cause changes such as increased blood pressure, available glucose, and blood levels of corticosteroids (Manci et al., 1988). It is possible that individuals would return to normal almost immediately after short-term or transient exposure, and the individual's metabolism and energy budget would not be affected in the long term. Studies have also shown that birds can habituate to noise following frequent exposure and cease to respond behaviorally to the noise (Larkin et al., 1996; National Park Service, 1994; Plumpton, 2006). However, the likelihood of habituation is dependent upon a number of factors, including species of bird (Bowles et al., 1991) and frequency of and proximity to exposure. Although Andersen et al. (1990) did not evaluate noise specifically, they found evidence that anthropogenic disturbance is related to changes in home ranges; for example, raptors have been shown to shift their terrestrial home range when concentrated military training activity was introduced to the area. On the other hand, cardinals nesting in areas with high levels of military training activity (including gunfire, artillery, and explosives) were observed to have similar reproductive success and stress hormone levels as cardinals in areas of low activity (Barron et al., 2012).

While physiological responses such as increased heart rate or startle response can be difficult to measure in the field, they often accompany more easily measured reactions like behavioral responses. A startle is a reflex characterized by rapid increase in heart rate, shutdown of nonessential functions, and mobilization of glucose reserves. Habituation keeps animals from expending energy and attention on harmless stimuli, but the physiological component might not habituate completely (Bowles, 1995).

A strong and consistent behavioral or physiological response is not necessarily indicative of negative consequences to individuals or to populations (Bowles, 1995; Larkin et al., 1996; National Park Service, 1994). For example, many of the reported behavioral and physiological responses to noise are within the range of normal adaptive responses to external stimuli, such as predation, that wild animals face on a regular basis. In many cases, individuals would return to homeostasis or a stable equilibrium almost immediately after exposure. The individual's overall metabolism and energy budgets would not be affected if it had time to recover before being exposed again. If the individual does not recover before being exposed again, physiological responses could be cumulative and lead to reduced fitness. However,

it is also possible that an individual would have an avoidance reaction (i.e., move away from the noise source) to repeated exposure or habituate to the noise when repeatedly exposed.

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

3.9.3.1.1.5 Behavioral Reactions

Section 3.0.4.3 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities) provides additional information on behavioral reactions and the framework used to analyze this potential impact. Numerous studies have documented that birds respond to human-made noise, including aircraft overflights, weapons firing, and explosions (Larkin et al., 1996; National Park Service, 1994; Plumpton, 2006). The manner in which an animal responds to noise could depend on several factors, including life history characteristics of the species, characteristics of the noise source, sound source intensity, onset rate, distance from the noise source, presence or absence of associated visual stimuli, food and habitat availability, and previous exposure (see Section 3.0.4.3, Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities). Researchers have documented a range of bird behavioral responses to noise, including no response, head turn, alert behavior, startle response, flying or swimming away, diving into the water, and increased vocalizations (Brown et al., 1999; Larkin et al., 1996; National Park Service, 1994; Plumpton, 2006; Pytte et al., 2003; Stalmaster & Kaiser, 1997). Some behavioral responses may be accompanied by physiological responses, such as increased heart rate or short-term changes in stress hormone levels (Partecke et al., 2006).

Behavioral responses may depend on the characteristics of the noise and whether the noise is similar to biologically relevant sounds such as alarm calls by other birds and predator sounds. For example, European starlings (*Sturnus vulgaris*) took significantly longer to habituate to repeated bird distress calls than white noise or pure tones (Johnson et al., 1985). Starlings may have been more likely to continue to respond to the distress calls because they are more biologically meaningful. Starlings were also more likely to habituate in winter than summer, possibly meaning that food scarcity or seasonal physiological conditions may affect intensity of behavioral response (Johnson et al., 1985).

Behavioral Reactions to Impulsive Sound Sources

It is assumed that most species would react similarly to impulsive sources such as weapons noise and explosions. However, it is important to note that most data on behavioral reactions to impulsive sources is collected from studies using air guns and impact pile driving, sources that do not occur in the TMAA. Studies regarding behavioral responses by non-nesting birds to impulsive sound sources are limited. Seismic surveys had no noticeable impacts on the movements or diving behavior of long-tailed ducks undergoing wing molt, a period in which flight is limited and food requirements are high (Lacroix et al., 2003). The birds may have tolerated the seismic survey noise to stay in preferred feeding areas.

Responses to aircraft sonic booms are informative of responses to single impulsive sounds. Responses to sonic booms are discussed below in Behavioral Reactions to Aircraft.

Behavioral Reactions to Sonar and Other Active Acoustic Sources

One study has measured bird responses to sonar. Hansen et al. (2020) exposed two common murres to broadband sound bursts and mid-frequency active sonar playback during an underwater foraging task and found that both birds exhibited behavioral reactions to both stimuli as compared to no reactions in control trials. One subject exhibited stronger behavioral reactions to the noise bursts, and the other to

the sonar. The authors found this effect for received levels between 110 and 137 dB re 1 μ Pa root mean squared and noted that the birds tended to turn or swim away from the sound source. This research suggests that anthropogenic noise within the birds' hearing range may cause behavioral disturbance while foraging underwater.

The effect of fishing net pingers on bird bycatch has also been examined. Fewer common murre (*Uria aalge*) were entangled in gillnets when the gillnets were outfitted with 1.5 kHz pingers with a source level of 120 dB re 1 μ Pa; however, there was no significant reduction in rhinoceros auklet (*Cerorhinca monocerata*) bycatch in the same nets (Melvin et al., 2011; Melvin et al., 1999). It was unknown whether the pingers elicited a behavioral response by the birds.

Behavioral Reactions to Aircraft

There are multiple possible factors involved in behavioral responses to aircraft overflights, including the noise stimulus as well as the visual stimulus. Observations of tern colonies responses to balloon overflights suggest that visual stimulus is likely to be an important component of disturbance from overflights (Brown, 1990). Although it was assumed nesting colonial waterbirds would be more likely to flush or exhibit a mob response when disturbed, observations of nesting black skimmers and nesting least, gull-billed, and common terns showed they did not modify nesting behavior in response to military fixed-wing aircraft engaged in low-altitude tactical flights and rotary-wing overflights (Hillman et al., 2015). Maximum behavioral responses by crested tern (*Sterna bergii*) to aircraft noise were observed at sound level exposures greater than 85 A-weighted decibels (dBA) re 20 μ Pa. However, herring gulls (*Larus argentatus*) significantly increased their aggressive interactions within the colony and their flights over the colony during overflights with received SPLs of 101–116 dBA re 20 μ Pa (Burger, 1981).

Raptors and wading birds have responded minimally to jet (110 dBA re 20 μ Pa) and propeller plane (92 dBA re 20 μ Pa) overflights, respectively (Ellis, 1981). Jet flights greater than 1,640 ft. (500 m) distance from raptors were observed to elicit no response (Ellis, 1981). The impacts of low-altitude military training flights on wading bird colonies in Florida were estimated using colony distributions and turnover rates. There were no demonstrated impacts of military activity on wading bird colony establishment or size (Black et al., 1984). Fixed-wing jet aircraft disturbance did not seem to adversely affect waterfowl observed during a study in coastal North Carolina (Conomy et al., 1998); however, harlequin ducks (*Histrionicus histrionicus*) were observed to show increased agonistic behavior and reduced courtship behavior up to one to two hours after low-altitude military jet overflights (Goudie & Jones, 2004).

