3.6 Marine Birds

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

3.6 MARINE BIRDS

MARINE BIRDS SYNOPSIS

The United States Department of the Navy considered all potential stressors, and the following were analyzed for marine birds:

- Acoustic (sonar and other active acoustic sources; underwater explosives; swimmer defense airguns; weapons firing, launch, and impact noise; vessel noise; and aircraft noise)
- Energy (electromagnetic devices)
- Physical disturbance and strike (aircraft and aerial targets, vessels, in-water devices, military expended materials, ground disturbance, and wildfires)
- Ingestion (munitions and military expended materials other than munitions)
- Secondary (impacts associated with sediments, water quality and air quality)

Preferred Alternative (Alternative 1)

- Acoustic: Pursuant to the Endangered Species Act (ESA), the use of sonar and other active acoustic sources, underwater explosives, swimmer defense airguns, vessel noise, and aircraft noise would have no effect on ESA-listed marine birds.
- Energy: Pursuant to the ESA, the use of electromagnetic devices would have no effect on ESA-listed marine birds.
- Physical Disturbance and Strike: Pursuant to the ESA, the use of aircraft, vessels, in-water devices, and military expended materials would have no effect on ESA-listed marine birds.
- Ingestion: Pursuant to the ESA, the potential for ingestion of military expended materials would have no effect on ESA-listed marine birds.
- Secondary: Pursuant to the ESA, secondary stressors would have no effect on ESA-listed marine birds. There is no critical habitat for ESA-listed marine birds within the MITT Study Area.
- Under the Migratory Bird Treaty Act regulations applicable to military readiness activities (50 C.F.R. Part 21), the stressors introduced during training and testing activities would not result in a significant adverse effect on migratory bird populations.

3.6.1 INTRODUCTION

This section focuses on marine birds that breed in or migrate through the Mariana Islands Training and Testing (MITT) Study Area (Study Area). This large category includes seabirds, shorebirds, or other birds that use the marine environment. Some of these birds are year-round residents in the Mariana Islands, while some species are migratory. Seabirds are birds whose normal habitat and food source is the sea, whether they utilize coastal waters (the nearshore), offshore waters, or pelagic waters (the open sea) (Harrison 1983, U.S. Fish and Wildlife Service 2005). Shorebirds are birds that primarily forage in coastal waters (including beaches, tidal areas, and estuaries) and inland freshwater marshes and riverine areas (Temple 2001, Engilis and Naughton 2004). This section provides profiles of Endangered Species Act (ESA)-listed species, a list of species protected under the Migratory Bird Treaty Act (MBTA) and considered by the United States (U.S.) Fish and Wildlife Service to be Birds of Conservation Concern, and a general description of major species groups of birds in the Study Area.

Section 3.6.1 (Introduction) provides an introduction of major taxonomic groups of marine birds that may be found within the Study Area, as well as regulatory frameworks concerning these species. Section 3.6.2 (Affected Environment) provides more detailed information on known occurrences and behavior at sea and on land, as well as detailed species descriptions for special status species. Complete analysis and summary of potential impacts of the Proposed Action on birds are found in Sections 3.6.3 (Environmental Consequences) and 3.6.4 (Summary of Potential Impacts on Marine Birds), respectively.

3.6.1.1 Endangered Species Act

Three seabirds that occur in the Study Area are listed under the ESA as threatened or endangered species. The short-tailed albatross (*Phoebastria albatrus*) and Hawaiian petrel (*Pterodroma sandwichensis*) are listed as endangered, and the Newell's shearwater (*Puffinus auricularis newelii*) is listed as threatened. The Hawaiian petrel and Newell's shearwater rarely occur within the Study Area. The status, presence, and nesting occurrence of ESA-listed seabirds in the Study Area are provided in Table 3.6-1. In 2010, the U.S. Fish and Wildlife Service (USFWS) concurred with the U.S. Department of the Navy's (Navy's) determination that training activities included in the Mariana Islands Range Complex (MIRC) Environmental Impact Statement (EIS)/Overseas EIS (OEIS) would have no effect on the short-tailed albatross, Hawaiian petrel, or Newell's shearwater (U.S. Fish and Wildlife Service 2010). In early 2015, the Navy and USFWS completed Section 7 ESA consultation with the issuance by the USFWS of a new Biological Opinion for activities proposed in this EIS/OEIS (U.S. Fish and Wildlife Service 2015). Like the 2010 Biological Opinion, the activities proposed in this EIS/OEIS would have no effect on ESA-listed marine birds. Other ESA-listed bird species do occur within the MITT Study Area, but these species are associated with terrestrial habitats and are therefore analyzed for impacts in Section 3.10 (Terrestrial Species and Habitats). These bird species include the Mariana swiftlet (*Aerodramus bartschi*), Mariana crow (*Corvus kubaryi*), Mariana common moorhen (*Gallinula chloropus guami*), Micronesian megapode (*Megapodius laperous*), Nightingale reed warbler (*Acrocephalus luscinia*), and Rota bridled white-eye (*Zosterops rotensis*).