It is possible that birds could habituate and no longer exhibit behavioral responses to aircraft noise, as has been documented for some impulsive noise sources (Ellis, 1981; Russel et al., 1996) and aircraft noise (Conomy et al., 1998). Ellis (1981), found that raptors would typically exhibit a minor short-term startle response to simulated sonic booms, and there was no long-term effect to productivity.

3.9.3.1.1.6 Long-Term Consequences

Long-term consequences to birds due to acoustic exposures are considered following the Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities (see Section 3.0.4.3).

Long-term consequences due to individual behavioral reactions and short-term instances of physiological stress are especially difficult to predict because individual experience over time can create complex contingencies. It is more likely that any long-term consequences to an individual would be a result of costs accumulated over a season, year, or life stage due to multiple behavioral or stress

responses resulting from exposures to multiple stressors over significant periods of time. Conversely, some birds may habituate to or become tolerant of repeated acoustic exposures over time, learning to ignore a stimulus that in the past did not accompany any overt threat. Most research on long-term consequences to birds due to acoustic exposures has focused on breeding colonies or shore habitats, and does not address the brief exposures that may be encountered during migration or foraging at sea. More research is needed to better understand the long-term consequences of human-made noise on birds, although intermittent exposures are assumed to be less likely than prolonged exposures to have lasting consequences.

3.9.3.1.2 Impacts from Sonar and Other Transducers

Sonar and other transducers could be used throughout the TMAA under the Proposed Action. 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 3.0.4.1 (Acoustic Sources).

Information regarding the impacts of sonar on birds is limited, and little is known about the ability of birds to hear underwater. The limited information available (Crowell, 2016; Crowell et al., 2015; Crowell et al., 2016; Johansen et al., 2016; Maxwell et al., 2017) suggest the range of best hearing may shift to lower frequencies in water (Dooling & Therrien, 2012; Therrien, 2014) (see Section 3.9.2.1.5, Hearing and Vocalization). Because few birds can hear above 10 kHz in air, it is likely that the only sonar sources they may be able to detect are low and mid-frequency sources.

The possibility of an ESA-listed bird species being exposed to sonar and other transducers depends on whether it submerges during foraging, and if so, whether it is a pursuit-diver or plunge-diver. Other than pursuit-diving species, birds' exposure to these sounds is likely negligible because they spend only a very short time underwater (plunge-diving or surface-dipping) or forage only at the water surface. Possible exposure also depends on whether it forages in areas where these sound sources may be used.

In addition to diving behavior, the likelihood of a bird being exposed to underwater sound depends on factors such as source duty cycle (defined as the percentage of the time during which a sound is generated over a total operational period), whether the source is moving or stationary, and other activities that might be occurring in the area. For moving sources, such as most hull-mounted sonar use, the likelihood of an individual bird being repeatedly exposed to an intense sound source over a short period of time is low because the training activities are transient and both sonar use and bird diving are intermittent. The potential for birds to be exposed to intense sound associated with stationary sonar sources would likely be limited for some activities because other activities occurring in conjunction may cause them to leave the immediate area. For example, birds would likely react to helicopter noise during dipping sonar exercises by flushing from the immediate area and would therefore not be exposed to underwater sonar. Any exposure would be limited to a bird's dive duration, and a bird may reduce its exposure if its dive is disrupted or the bird re-locates to another foraging area.

Injury due to acoustic resonance of air space in the lungs from sonar and other transducers is unlikely in birds. Unlike mammals, birds have compact, rigid lungs with strong pulmonary capillaries that do not change much in diameter when exposed to extreme pressure changes (Baerwald et al., 2008), leading to resonant frequencies lower than the frequencies used for Navy sources. Furthermore, potential direct injuries (e.g., barotrauma, hemorrhage, or rupture of organs or tissue) from non-impulsive sound sources such as sonar are unlikely because of slow rise times, lack of a strong shock wave such as that associated with an explosive, and relatively low peak pressures.

A physiological impact, such as hearing loss, could only occur if a seabird were close to an intense sound source. An underwater sound exposure would have to be intense and of a sufficient duration to cause hearing loss (see Section 3.9.3.1.1.2, Hearing Loss). Avoiding the sound by returning to the surface would limit extended or multiple sound exposures underwater. Additionally, some diving birds may avoid interactions with large moving vessels upon which the most powerful sonars are operated (Schwemmer et al., 2011). In general, birds are less susceptible to both TTS and PTS than mammals (Saunders & Dooling, 1974). Diving birds have adaptations to protect the middle ear and tympanum from pressure changes during diving that may affect hearing (Dooling & Therrien, 2012). While some adaptations may exist to aid in underwater hearing, other adaptations to protect in-air hearing may limit aspects of underwater hearing (Hetherington, 2008). Because of these reasons, the likelihood of a diving bird experiencing an underwater exposure to sonar or other transducer that could result in an impact on hearing is considered low. Similarly, the masking of important acoustic signals underwater by sonar or other transducers is unlikely given the low probability of spatial, temporal, and spectral (e.g. sound frequency) overlap.

Given the information and adaptations discussed above, diving seabirds are not expected to detect high-frequency sources underwater and are only expected to detect mid- and low-frequency sources when in close proximity. A diving bird may not respond to an underwater source, or it may respond by altering its dive behavior, perhaps by reducing or ceasing a foraging bout. It is expected that any behavioral interruption would be temporary as the source or the bird changes location.

Some birds commonly follow vessels, including certain species of gulls, storm petrels, and albatrosses, as there is increased potential of foraging success as the prop wake brings prey to the surface (Hamilton, 1958; Hyrenbach, 2001, 2006; Melvin et al., 2001). Birds that approach vessels while foraging will be exposed to vessel noise and are the most likely to be exposed to underwater active acoustic sources, but only if the ship is engaged in anti-submarine warfare with active acoustic sources. However, hull mounted sonar does not project sound aft of ships (behind the ship, opposite the direction of travel), so most birds diving in ship wakes would not be exposed to sonar. In addition, based on what is known about bird hearing capabilities in air, it is expected that diving birds may have limited or no ability to perceive high-frequency sounds, so they would likely not be impacted by high-frequency sources.

3.9.3.1.2.1 Methods for Analyzing Impacts from Sonar and Other Transducers

The Navy performed a quantitative analysis to estimate the range to auditory injury for short-tailed albatross exposed to sonar and other transducers used during Navy training activities. Inputs to the quantitative analysis included sound propagation modeling in the Navy Acoustic Effects Model to the sound exposure criteria and thresholds presented below to predict ranges to effects.

There are no published studies specific to sonar and its effects on short-tailed albatross. In order to set a threshold for auditory injury, a multi-disciplinary Hydroacoustic Science Panel (Science Applications International Corporation, 2011) used data from in-air sound that caused threshold shift in birds (Ryals et al., 1999) to conclude that 40 dB of threshold shift was required to produce auditory injury in birds for tonal sound sources in air. Thresholds for hearing loss are typically reported in cumulative SEL to account for the duration of the exposure. The boundary for onset of auditory injury (40 dB threshold shift) corresponds to an SEL of 158 dB re 20 $\mu\text{Pa}^2\text{s}$ in air. To translate this criterion into a threshold to auditory injury underwater, correction factors were applied: 36 dB were added for impedance and 26 dB were added for the difference in air-to-water reference pressure to the level at which threshold shift occurred. The impedance adjustment accounts for the suspected hearing capabilities of birds underwater, which is estimated using the limited data on bird hearing underwater discussed in Section

3.9.2.1.5 (Hearing and Vocalization) and by considering the hearing capabilities of other amphibious animals [i.e., otariids (U.S. Department of the Navy, 2017a)]. The results of the analysis determined a cumulative SEL threshold to auditory injury of 220 dB re 1 $\mu\text{Pa}^2\text{s}$. After reviewing the best available science since 2016 (Crowell, 2016; Crowell et al., 2015; Crowell et al., 2016; Hansen et al., 2017; Johansen et al., 2016; Maxwell et al., 2017), the Navy has re-affirmed this criterion.

3.9.3.1.2.2 Impact Ranges for Sonar and Other Transducers

The Navy performed a quantitative analysis to estimate the range to auditory injury (PTS) for birds exposed to sonar and other transducers used during Navy training using the Navy Acoustic Effects Model, described in Section 3.0.1.2.3 (The Navy Acoustic Effects Model). This is a change in methodology from the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS. Table 3.9-2 provides sonar ranges to auditory injury for the short-tailed albatross.

Based on the sound source level, source depth, angle of the vertical beam pattern, and dive depth, the short-tailed albatross would not receive SELs from sonar that meet or exceed the threshold for onset of auditory injury. The received sound exposure levels calculated at the short-tailed albatross' maximum dive depth from each of the modelled sources all fall below the PTS and TTS threshold levels. This results in range-to-effects values of zero meters.

Table 3.9-2: Ranges to Auditory Injury from Three Representative Sonar Bins

Acoustic Bin	Range to Auditory Injury (in meters) ¹				
	Exposure Duration of 1 sec	Exposure Duration of 30 sec	Exposure Duration of 60 sec	Exposure Duration of 120 sec	Exposure Duration of 300 sec
MF1	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)
MF4	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)
MF5	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)

¹Bins shown are those approved for public release. Ranges were modeled for the typical duty cycle of each bin.

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

Under the No Action Alternative, proposed Navy training activities would not occur within the GOA Study Area, referred to as the TMAA. The impacts associated with Navy training activities would not be introduced into the marine environment. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing Navy training activities.

3.9.3.1.2.4 Impacts from Sonar and Other Transducers Under Alternative 1

The Navy's Proposed Action is consistent with the Proposed Action presented in the 2011 GOA Final EIS/OEIS (U.S. Department of the Navy, 2011a), *Record of Decision for Final Environmental Impact Statement/Overseas Environmental Impact Statement for the Gulf of Alaska Navy Training Activities* (U.S. Department of the Navy, 2011b), the 2016 GOA Final SEIS/OEIS (U.S. Department of the Navy, 2016), and *Record of Decision for the Gulf of Alaska Final Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement* (U.S. Department of the Navy, 2017b). The Proposed Action, described in detail in Chapter 2 (Description of Proposed Action and Alternatives),

entails the military continuing training activities previously conducted and as described in the 2016 GOA Final SEIS/OEIS, for which a Record of Decision was issued. Though the types of activities and number of events in the Proposed Action are the same as in the previous documents (Alternative 1 in both the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS), there have been minor changes in the platforms and systems used as part of those activities.

Sonar and other transducers proposed for use are typically transient and temporary because activities that involve sonar and other transducers take place at different locations and many platforms are generally moving throughout the TMAA. In addition, the Proposed Action would occur over a maximum time period of up to 21 consecutive days during the months of April–October, further limiting the total potential time when sonar and other transducers may impact birds within the TMAA. General categories and characteristics of sonar systems and the number of hours these sonars would be operated during training under Alternative 1 are described in Section 3.0.4.1 (Acoustic Sources). Activities using sonars and other transducers would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activities Descriptions). The proposed use of sonar for training activities would be almost identical to what is currently conducted (see Table 2.6-1 for details) and would be operated within the same location as analyzed under the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS. Although the existing conditions have not changed appreciably, and no new Navy training activities are proposed in the TMAA in this SEIS/OEIS, a re-analysis of the Alternative 1 with respect to birds (the short-tailed albatross) is provided here to supplant previous analyses based on available new literature, adjusted sound exposure criteria, and new acoustic effects modeling.

The short-tailed albatross may be exposed to sonar and other transducers within the TMAA during the proposed training activities. Short-tailed albatross forage in offshore, open ocean waters and are present within the TMAA. There have been 19 recorded instances of short-tailed albatross occurrence in the TMAA in 20 years (see Section 3.9.2.2.3, Distribution). However, given increasing populations of this species, and considering juvenile short-tailed albatross presence in the TMAA, training activities conducted within the TMAA present a chance that direct or indirect impacts could occur to this species because of training activities that use sonars and other transducers.

Direct, non-auditory injury (e.g., barotrauma) to birds is unlikely because sonar and other non-impulsive sources lack the characteristics that can cause these injuries, and birds have rigid lungs that are relatively unaffected by extreme pressure changes (see Section 3.9.3.1.2, Impacts from Sonar and Other Transducers). The shallow dive depths and short dive durations used by this species combined with their limited range of hearing greatly reduce the potential for auditory injury after exposure to sonar and other transducers.

Mid-frequency sources are within the hearing range of birds (Dooling & Popper, 2000, 2007; Dooling & Therrien, 2012)(see Section 3.9.2.1.5, Hearing and Vocalization). Therefore, mid-frequency sonar sources (1 kHz to 10 kHz) are considered in this analysis. See Section 3.0.4.1.1 (Sonar and other Transducers) for a complete description of sonar and other transducers used for the Proposed Action.

The spatial and temporal variability of both the occurrence of a short-tailed albatross and the training activities conducted within the TMAA presents a negligible chance that a direct or indirect impact would occur to this species from sonar or other transducers. Due to the transient nature of most sonar operations, impacts, if any, would be localized and infrequent, only lasting a few seconds or minutes. The Navy used established criteria for auditory injury in birds and the Navy's Acoustic Effects Model (described in Section 3.0.1.2.3, The Navy Acoustic Effects Model) to generate ranges to auditory injury

for representative sonar sources proposed for Navy training activities in the TMAA, and calculated a range to effect of zero meters for all sources and exposure durations (see Section 3.9.3.1.2.2, Impact Ranges for Sonar and Other Transducers, and Table 3.9-2). This analysis concludes that the short-tailed albatross would not receive SELs from sonar that meet or exceed the threshold for onset of auditory injury.

Since mid-frequency sources are audible to birds, sonar and other transducers have the potential to mask important biological sounds (see Section 3.9.3.1.1.3, Masking). However, since the short-tailed albatross is not a pursuit-diver and only briefly dives under the water surface to capture prey, sonar and other transducers are extremely unlikely to create any masking effect. Sonar and other transducers have the potential to cause behavioral reactions and physiological stress. Although individuals may be impacted, long-term consequences for populations would not be expected.