Table 3.6-1: Endangered Species Act Listed Seabird Species Found in the Study Area

Species Name and Regulatory Status			Presence in Study Area[1]	
Common Name	**Scientific Name**	**Endangered Species Act Status**	**Open Ocean/ Transit Corridor**	**Coastal/ Breeding Areas[2]**
Hawaiian petrel	*Pterodroma sandwichensis*	Endangered	Yes	No
Short-tailed albatross	*Phoebastria albatrus*	Endangered	Yes	No
Newell's shearwater	*Puffinus auricularis newelli*	Threatened	Yes	No

[1] No Endangered Species Act-listed seabird has been observed on land within the Mariana Islands. These seabirds were observed at sea during marine mammal surveys in 2007 (U.S. Department of the Navy 2007).
[2] See Table 3.6-5 for a list of known breeding locations for seabirds within the Study Area.

3.6.1.2 Migratory Bird Treaty Act Species and 50 Code of Federal Regulations Part 21.15 Requirements

Marine birds in the Study Area include those listed under the MBTA of 1918 (16 United States Code 703–712; Ch. 128; 13 July 1918; 40 Stat. 755 as amended) (U.S. Department of Defense and 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 (DoD) signed a Memorandum of Understanding to promote conservation of migratory birds (U.S. Department of Defense and U.S. Fish and Wildlife Service 2006). Of the 1,007 species protected under the MBTA, over 100 species are known or believed to occur in the Study Area. These species are not analyzed individually, but rather are grouped based on taxonomic or behavioral similarities based on the stressor being analyzed. The summary of conclusions of potential impacts on species protected under the MBTA is presented in Section 3.6.3 (Environmental Consequences).

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 on 28 February 2007 (Federal Register Volume 72, No. 29, 28 February 2007), and may be found at 50 Code of Federal Regulations (C.F.R.) 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. 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 C.F.R. 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 C.F.R. 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."

The Navy identified two species that breed on Farallon de Medinilla (FDM) that may warrant conferring with the USFWS because of regional distributions and use of FDM as a rookery. The great frigatebird (*Fregata minor*) may occasionally nest on FDM, which is one of only two small breeding colonies known to exist within the Mariana Islands. The masked booby (*Sula dactylatra*) breeds on FDM, the largest breeding colony in Mariana Islands. Because of the apparent importance of FDM to these two species, the great frigatebird and masked booby are analyzed in more detail in this section, with an emphasis on how military use of FDM may impact these species. Further, an analysis is presented in this section as to whether military use of FDM may significantly affect populations, pursuant with 50 C.F.R. Part 21.15.

For the purposes of this analysis, the Navy examined the best available distribution data for the masked booby and great frigatebird within the western and central Pacific basin. This information is described in further detail in Section 3.6.2.6 (Rookery Locations and Breeding Activities within the Mariana Islands Training and Testing Study Area). For the great frigatebird, breeding on FDM is rare and sporadic. FDM does not appear to be a stable breeding location. Further, statistical analyses of survey data collected over the past 18 years at FDM (as described in Section 3.6.2.6) demonstrated that no definite conclusions about long-term population trends can be reached, i.e., the results are statistically non-significant.

FDM has been used as a bombing range since 1971, and the U.S. government entered into a formal lease agreement for military use of the island with the Commonwealth of the Northern Mariana Islands (CNMI) in 1983 (United States of America and Commonwealth of the Northern Mariana Islands 1983).

3.6.1.3 United States Fish and Wildlife Service Birds of Conservation Concern

Birds of Conservation Concern are species, subspecies, and populations of migratory and non-migratory birds that the USFWS determines through policy documents to be the highest priority for conservation actions (U.S. Fish and Wildlife Service 2008a). The purpose of the Birds of Conservation Concern category is to prevent or remove the need for additional ESA bird listings by implementing proactive management and conservation actions needed to conserve these species. The USFWS maintains a list of Birds of Conservation Concern (U.S. Fish and Wildlife Service 2008a). There are five species considered Birds of Conservation Concern that occur within the Study Area. These species are the black-footed albatross (*Phoebastria nigripes*), Audubon's shearwater (*Puffinus lherminieri*), Christmas shearwater (*Puffinus nativitatis*), Herald petrel (*Pterodroma arminjoniana*), and Tahiti petrel (*Pseudobulweria rostrata*). Four of these species were observed at sea during the 2007 Mariana Islands Sea Turtle and Cetacean Survey, with the lone exception being the Christmas shearwater (U.S. Department of the Navy 2007). This species is known to occur in the northern portion of the Mariana archipelago (Pratt et al. 1987). Only the Audubon's shearwater has been observed on Guam, Tinian, and FDM and is thought to be a rare, non-breeding visitor to these islands (Pratt et al. 1987). Table 3.6-2 lists Birds of Conservation Concern, as well as seabirds and shorebirds, known to breed within the Study Area.

3.6.1.4 Major Bird Groups

There are six major groups of seabirds, shorebirds, and other birds associated with marine and freshwater habitats within the Study Area. These major bird groups are listed in Table 3.6-3. Some of these birds breed on land within the Mariana Islands and forage in freshwater or brackish waters (such as estuaries and inland freshwater wetlands).

Seabirds are primarily open ocean or coastal water feeders. Seabird species that forage in the open ocean are strictly marine, ranging far out to sea and returning to land only to breed. Laysan, black-footed, and short-tailed albatrosses, and sooty and arctic terns are examples of Pacific seabirds that live and feed in the open ocean (U.S. Fish and Wildlife Service 2005). Major seabird groupings include Pelecaniformes (pelicans, cormorants, gannets, and frigatebirds), Phaethontiformes (tropicbirds), and Procellariiformes (albatrosses, petrels, storm-petrels, and shearwaters). Charadriiformes include species that are considered both seabirds and shorebirds. Within this taxonomic group, skuas, jaegers, gulls, terns, and noddies have more pelagic characteristics and are therefore considered to be seabirds. Plovers, tattlers, sandpipers, and phalaropes are species groupings within the Charadriiformes that are considered shorebirds. Shorebirds rarely range far from land (except during migrations), foraging in marine, estuarine, freshwater, and sometimes terrestrial habitats, and most return to land to roost at night. Anseriformes (ducks, geese, swans, and wigeons) are considered wading birds. These birds are closely associated with freshwater and brackish habitats. Other bird species that are not considered seabirds or shorebirds may rarely visit the Mariana Islands. For instance, rare occurrences of ospreys (Pratt et al. 1987) and peregrine falcons (Aguon et al. 2000) have been reported on Guam. Because these migratory birds of prey are closely associated with marine and estuarine environments (and prey on seabirds and shorebirds), they are included in Table 3.6-3 as a sixth major grouping.

Table 3.6-2: United States Fish and Wildlife Service Birds of Conservation Concern and Breeding Seabirds within the Study Area

Common Name	Scientific Name	Breeding location on DoD Owned or Leased Property[1]	Other Islands within the Study Area[2]
Black-footed albatross	*Phoebastria nigripes*	**-**	**-**
Audubon's shearwater	*Puffinus lherminieri*	**-**	**-**
Christmas shearwater	*Puffinus nativitatis*	**-**	**-**
Herald petrel	*Pterodroma arminjoniana*	**-**	**-**
Tahiti petrel	*Pseudobulweria rostrata*	**-**	**-**
Red-tailed tropicbird	*Phaethon rubricauda*	-	Uracas, Maug, Pagan, Guguan, Rota
White-tailed tropicbird	*Phaethon lepturus*	-	Guguan
Wedge-tailed shearwater	*Puffinus pacificus*	-	Saipan, Naftan Rock (off Aguiguan)
White tern	*Gygis alba*	NBG Main Base (Neye Island[3] north coast of Orote Point and rocky offshore islets, trees on the main installation), Tinian (Puntan Masalok), FDM	Uracas, Pagan, Agrihan, Asunción, Maug, Alamagan, Guguan, Sarigan, Anatahan, Saipan, Aguiguan
Sooty tern	*Sterna fuscata*	FDM	Uracas, Maug (possible), Asunción, Guguan, Naftan Rock (off Aguiguan)
Black noddy	*Anous minutes*	NBG Main Base (Neye Island), Andersen AFB (shoreline between Pati Point and Tagua Point), Tinian (Puntan Masalok), FDM	Uracas, Maug, Asunción, Agrihan, Pagan, Guguan, Aguiguan
Brown noddy	*Anous stolidus*	NBG Main Base (Orote Island and rocky offshore islets, Neye Island[3]), Andersen AFB (shoreline between Pati Point and Tagua Point), Tinian (Puntan Masalok), FDM	Uracas, Maug, Asunción, Agrihan, Pagan (Tograi Rock, possible), Alamagan, Guguan, Sarigan, Anatahan (Bird Rock), Saipan, Aguiguan (and Naftan Rock), Rota
Masked booby	*Sula dactylatra*	FDM	Uracas, Maug, Guguan
Red-footed booby	*Sula*	FDM	Maug, Asunción, Pagan, Guguan, Rota
Brown booby	*Sula leucogaster*	FDM	Uracas, Maug, Asunción, Agrihan, Pagan, Alamagan, Guguan, Sarigan, Anatahan, Saipan, Naftan Rock, Rota
Great frigatebird	*Fregata minor*	FDM	Maug (possible)