As described above, there is new information that applies to the analysis of impacts of sonar and other transducers on birds. Though the types of activities and number of events in the Proposed Action are the same as in the previous documents (Alternative 1 in both the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS), there have been changes in the platforms and systems used as part of those activities. However, this new information does not substantively change the affected environment, which forms the environmental baseline of the analysis in the 2011 GOA Final EIS/OEIS and the 2016 GOA Final SEIS/OEIS. Additionally, no new Navy training activities are being proposed in this SEIS/OEIS that would affect birds in the TMAA. Therefore, conclusions for birds made for Alternative 1 that were analyzed in the 2011 GOA Final EIS/OEIS and the 2016 GOA Final SEIS/OEIS remain unchanged in this SEIS/OEIS. For a summary of effects of the action alternative on birds under both NEPA and Executive Order 12114, please refer to Table 3.6-11 in the 2011 GOA Final EIS/OEIS.

The underlying conclusions reached in the 2011 GOA Final EIS/OEIS and the 2016 GOA Final SEIS/OEIS remain unchanged—exposures to sonar and other transducers are unlikely to impact the short-tailed albatross.

Pursuant to the ESA, noise produced by sonar and other transducers during training activities as described under Alternative 1 may affect the ESA-listed short-tailed albatross. The Navy will consult with USFWS as required by section 7(a)(2) of the ESA.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from sonar and other transducers during training activities described under Alternative 1 would not result in a significant adverse effect on populations of seabirds, shorebirds, and other birds protected under the MBTA.

3.9.3.1.3 Impacts from Vessel Noise

The different types of vessels and the noise they generate are discussed in Section 3.0.4.1.2 (Vessel Noise). Background information on responses of birds to aircraft and other acoustic stressors is provided in Section 3.9.3.1.1.5 (Behavioral Reactions). Naval combat vessels are designed to be quiet to avoid detection; therefore, disturbance to birds is expected to be due to visual, rather than acoustic, stressors. Other training support vessels, such as rigid hull inflatable boats, use outboard engines that can produce substantially more noise even though they are much smaller than warships. Noise due to watercraft with outboard engines, or noise produced by larger vessels operating at high speeds, may briefly disturb birds while foraging or resting at the water surface. However, the responses due to both acoustic and visual exposures are likely related and difficult to distinguish.

3.9.3.1.3.1 Impacts from Vessel Noise Under the No Action Alternative

Under the No Action Alternative, proposed Navy training activities would not occur within the GOA Study Area, referred to as the TMAA. The impacts associated with Navy training activities would not be introduced into the marine environment. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing Navy training activities.

3.9.3.1.3.2 Impacts from Vessel Noise Under Alternative 1

Birds may be exposed to noise from vessel movements. A detailed description of the acoustic characteristics and typical sound levels of vessel noise are in Section 3.0.4.1 (Acoustic Sources). Many proposed training activities within the TMAA involve maneuvers by various types of surface ships, boats, and submarines (collectively referred to as vessels). Though the types of activities and number of events in the Proposed Action are the same as in the previous documents (Alternative 1 in both the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS), there have been changes in the platforms and systems used as part of those activities. Increases and decreases shown in Table 2.6-1 for proposed activities under Alternative 1 do not appreciably change the impact conclusions presented in the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS.

Since the 2016 GOA Final SEIS/OEIS, no new information was identified during the Navy's literature review that would substantially alter the assessment of potential impacts on marine birds, including the short-tailed albatross, from vessel noise. Although loud, sudden noises can startle and flush birds, Navy vessels are not expected to result in major acoustic disturbance of seabirds in the TMAA. Noise from Navy vessels is similar to or less than those of the general maritime environment. The potential is very low for noise generated by Navy vessels to impact individual seabirds, and such noise would not result in impacts on seabird populations. The 2016 GOA Final SEIS/OEIS concluded that, although sound levels originating from Navy vessels and aircraft are likely detectable by birds, they would not be exposed for long enough durations to cause auditory injury. Therefore, the previous conclusion that effects from vessel noise are insignificant remains valid.

Pursuant to the ESA, noise produced by vessels during training activities as described under Alternative 1 may affect the ESA-listed short-tailed albatross. The Navy will consult with USFWS as required by section 7(a)(2) of the ESA.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from sonar and other transducers during training activities described under Alternative 1 and would not result in a significant adverse effect on populations of seabirds, shorebirds, and other land birds protected under the MBTA.

3.9.3.1.4 Impacts from Aircraft Noise

The different types of aircraft and the noise they generate are detailed in Section 3.0.4.1.3 (Aircraft Noise). Reactions by birds to aircraft noise are detailed in Section 3.9.3.1.1.5 (Behavioral Reactions). Potential impacts considered are masking of other biologically relevant sounds, physiological stress, and changes in behavior.

3.9.3.1.4.1 Impacts from Aircraft Noise Under the No Action Alternative

Under the No Action Alternative, proposed Navy training activities would not occur within the GOA Study Area, referred to as the TMAA. The impacts associated with Navy training activities would not be introduced into the marine environment. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing Navy training activities.

3.9.3.1.4.2 Impacts from Aircraft Noise Under Alternative 1

Birds may be exposed to noise from aircraft overflights. A detailed description of the acoustic characteristics and typical sound levels of aircraft overflights are in Section 3.0.4 (Stressors-Based Analysis). Many proposed training activities within the TMAA involve maneuvers by various types of fixed, rotary-wing, and tilt-rotor aircraft (collectively referred to as aircraft). Most aircraft noise would be temporary and intermittent because there are no airbases or fixed ranges within the TMAA for which aircraft would be concentrated. However, some aircraft noise could concentrate in the area immediately surrounding aircraft carriers at sea during aircraft takeoffs and landings, or during helicopter-deployed dipping sonar use.

Given the proposed timing, location, and infrequent nature of training under the Proposed Action, and the small number of short-tailed albatross that are likely to occur in the TMAA at any given time, it is unlikely that individual albatross would co-occur with aircraft noise. Therefore, any adverse effects of aircraft noise on short-tailed albatross would be discountable.

Though the types of activities and number of events in the Proposed Action are the same as in the previous documents (Alternative 1 in both the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS), there have been changes in the platforms and systems used as part of those activities. Because the existing conditions have not changed appreciably, and no new Navy training activities are proposed in the TMAA in this SEIS/OEIS, a detailed re-analysis of the alternatives with respect to birds is not warranted. Activities may vary slightly from those previously analyzed in the 2016 GOA Final SEIS/OEIS, but the overall determinations presented remain valid. Increases and decreases shown in Table 2.6-1 for proposed activities under Alternative 1 do not change the impact conclusions presented in the 2016 GOA Final SEIS/OEIS.

Pursuant to the ESA, noise produced by aircraft during training activities as described under Alternative 1 may affect the ESA-listed short-tailed albatross. The Navy will consult with USFWS as required by section 7(a)(2) of the ESA.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from aircraft noise during training activities described under Alternative 1 would not result in a significant adverse effect on populations of seabirds, shorebirds, and other birds protected under the MBTA.

3.9.3.1.5 Impacts from Weapons Noise

Training activities involving weapons noise are analyzed for potential impacts to birds within the GOA Study Area, referred to as the TMAA. The effects due to potential exposures of ESA-listed birds to explosives are analyzed separately from acoustic stressors in Section 3.9.3.2 (Explosive Stressors).