[1] There are over 100 species of seabirds and shorebirds known to occur or likely to occur within the Study Area. This table lists birds that are known to breed or likely to breed on DoD-owned or leased lands and other islands within the Study Area, as well as birds considered by the U.S. Fish and Wildlife Service as Birds of Conservation Concern. Birds of Conservation Concern are highlighted in bold.
[2] These islands are located within the Study Area; however, these islands do not include Navy owned or leased lands. Limited training activities may occur on Rota and Saipan through special use agreement with local authorities.
[3] Breeding activity at Neye Island or species is questionable due to the possible presence of brown treesnakes
Notes: Andersen AFB = Andersen Air Force Base, DoD = United States Department of Defense, FDM = Farallon de Medinilla, NBG = Naval Base Guam
Sources: Reichel (1991), Lusk et al. (2000), Wiles (2005), National Oceanic and Atmospheric Administration (2005a, b, c, d, e), U.S. Department of the Navy (2013a), U.S. Fish and Wildlife Service (2011a).

3.6.1.5 Areas Included in the Analysis

As discussed in Chapter 2 (Description of Proposed Action and Alternatives), the MITT Study Area includes approximately 502,000 square nautical miles (nm^2), all of which may be used by species belonging to the six taxonomic orders listed in Table 3.6-3. Chapter 2 (Description of Proposed Action and Alternatives) also describes the areas owned or leased by the DoD on Guam and the CNMI.

Table 3.6-3: Descriptions and Examples of Major Taxonomic Groups within the Study Area

Major Taxonomic Groups[1]		Vertical Distribution in the Mariana Islands Training and Testing Study Area		
Common Name (Taxonomic Group)	Description	Open Ocean Areas	Bays, Estuaries, and Rivers	Inland Wetlands and Open Upland Areas
Boobies, pelicans, cormorants, and frigatebirds (order Pelecaniformes)	Diverse group of large, fish-eating seabirds with four toes joined by webbing, often occur in large flocks near high concentrations of bait fish.	Airborne, surface, water column	Airborne, surface, water column	Potential foraging in freshwater wetlands
Tropicbirds (order Phaethontiformes)	Fish-eating group of birds, nesting in solitary pairs away from other breeding concentrations of seabirds.	Airborne, surface, water column	Airborne, surface, water column	Potential foraging in freshwater wetlands
Albatrosses, petrels, shearwaters, and storm-petrels (order Procellariiformes)	Group of largely pelagic seabirds, fly nearly continuously when at sea, and soar low over the water surface to find prey, some species dive below the surface.	Airborne, surface, water column	Airborne, surface, water column	Potential foraging in freshwater wetlands
Phalaropes, plovers, tattlers, sandpipers, gulls, noddies, terns, skimmers, skuas, and jaegers (order Charadriiformes)	Diverse group of small to medium sized shorebirds, seabirds and allies inhabiting coastal, nearshore, and open-ocean waters	Airborne, surface, water column	Airborne, surface, water column	Potential foraging in freshwater wetlands, potential foraging in open grasslands and mowed areas
Wading birds, such as ducks, herons, wigeons (order Anseriformes)	Plant and fish eating group of shorebirds with close associations with freshwater breeding and wintering grounds.	Airborne	Airborne, surface, water column	Airborne, surface, water column
Birds of prey, such as osprey and peregrine falcons (order Accipitriformes)	Birds of prey, rare occurrences within the Mariana Islands, preying on seabirds and shorebirds	Airborne	Airborne, surface (for foraging)	Airborne, surface (for foraging)

[1] Major taxonomic groups based on American Ornithologists Union's Checklist of North American Birds (7th Ed.) (Chesser et al. 2009) and Sibley (Sibley 2000).

Not all of the land areas within the MITT Study Area are included for analysis for potential impacts on seabirds and shorebirds. For instance, some land training areas on Guam do not contain seabird or shorebird habitats, and therefore the likelihood of potential impacts due to training and testing activities is negligible. Rota is excluded from the analysis because training activities on Rota occur in urban and developed settings, such as urban warfare exercises. Saipan is also not included in the analysis for seabirds and shorebirds, although this island supports occasional land training. The area identified for land training activities is the Marpi Maneuver Area, and it does not contain aquatic or marine habitats or terrestrial roosting habitats for seabirds or shorebirds.

Based on these criteria, only the following land areas within the Study Area are carried forward for analysis: Andersen Air Force Base, Naval Main Base (Naval Base Guam Apra Harbor, Sasa Valley and Tenjo Vistas Tank Farms, and Naval Base Guam Munitions Site), Tinian Military Lease Area, and FDM. These areas are described in more detail throughout this section.

3.6.2 AFFECTED ENVIRONMENT

Seabirds, shorebirds, and other species that use the marine environment occur within the Study Area year-round, seasonally, or during migration seasons. Some of these bird species are considered rare vagrants, their known ranges are thought to be outside of the Study Area, however, may transit the Study Area because of storm fronts or other weather-related factors.

Inhabited islands within the Study Area have been extensively altered by humans and support a wide array of introduced predators, plants, and invertebrate pests. The largest inhabited islands are located in the southern portion of the Marianas Archipelago (Guam, Rota, Saipan, and Tinian) and support less than 4 percent of the 265,000 seabirds estimated to occur within the Study Area (U.S. Fish and Wildlife Service 2005). The most important colony locations for seabirds are in the northern portion of the Mariana archipelago, particularly Uracas, Maug, Guguan, Asunción, FDM, and Naftan Rock off of Aguiguan (Reichel 1991, U.S. Fish and Wildlife Service 2005). These islands are of little commercial value, and with the exception of FDM, are all designated by CNMI as wildlife areas or sanctuaries (Reichel 1991, U.S. Fish and Wildlife Service 2005).

Ocean habitats are dynamic and often change in size, shape, magnitude, and location as water masses of varying temperature, salinity and velocity converge and diverge (U.S. Fish and Wildlife Service 2005). Dynamic habitats are also created when water interacts with ocean floor topography (such as islands, seamounts, and ocean trenches). Current convergences and eddy effects (created by islands) promote productivity and concentrate prey for seabirds (Mann and Lazier 1996, Oedekoven et al. 2001). Generally, most fish are found in schools close to land, and consequently most distinctive seabirds of this region (e.g., tropicbirds, boobies, frigatebirds, and several species of terns) keep to nearshore or coastal waters (McGowan et al. 2003).

Nonresident migrant shorebirds, such as the Pacific golden plover, migrate to Guam and the CNMI during winter months along the West Pacific Flyway. There are no breeding shorebirds in the Mariana Islands (Engilis and Naughton 2004). The West Pacific Flyway, shown in Figure 3.6-1, includes various other Pacific archipelagos, such as New Zealand, Samoa, Line Islands, Phoenix Islands, Hawaii, and continental sub-arctic and arctic regions in Alaska. Upon arrival, the Mariana Islands provide limited resources for shorebirds due to small island size, narrow intertidal zones, and lack of extensive mudflats (Parish et al. 1987). The highest quality habitats for wintering shorebirds are found on Guam and Saipan (Stinson et al. 1997). During the wet season, approximately June through November, ephemeral basins with short grass, exposed mud, and shallow pools provide habitat for migratory shorebirds wintering in the islands. Larger expanses of short grass habitats associated with military bases, airports, golf courses, fields, and residential parks are utilized by golden-plovers and, to a lesser extent, turnstones (Engilis and Naughton 2004).