3.9.3.1.5.1 Impacts from Weapons Noise Under the No Action Alternative

Under the No Action Alternative, proposed Navy training activities would not occur within the TMAA. The impacts associated with Navy training activities would not be introduced into the marine environment. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing Navy training activities.

3.9.3.1.5.2 Impacts from Weapons Noise Under Alternative 1

Birds may be exposed to sounds caused by the firing of weapons, objects in flight, and impact of non-explosive munitions on the water's surface, which are described in Section 3.0.4.1 (Acoustic Sources). In general, these are impulsive sounds (such as those discussed under Section 3.0.4.2,

Explosive Stressors) 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. Non-explosive weapon noise is therefore extremely unlikely to affect birds underwater, and no acoustic impacts to birds are expected as a result of underwater weapon noise. Conversely, in-air weapon noise produced during training activities has the potential to cause behavioral reactions, physiological stress, and auditory injury due to impulsive noise exposure.

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. Due to the transient nature of most activities that produce weapon noise, overall effects would be localized and infrequent, only lasting a few seconds or minutes. Reactions by birds to these specific stressors have not been recorded, however birds would be expected to react to weapon noise as they would react to other transient impulsive sounds. Marine birds would be exposed to this type of noise for a very brief period of time (less than a few seconds), and weapon noise would likely cause behavioral reactions described previously for other in-air noise disturbances. Bird responses to firing, blast, and impact noise may include short-term behavioral responses such as alerting or startle, or may result in a bird avoiding the affected area. Available data on bird responses to impulsive in-air noises are summarized above in Section 3.9.3.1.1.5 (Behavioral Reactions). Initial close exposures to impulsive weapons noise may result in received levels high enough to cause auditory injury (e.g., PTS; see Section 3.9.3.1.1.2, Hearing Loss). Birds that are initially within the area of effect for auditory injury at the start of an activity could be at risk of auditory impacts. Although individuals may be impacted, long-term consequences for populations would not be expected.

In addition to standard operating procedures, the Navy developed mitigation measures for the purpose of avoiding or reducing potential impacts of large-caliber weapons firing noise on ESA-listed short-tailed albatross in the TMAA. Additional information about mitigation for birds is presented in Chapter 5 (Mitigation) of this SEIS/OEIS.

Proposed training activities would be almost identical to what is currently conducted (see Table 2.6-1 for details) and would be operated within the same location as analyzed under the 2011 GOA Final EIS/OEIS and the 2016 GOA Final SEIS/OEIS. Though the types of activities and number of events in the Proposed Action are the same as in the previous documents (Alternative 1 in both the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS), there have been changes in the platforms and systems used as part of those activities. Because the existing conditions have not changed appreciably, and no new Navy training activities are proposed in the TMAA in this SEIS/OEIS, a detailed re-analysis of the alternatives with respect to birds is not warranted. Therefore, conclusions based on the previous analyses remain valid.

Pursuant to the ESA, weapon noise produced during training activities as described under Alternative 1 may affect the ESA-listed short-tailed albatross. The Navy will consult with USFWS as required by section 7(a)(2) of the ESA.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from weapons noise during training activities described under Alternative 1 would not result in a significant adverse effect on populations of seabirds, shorebirds, and other birds protected under the MBTA.

3.9.3.2 Explosive Stressors

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

Explosives are usually described by their net explosive weight, which accounts for the weight and type of explosive material. Explosives sources used during training in the TMAA are provided in Table 3.0-8. Additional explanation of the acoustic and explosive terms and sound energy concepts used in this section is found in Appendix B (Acoustic and Explosive Concepts).

This section begins with a summary of relevant data regarding explosive impacts on birds in Section 3.9.3.2.1 (Background). The ways in which an explosive exposure could result in immediate effects or lead to long-term consequences for an animal are explained in Section 3.0.4.3 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities), and this section follows that framework.

Due to adjusted sound exposure criteria and new acoustic effects modeling, the analysis provided in this section supplants the 2011 GOA Final EIS/OEIS and the 2016 GOA Final SEIS/OEIS for birds.

3.9.3.2.1 Background

3.9.3.2.1.1 Injury

If a bird is close to an explosive detonation, the exposure to high pressure levels and sound impulse can cause barotrauma. Barotrauma is physical injury due to a difference in pressure between an air space inside the body and the surrounding air or water. Sudden very high pressures can also cause damage at tissue interfaces due to the way pressure waves travel differently through tissues with different material properties. Damage could also occur to the structure of the ear, considered to be the body part most susceptible to pressure damage.

Detonations that occur underwater could injure, kill, or disturb diving birds, particularly pursuit divers that spend more time underwater than other foraging birds (Danil & St Leger, 2011). Studies show that birds are more susceptible to underwater explosions when they are submerged versus partially submerged on the surface. Two species of duck were exposed to explosive blasts while submerged 0.61 m and while sitting on the water surface. Onset of mortality was predicted to occur at an impulse exposure of 248 pascal seconds (Pa-s) (36 pounds per square inch per millisecond [psi-ms]) for birds underwater and 690 Pa-s (100 psi-ms) for birds at the water surface (Yelverton & Richmond, 1981). No injuries would be expected for birds underwater at blast pressures below 41 Pa-s (6 psi-ms) and for birds on the surface at blast pressures below 207 Pa-s (30 psi-ms) (Yelverton & Richmond, 1981). Tests of underwater explosive exposures to other taxa (fish, mammals) have shown that susceptibility to injury is related to animal mass, with smaller animals being more susceptible to injury (Yelverton & Richmond, 1981). It is reasonable to assume that this relationship would apply to birds as well. The range to these thresholds would be based on several factors, including charge size, depth of the detonation, and how far the bird is beneath the water surface.

Detonations in air or at the water surface could also injure birds while either in flight or at the water surface. Experiments that exposed small, medium, and large birds to blast waves in air were conducted to determine the exposure levels that would be injurious (Damon et al., 1974). Birds were assessed for internal injuries to air sacs, organs, and vasculature, as well as injury to the auditory tympanum, but

internal auditory damage was not assessed. Results indicated that peak pressure exposure of 5 pounds per square inch (psi) would be expected to produce no blast injuries, 10 psi would produce slight to extensive injuries, and 20 psi would produce 50 percent mortality. These results also suggested that birds with higher mass may be less susceptible to injury. In addition to the risk of direct blast injury, exposure to an explosion in air may cause physical displacement of a bird that could be injurious if the animal impacts a surface. The same study examined displacement injuries to birds (Damon et al., 1974). Results indicated that impulse exposures below 5 psi-ms would not be expected to result in injuries.

One experiment was conducted with birds in flight, showing how birds can withstand relatively close exposures to in-air explosions (Damon et al., 1974). Flying pigeons were exposed to a 64-pound net explosive weight explosion. Birds at 44–126 ft. from the blast exhibited no signs of injury, while serious injuries were sustained at ranges less than 40 ft. The no-injury zone in this experiment was also for exposures less than 5 psi-ms impulse, similar to the results of the displacement injury study. Ranges to the no injury threshold for a range of in-air explosives are shown in Table 3.9-3.

Table 3.9-3: Range to the No Injury Threshold for Birds Exposed to In-Air Explosives

<i>Net Explosive Weight</i>	<i>Range to 5 psi</i>
5 lb.	21 ft.
10 lb.	26 ft.
100 lb.	57 ft.