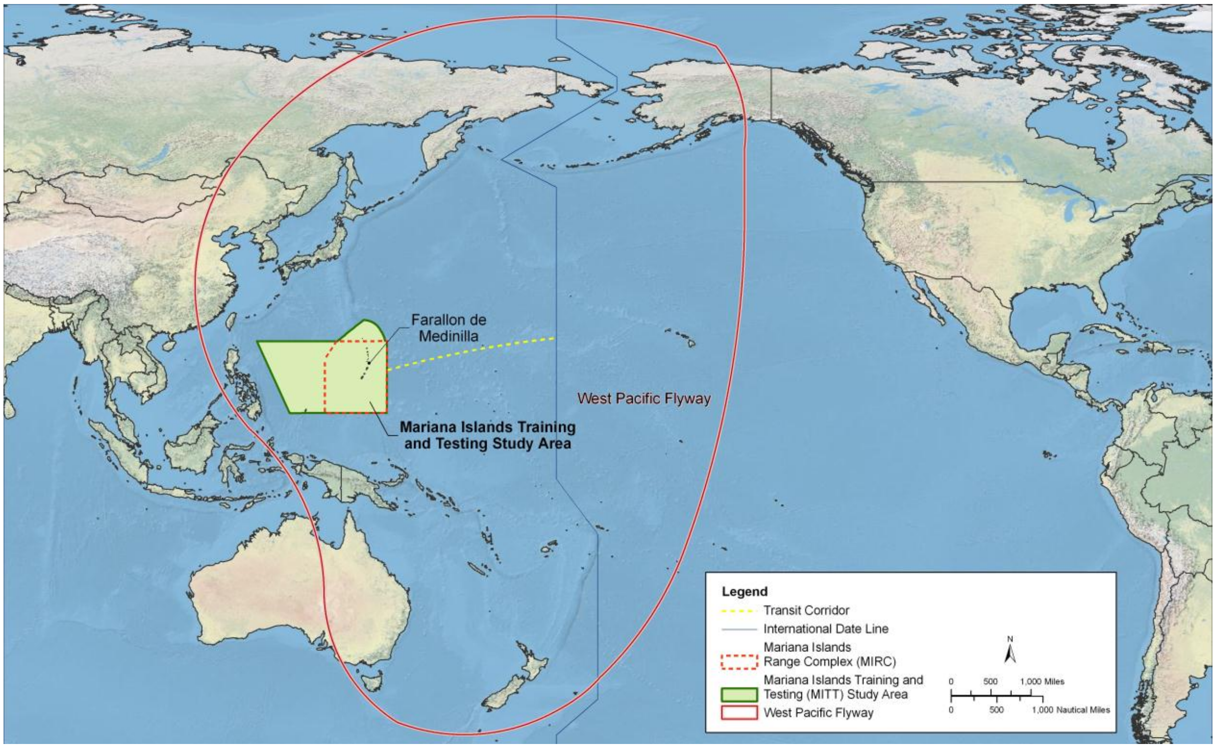


Figure 3.6-1: West Pacific Flyway

3.6.2.1 Group Size

A variety of group sizes and diversity may be encountered throughout the Study Area, ranging from solitary migration of an individual bird to large concentrations of mixed-species flocks. Flock size is likely dependent on the type of species, proximity to land, and seasonality of prey species. For instance, seabird species such as boobies, noddies, shearwaters, and white terns are frequent above tuna schools, while albatrosses and petrels tend to be more solitary (Squire et al. 1977).

3.6.2.2 Diving

Most seabirds found within the Study Area will feed by diving, skimming, or grasping prey at the water's surface or within the upper portion (1–2 meters [m] [3–6 feet {ft.}]) of the water column (Sibley 2000). Plunge-diving, as utilized by terns and pelicans, is a foraging strategy in which the bird hovers over the water and dives into the water to pursue fish. Diving behavior in terns is limited to plunge-diving during foraging (Tremblay et al. 2003) and, in general, tern species do not usually dive deeper than 3 ft. (1 m).

3.6.2.3 Bird Hearing

Although hearing range and sensitivity has been measured for many land birds, little is known of seabird hearing. The majority of the published literature on bird hearing focuses on terrestrial birds and their ability to hear in flight. A review of 32 terrestrial and marine species reveals that birds generally have greatest hearing sensitivity between 1 and 4 kilohertz (kHz) (Ryals et al. 1999). Very few can hear below 20 Hertz (Hz), most have an upper frequency hearing limit of 10 kHz, and none exhibit hearing at frequencies higher than 15 kHz (Dooling et al. 2000). Hearing capabilities have been studied for only a few seabirds (Beason 2004, Beuter et al. 1986, Thiessen 1958, Wever et al. 1969); these studies show that seabird hearing ranges and sensitivity are consistent with what is known about bird hearing in general.

There is little published literature on the hearing abilities of birds underwater. In fact, there are no measurements of the underwater hearing of any diving birds (Therrien et al. 2011). There are some studies of bird behavior underwater when exposed to sounds, from which some hearing abilities of birds underwater could be inferred. Common murres (*Uria aalge*) were deterred from gillnets by acoustic pingers emitting 1.5 kHz pings at 120 decibels (dB) referenced (re) to 1 micropascal (μPa); however, there was no significant reduction in rhinoceros auklet (*Cerorhinca monocerata*) bycatch in the same nets (Melvin and Parrish 1999). In another study, firing of guns over water deterred African penguins (*Spheniscus demersus*) from an area, but playback of Orca *(Orcinus orca)* vocalizations did not (Cooper 1982).

3.6.2.4 General Threats

Threats to seabird populations in the Study Area may include human-caused stressors such as incidental mortality from interactions with commercial and recreational fishing gear, introduced/non-native species, disturbance and degradation of nesting areas by humans and feral animals, egg collecting, noise pollution from construction and other human activities, nocturnal collisions with power lines and artificial lights, and pollution, such as that from oil spills and plastic items (Clavero et al. 2009, International Union for Conservation of Nature and Natural Resources 2010, North American Bird Conservation Initiative 2010, U.S. Fish and Wildlife Service 2005, 2008b). Predation of seabird eggs, chicks, and eggs by invasive species is of particular concern. Disease, volcanic eruptions, storms, and harmful algal blooms are also threats to seabirds (Jessup et al. 2009, North American Bird Conservation Initiative 2010, U.S. Fish and Wildlife Service 2005, 2008b). In addition, seabird distribution, abundance, breeding, and other behaviors are affected by cyclical environmental events, such as the El Niño Southern Oscillation and Pacific Decadal Oscillation in the Pacific Ocean (Vandenbosch 2000), as noted in Section 3.1 (Sediments and Water Quality).

An estimated 39 percent of seabirds that depend on ocean habitats are declining (North American Bird Conservation Initiative 2010). In the long term, climate change could be the largest threat to seabirds. Climate change effects include changes in air and sea temperatures, in precipitation, in the frequency and intensity of storms, in pH level of sea water, and in sea level rise. These changes could affect overall marine productivity and biodiversity, which could affect the food resources, distribution, and reproductive success of seabirds (Duffy 2011, Aebischer et al. 1990, Congdon et al. 2007, North American Bird Conservation Initiative 2010). Projections indicate that a 1 m (3.3 ft.) rise by the year 2100 is plausible (Fletcher 2009). As a result, seabird nesting colonies that occur along sections of coastlines undergoing sea level rise may experience a loss of nesting habitat (Congdon et al. 2007).