Note: ft. = feet, lb. = pounds
Ranges calculated using the methods in (Swisdak, 1978; Swisdak & Montanaro, 1992).

Another risk of explosions in air is exposure to explosive fragmentation, in which pieces of the casing of a cased explosive are ejected at supersonic speeds from the explosion. The risk of direct strike by fragmentation would decrease exponentially with distance from the explosion, as the worst case for strike at any distance is the surface area of the casing fragments, which ultimately would decrease their outward velocity under the influence of drag. It is reasonable to assume that a direct strike in air or at the water surface would be lethal. Once in water, the drag on any fragments would quickly reduce their velocity to non-hazardous levels (Swisdak & Montanaro, 1992).

The initial detonation in a series of detonations may deter birds from subsequent exposures via an avoidance response, however, birds have been observed taking interest in surface objects related to detonation events and subsequently being killed following detonation (R. Stemp in Greene et al. (1985)).

3.9.3.2.1.2 Hearing Loss

Exposure to intense sound may result in hearing loss that persists after cessation of the noise exposure. There are no data on hearing loss in birds specifically due to explosives; therefore, the limited data on hearing loss due to impulsive sounds, described for acoustic stressors in Section 3.9.3.1.1.2 (Hearing Loss), apply to explosive exposures.

3.9.3.2.1.3 Physiological Stress

Marine animals naturally experience stressors within their environment and as part of their life histories. Changing weather and ocean conditions, exposure to diseases and naturally occurring toxins, lack of prey availability, social interactions with members of the same species, nesting, and interactions with predators all contribute to stress. Exposures to explosives have the potential to provide additional stressors beyond those that naturally occur, as described in Section 3.0.4.3 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities).

There are no data on physiological stress in birds specifically due to explosives; therefore, the limited data on physiological stress due to impulsive sounds, described for acoustic stressors in Section 3.9.3.1.1.4 (Physiological Stress), apply to explosive exposures.

3.9.3.2.1.4 Masking

Masking occurs when one sound, distinguished as the “noise,” interferes with the detection or recognition of another sound. Exposure to explosives may result in masking. There are no data on masking in birds specifically due to explosives; therefore, the limited data on masking due to impulsive sounds, described for acoustic stressors in Section 3.9.3.1.1.3 (Masking), apply to explosive exposures. Due to the very brief duration of an explosive sound, any masking would be brief during an explosive activity.

3.9.3.2.1.5 Behavioral Reactions

Numerous studies have documented that birds and other wild animals respond to human-made noise, including aircraft overflights, weapons firing, and explosions (Larkin et al., 1996; National Park Service, 1994; Plumpton, 2006). The limited data on behavioral reactions due to impulsive sounds, described for acoustic stressors in Section 3.9.3.1.1.5 (Behavioral Reactions), apply to explosive exposures.

Because data on behavioral responses by birds to explosions is limited, information on bird responses to other impulsive sounds may be informative. Seismic surveys had no noticeable impacts on the movements or diving behavior of long-tailed ducks undergoing wing molt, a period in which flight is limited and food requirements are high (Lacroix et al., 2003). The birds may have tolerated the seismic survey noise to stay in preferred feeding areas. The sensitivity of birds to disturbance may also vary during different stages of the nesting cycle. Similar noise levels may be more likely to cause nest abandonment during incubation of eggs than during brooding of chicks because birds have invested less time and energy and have a greater chance of re-nesting (Knight & Temple, 1986).

3.9.3.2.1.6 Long-Term Consequences

Long-term consequences to a population are determined by examining changes in the population growth rate. For additional information on the determination of long-term consequences, see Section 3.0.4.3 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities). Physical effects from explosive sources that could lead to a reduction in the population growth rate include mortality or injury, which could remove animals from the reproductive pool, and temporary hearing impairment or chronic masking, which could affect foraging, behavioral responses (e.g. 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 highly nomadic and unpredictable species like the short-tailed albatross. For example, a lost feeding opportunity could be a measurable cost to the individual; however, short-term costs may be recouped during the life of an otherwise healthy individual. It is more likely that any long-term consequences to an individual would be a result of costs accumulated over a season, year, or life stage due to multiple behavioral or stress responses resulting from exposures to multiple stressors over significant periods of time. Conversely, some birds may habituate to or become tolerant of repeated acoustic exposures over time, learning to ignore a stimulus that in the past did not accompany any overt threat. More research is needed to better understand the long-term consequences of anthropogenic stressors, although intermittent exposures to explosive noise are assumed to be less likely to have lasting consequences. These factors are taken into consideration when assessing risk of long-term consequences.

3.9.3.2.2 Impacts from Explosives

This section analyzes the impacts on birds due to explosives that would be used during the proposed activities and synthesizes the background information presented above. Proposed training activities would be almost identical to what is currently conducted (see Table 2.6-1 for details), with one exception. Consistent with the previous analyses for Alternative 1, the sinking exercise activity will not be part of the proposed action for this SEIS/OEIS, and therefore the explosive use associated with that activity is no longer part of this proposed action. Due to adjusted sound exposure criteria and new acoustic effects modeling, the analysis provided in this section supplants the 2011 GOA Final EIS/OEIS and the 2016 GOA Final SEIS/OEIS for birds.

As discussed above, sound and energy from underwater explosions are capable of causing mortality, injury, hearing loss, masking, physiological stress, or a behavioral response, depending on the level and duration of exposure (Damon et al., 1974). Background information on studies of injuries to birds, both in air and underwater, is presented above in Section 3.9.3.2.1.1 (Injury).

Exposures that result in non-auditory injuries 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 affect its ability to reproduce. Auditory injury can also impair an animal's abilities, although the individual may recover quickly. Background information on studies of hearing loss in birds is presented above in Section 3.9.3.2.1.2 (Hearing Loss).

3.9.3.2.2.1 Methods for Analyzing Impacts from Explosives

The Navy performed a quantitative analysis to estimate ranges to effect for birds exposed to explosives during the proposed activities. Inputs to the quantitative analysis included underwater sound propagation modeling in the Navy's Acoustic Effects Model, described in Section 3.0.1.2.3 (The Navy Acoustic Effects Model). The ranges to effect for in-air explosions were calculated using the methods in Swisdak (1975). These are changes in methodology from the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS.

Background information on studies of injuries to birds, both in air and underwater, is presented above in Section 3.9.3.2.1.1 (Injury). The established injury and mortality thresholds for in-air and underwater explosions are reported in Table 3.9-4. The injury and mortality thresholds for in-air exposures to explosions were established using the data for multiple species of birds exposed to explosions in Damon et al. (1974). The data available from that study enabled establishment of dual metric thresholds for injury and mortality using peak pressure (dB peak) and impulse (Pa-s). There was insufficient data to correct for the mass of the bird using the data in Damon et al. (1974); therefore, the lowest values associated with injury and mortality were applied.

The injury and mortality thresholds for underwater exposures to explosions were established using the data for ducks exposed to explosions in Yelverton et al. (1973). The authors of that study correlated the impulse metric (Pa-s) to injuries observed in birds. The thresholds for injury and mortality developed using the data in Yelverton et al. (1973) were adjusted to account for the relatively smaller mass of the relatively larger mass of the short-tailed albatross (4,000 grams) compared to the ducks in the study. This adjustment was based on the data in Yelverton and Richmond (1981).

Background information on studies of hearing loss in birds is presented above in Section 3.9.3.2.1.2 (Hearing Loss). Table 3.9-4 presents the auditory and non-auditory onset thresholds for birds from underwater and in-air explosions. See Section 3.9.3.2.1.2 (Hearing Loss) above for a detailed description

of peak pressure (dB peak), impulse (Pa-s), and sound exposure level (dB re 1 μPa^2 s) metrics. The in-air threshold for onset of auditory injury for impulsive noise exposure is 165 dB re 20 μPa peak. Based on the hearing loss found by Hashino et al. (1988), exposure to peak pressure of 169 dB re 1 μPa peak SPL could exceed the onset of auditory injury. However, for that study, the SEL, which is another metric for determining auditory injury, was not reported and could not be reliably approximated.

The underwater threshold for auditory injury is extrapolated from the available data on bird hearing loss from in-air exposures. The Hydroacoustic Science Panel (Science Applications International Corporation, 2011), set a sound exposure threshold (unweighted) of 135 dB re 20 μPa^2 s cumulative SEL plus a spectral correction factor of 15 dB to account for low-frequency energy in an impulsive exposure as an approximate threshold for onset of auditory injury in birds due to impulsive sources in air. To convert this threshold to an underwater auditory injury threshold, the reference pressure is changed from 20 μPa in air to 1 μPa in water (add 26 dB) and the hearing ability of birds, and correspondingly their sensitivity to auditory impacts, is estimated using the limited data on bird hearing underwater (see Section 3.9.1, Introduction) and data from other amphibious species, specifically otariids (U.S. Department of the Navy (2017a). That data suggests a 36 dB impedance value for birds underwater. The resulting in-water auditory injury threshold is 212 dB re 1 μPa^2 s SEL.

Table 3.9-4: Explosive Effects Onset Thresholds for ESA-Listed Bird Species

<i>Species</i>	<i>Underwater</i>			<i>In Air</i>		
	<i>Auditory Injury¹ (dB re 1 μPa^2 s)</i>	<i>Injury² (Pa-s)</i>	<i>Mortality² (Pa-s)</i>	<i>Auditory Injury (dB re 20 μPa peak)</i>	<i>Injury³ Dual metric (dB re 20 μPa peak) (Pa-s)</i>	<i>Mortality³ Dual metric (dB re 20 μPa peak) (Pa-s)</i>
Short-Tailed Albatross	212	94	361	165	185 dB re 20 μPa peak 34.5 Pa-s	191 dB re 20 μPa peak 69 Pa-s

Notes: Underwater sound exposure level = dB re 1 μPa^2 s, In-air peak pressure = dB re 20 μPa peak, Impulse = Pa-s (pascal seconds)

¹Threshold based on methods of the Hydroacoustic Science Panel, consistent with the analysis in the 2015 BO.

²Underwater injury and mortality thresholds are adjusted to consider typical mass of bird species, based on the relationships between injury and mass for fish.

³Dual metrics from observations of in-air explosive injuries to birds in Damon et al. (1974). Data similar to that for underwater explosive injuries is not available to conduct mass-scaling of in-air injury thresholds; however, the data in Damon et al. (1974) is specific to birds and included birds of similar size as considered in this analysis.

3.9.3.2.2.2 Impact Ranges for Explosives

The Navy performed a quantitative analysis to estimate the range to auditory injury (PTS) and non-auditory injury for short-tailed albatross exposed to explosives used during Navy training using the Navy Acoustic Effects Model, described in Section 3.0.1.2.3 (The Navy Acoustic Effects Model).

Table 3.9-5 provides impulse ranges to injury for the short-tailed albatross. These ranges to effect are based on the criteria and thresholds presented in Table 3.9-4 (see Section 3.9.3.2.2.1, Methods for Analyzing Impacts from Explosives). Detonations conducted during Navy activities would occur at or near the surface, although they are modeled in the acoustic effects analysis as if they occur fully underwater, since there is currently no means to model impacts from in-air detonations. Ranges may

vary depending on factors such as the cluster size (e.g., the number of rounds fired within a short duration), location, depth, and season of the event.

Table 3.9-5: Ranges to Effects from Three Representative Explosive Bins

<i>Source Bin (lb. NEW)</i>	<i>Range to Effects for Explosives: Short-tailed Albatross¹</i>			
	<i>Source Depth (meters)</i>	<i>Range to Auditory Injury (meters)</i>	<i>Range to Non-Auditory Injury (meters)</i>	<i>Range to Mortality (meters)</i>
E5	0.1	11 (8–14)	17 (17–17)	8 (8–8)
E9	0.1	15 (15–15)	30 (30–30)	16 (16–16)
E10	0.1	17 (17–17)	35 (35–35)	18 (18–18)
E12	0.1	20 (19–20)	40 (40–40)	21 (21–21)

¹Average distance (in meters) is shown with the minimum and maximum distances due to varying propagation environments in parentheses.

3.9.3.2.2.3 Impacts from Explosives Under the No Action Alternative

Under the No Action Alternative, proposed Navy training activities would not occur within the GOA Study Area, referred to as the TMAA. The impacts associated with Navy training activities would not be introduced into the marine environment. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing Navy training activities.

3.9.3.2.2.4 Impacts from Explosives Under Alternative 1

Short-tailed albatross pelagic range overlaps with areas that include detonations as part of training activities in the TMAA. If a short-tailed albatross were located in close proximity to an explosive detonation, mortality, injury, or various behavioral responses may occur. Due to the expected low numbers of short-tailed albatrosses at sea where training activities would occur, short-tailed albatrosses would have a low potential for any exposures from explosives use during training activities. Training activities under Alternative 1 would use surface or near-surface detonations and explosive ordinance. The use of explosives would occur throughout the TMAA, the same location as analyzed under the 2011 GOA Final EIS/OEIS and the 2016 GOA Final SEIS/OEIS, and are typically dispersed in space and time. The number and type (i.e., source bin) of explosives that would be used during training under Alternative 1 are described in Section 3.0.4.2 (Explosive Stressors). Activities using explosives would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activities Descriptions). The proposed use of explosives for training activities would be almost identical to what is currently conducted (see Table 2.6-1 for details) with one exception. Consistent with the previous analyses for Alternative 1, the sinking exercise activity will not be part of the proposed action for this SEIS/OEIS. Although the existing conditions have not changed appreciably, and no new Navy training activities are proposed in the TMAA in this SEIS/OEIS, a re-analysis of the Alternative 1 with respect to birds (the short-tailed albatross) is provided here to supplant previous analyses based on available new literature, adjusted sound exposure criteria, and new acoustic effects modeling.

The short-tailed albatross is a surface feeder and scavenger, and predominately takes prey by surface-seizing, not diving (U.S. Fish and Wildlife Service, 2008b). The probability of a short-tailed albatross being exposed to explosive stressors underwater is extremely low, and the bird would have to dive in close proximity to explosions to experience impacts (see Table 3.9-5).