Threats to shorebirds in the Mariana Islands include degradation of wetlands, ephemeral basins, tidal flats, and mangrove estuaries; loss of seasonally flooded agricultural lands from expanded development; and predation by brown treesnakes and introduced feral animals. For a more detailed discussion of introduced animals on Guam, Rota, Tinian, Saipan, and FDM, see Section 3.10 (Terrestrial Species and Habitats).

3.6.2.5 At-Sea Observations of Seabirds and Shorebirds

Distribution and abundance vary considerably by species, with some species primarily occurring in nearshore habitats and others primarily occurring in offshore pelagic habitats. The area from the beach to about 10 nautical miles (nm) offshore provides foraging areas, a migration corridor, and winter habitat for various breeding and transient pelagic seabirds and shorebirds. Wintering shorebirds and transient shorebirds on the way to other wintering grounds are commonly observed in open areas (e.g., mowed grassy and paved areas) throughout the Mariana Islands. Pelagic seabirds are widely distributed throughout the Marianas, but they tend to congregate in areas of high productivity and prey availability. The Navy-funded Mariana Islands Sea Turtle and Cetacean Survey observed a total of 40 bird species along four legs (trips), accounting for 814 individual observations of seabirds and shorebirds within the cruise area (U.S. Department of the Navy 2007). Figure 3.6-2 shows the general location of survey legs for the Mariana Islands Sea Turtle and Cetacean Survey, and Table 3.6-4 lists each species observed during each survey leg. Figure 3.6-2 also shows known rookery locations for breeding seabirds within the Study Area from other sources.

3.6.2.6 Rookery Locations and Breeding Activities within the Mariana Islands Training and Testing Study Area

Seabirds are known to breed in a few locations on DoD-owned and leased properties within the Study Area. Table 3.6-5 lists each property that supports breeding activities of seabirds. These areas are described in more detail in the following subsections. Rota and Saipan also support important breeding marine bird rookeries, such as I'Chenchon Bird Conservation Area on Rota and Bird Island of Saipan. These areas are not within or proximate to land training activities within the Study Area; therefore, these areas are excluded from the analysis.

3.6.2.6.1 Guam

The introduction of brown treesnakes (*Boiga irregularis*) and rats (*Rattus* spp.) are primarily responsible for the extirpation of avian species on Guam, and successful seabird breeding activities can only occur where brown treesnakes cannot easily access (GovGuam Division of Aquatic and Wildlife Resources 2006). For example, Pacific reef herons (*Ardrea sacra*) historically bred along the western coast from Orote Point to Cocos Island (Lusk et al. 2000), and the disappearance of this species coincided with the declines of forest bird species attributed to predation in the 1980s and 1990s (Rodda et al. 1997, Savidge 1987). The Mariana mallard (*Anas platyrhyncos*) and the white-browned rail (*Poliomnas cenereus*), however, were extirpated from Guam prior to the arrival of the brown treesnake (Savidge 1987).

Some nesting activities can persist on Guam in areas out of reach of introduced predators. Brown noddies (*Anous stolidus*) nest and roost on steep cliffs, rocky offshore islets, and on channel makers in Outer Apra Harbor. Additionally, this species roosts on at least two small emergent rock islands off the north and south coast of Orote peninsula. Brown boobies (*Sula leucogaster*) also nested on Orote Island previous to the construction of Kilo Wharf, but no longer nest on Guam. The coastal islets, reef flats, grassy fields, and other open areas on Guam provide seasonal foraging habitat to any number of migratory shorebirds (U.S. Department of the Navy 2013a).

Estuarine wetlands occur in areas of tidal intrusion or brackish water and consist primarily of mangroves and the lower channels of rivers. The largest concentrations of mangroves exist along the eastern shores of Naval Base Guam Apra Harbor and are considered the most extensive and diverse in the Mariana Islands (GovGuam Department of Aquatic and Wildlife Resources 2006). Marshes of bulrushes (*Scirpus littoralis*) are found at several locations in Naval Base Guam Apra Harbor. The largest area is the artificial San Luis Ponds, an important foraging location for many species of migratory shorebirds (GovGuam Department of Aquatic and Wildlife Resources 2006, U.S. Department of the Navy 2013a). Locations of known breeding sites of seabirds on Guam are shown in Figure 3.6-3.