In air, short-tailed albatross exposed to explosions may be subject to lethal or non-lethal injuries (see Table 3.9-3). Short-tailed albatross may survive exposure to explosions and associated stressors; however, these individuals could have reduced levels of fitness and reproductive success. For individual short-tailed albatross that are exposed to explosions but not injured or killed, responses would likely include startle responses or avoidance behaviors. In uninjured individuals, these responses would be short-term; and since short-tailed albatross are transient and geographically wide-ranging, no significant disruptions to their normal behavior would be expected that could create a likelihood of injury. The Navy developed mitigation measures for the purpose of avoiding or reducing potential impacts of explosive medium-caliber projectiles on ESA-listed short-tailed albatross in the TMAA. Additional information about mitigation for birds is presented in Chapter 5 (Mitigation) of this SEIS/OEIS. Although individuals may be impacted, long-term consequences for populations would not be expected.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 1 may affect the ESA-listed short-tailed albatross. The Navy will consult with USFWS as required by section 7(a)(2) of the ESA.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from explosives stressors during training activities using explosives described under Alternative 1 would not result in a significant adverse effect on populations of seabirds, shorebirds, and other birds protected under the MBTA.

3.9.3.3 Secondary Stressors

Navy training activities could pose indirect impacts on seabirds via habitat or prey as a result of explosives by-products, metals, chemicals, and transmission of disease and parasites. Analysis of the potential impacts on sediment and water quality are discussed in Section 3.3 (Water Resources) in the 2016 GOA Final SEIS/OEIS. The relatively low solubility of most explosives and their degradation products, metals, and chemicals means that concentrations of these contaminants in the marine environment, including those associated with either high-order or low-order detonations, are relatively low and readily diluted. For example, in the TMAA the concentration of unexploded ordnance, explosion byproducts, metals, and other chemicals would never exceed that of a World War II dump site. A series of studies of a World War II dump site off Hawaii have demonstrated only minimal concentrations of degradation products were detected in the adjacent sediments and that there was no detectable uptake in sampled organisms living on or in proximity to the site (Briggs et al., 2016; Carniel et al., 2019; Edwards et al., 2016; Hawaii Undersea Military Munitions Assessment, 2010; Kelley et al., 2016; Koide et al., 2016). It has also been documented that the degradation products of Royal Demolition Explosive are not toxic to marine organisms at realistic exposure levels (Lotufo, 2017; Rosen & Lotufo, 2010). Any remnant undetonated components from explosives such as trinitrotoluene (TNT), royal demolition explosive, and high melting explosive experience rapid biological and photochemical degradation in marine systems (Carniel et al., 2019; Cruz-Urbe et al., 2007; Juhasz & Naidu, 2007; Pavlostathis & Jackson, 2002; Singh et al., 2009; Walker et al., 2006). As another example, the Canadian Forces Maritime Experimental and Test Ranges near NanOOSE, British Columbia began operating in 1965 conducting test events for both U.S. and Canadian forces, which included many of the same test events

that are conducted in the TMAA. Environmental analyses of the impacts from years of testing at Nanoose were documented in 1996 and 2005 (Environmental Science Advisory Committee, 2005). These analyses concluded the Navy test activities "...had limited and perhaps negligible effects on the natural environment" (Environmental Science Advisory Committee, 2005). Therefore, based these and other similar applicable findings from multiple Navy ranges and based on the analysis in Section 3.3 (Water Resources) in the 2016 GOA Final SEIS/OEIS, indirect impacts on seabirds from the training activities in the TMAA would be negligible and would have no long-term effect on habitat.

Secondary stressors from training activities were analyzed for potential indirect impacts on seabird prey availability. Indirect impacts of explosives and unexploded ordnance on birds via water could not only cause physical impacts, but prey items (e.g., fishes) might also have behavioral reactions to underwater sound. For example, the sound from underwater explosions might induce startle reactions and temporary dispersal of schooling fishes if they are within close proximity. The abundances of fish and invertebrate prey species near the detonation point could be diminished for a short period of time before being repopulated by animals from adjacent waters. Secondary impacts from underwater explosions would be temporary, and no lasting impact on prey availability or the pelagic food web would be expected. Indirect impacts of underwater detonations and explosive ordnance use under the Proposed Action would not result in a decrease in the quantity or quality of bird populations or habitats, or prey species and habitats, in the TMAA.

Any effects to birds are not anticipated to be harmful or severe because of (1) the temporary nature of impacts on water or air quality, (2) the distribution of temporary water or air quality impacts, (3) the wide distribution of birds in the TMAA, and (4) the dispersed spatial and temporal nature of the training activities that may have temporary water or air quality impacts. No long-term or population-level impacts are expected.

Pursuant to the ESA, secondary impacts on prey availability during training activities as described under Alternative 1 may affect the short-tailed albatross. The Navy will consult with USFWS as required by section 7(a)(2) of the ESA.

Under the MBTA regulations applicable to military readiness activities (50 CFR Part 21), the impacts from secondary during training activities using explosives described under Alternative 1 would not result in a significant adverse effect on populations of seabirds, shorebirds, and other birds protected under the MBTA.

3.9.4 Summary of Stressor Assessment (Combined Impacts of All Stressors)

As described above, there is new information on existing environmental conditions since the analysis in the 2016 GOA Final SEIS/OEIS. However, this new information does not significantly change the affected environment, which forms the environmental baseline of the analyses in the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS. Additionally, no new activities are being proposed in this SEIS/OEIS that would affect birds in the TMAA. Therefore, conclusions for birds made for Alternative 1 in the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS remain unchanged in this SEIS/OEIS. For a summary of effects of the action alternative on birds under both the NEPA and Executive Order 12114, please refer to Table 3.9-3 in the 2011 GOA Final EIS/OEIS.

Migratory Bird Treaty Act Determination

The take of an individual bird from the Proposed Action is allowed under the MBTA regulations applicable to military readiness activities (50 CFR Part 21) provided it does not result in a significant

adverse effect on a population of a migratory bird species. As presented in the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS, the Proposed Action would not diminish the capacity of a population of a migratory bird species to maintain genetic diversity, to reproduce, and to function effectively in its native ecosystem, nor would it adversely affect migratory bird populations. Because the Proposed Action has not changed and there is no new information that would change the analysis conducted in support of the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS/OEIS, the Navy is not required to confer with the USFWS on the development and implementation of conservation measures to minimize or mitigate adverse effects to migratory birds that are not listed under the ESA.

Endangered Species Act Determinations

In accordance with Section 7 of the ESA (50 CFR Part 402), during the preparation of the 2011 GOA Final EIS/OEIS the Navy prepared a biological evaluation and submitted it to the USFWS. The Navy received a concurrence letter from USFWS (March 24, 2010), which agreed that the Navy's actions may affect, not likely to adversely affect, the short-tailed albatross. Other ESA-listed bird species discussed in the 2011 GOA Final EIS/OEIS and 2016 GOA Final SEIS (Steller's eider and spectacled eider) were not included in this previous consultation. As provided in 50 CFR Section 402.16, re-initiation of consultation is normally required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered, (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered, or (4) a new species is listed or critical habitat designated that may be affected by the action.

Because of revised acoustic and explosives criteria and methods, the Navy has requested reinitiation of consultation with the USFWS for the short-tailed albatross pursuant to Section 7 of the ESA. The Navy has determined that the Proposed Action will have no effect on Steller's eider and the spectacled eider.

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