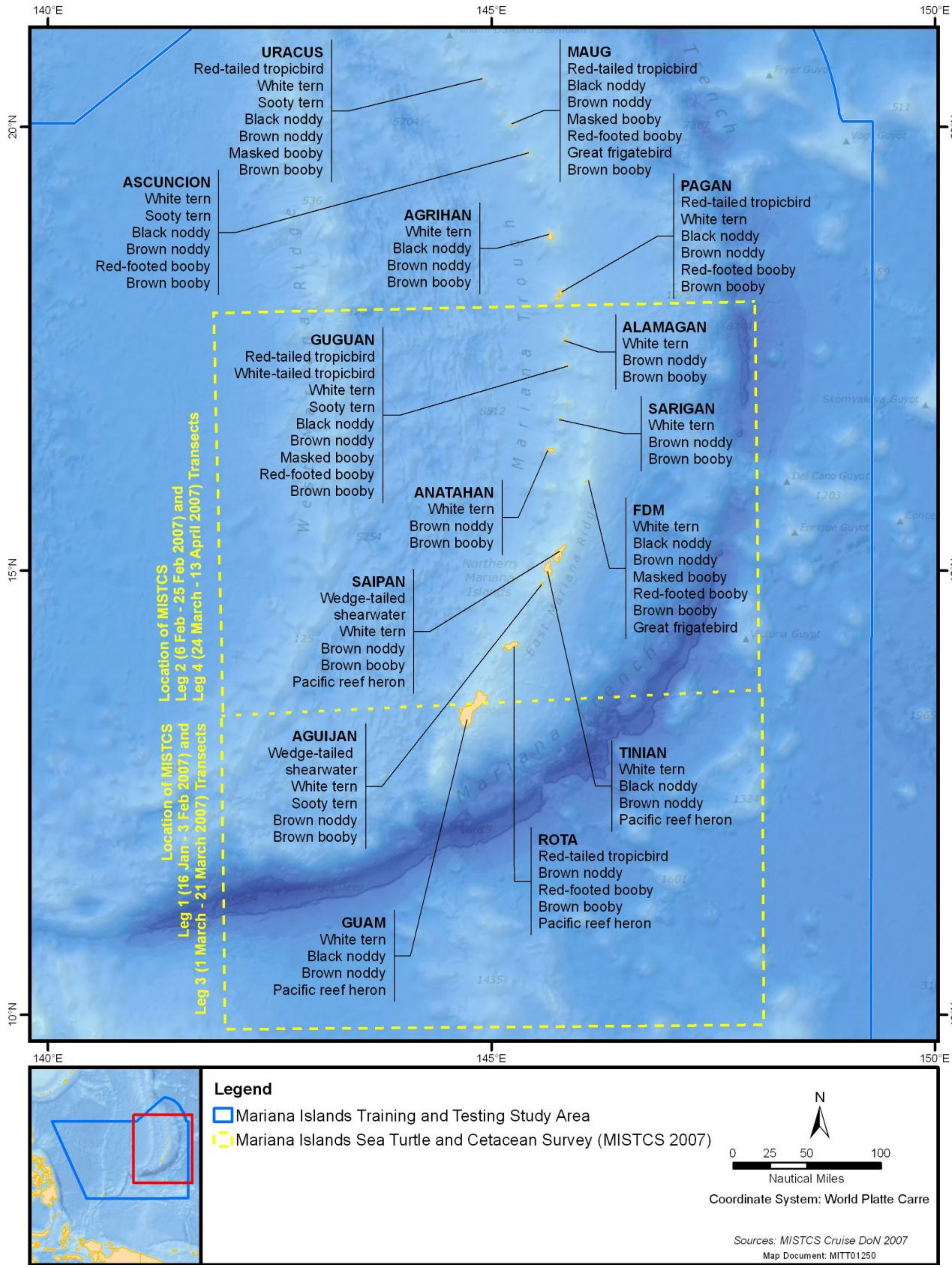


Figure 3.6-2: Breeding Locations of Seabirds within the Mariana Islands

Table 3.6-4: Pelagic Marine Bird Observations within the Study Area

Family	Common Name[1]	Scientific Name	MISTCS Survey Leg[2]				TOTAL
			Leg 1	Leg 2	Leg 3	Leg 4	
Albatrosses Family Diomedeidae	Short-tailed Albatross	*Phoebastria albatrus*	-	1	-	1	*2*
	Black-footed Albatross	*Phoebastria nigripes*	-	-	-	1	*1*
Petrels and Shearwaters (Family Procellariidae)	Tahiti Petrel	*Pseudobulweria rostrata*	3	-	-	2	*5*
	Mottled Petrel	*Pterodroma inexpectata*	-	-	1	-	*1*
	Kermadec Petrel	*Pterodroma neglecta*	3	4	-	1	*8*
	Herald Petrel	*Pterodroma arminjoniana*	6	3	2	1	*12*
	Hawaiian Petrel	*Pterodroma sandwichensis*	3	-	-	-	*3*
	White-necked Petrel	*Pterodroma cervicalis*	5	-	-	-	*5*
	Bonin Petrel	*Pterodroma hypoleuca*	7	12	9	7	*35*
	Black-winged Petrel	*Pterodroma nigripennis*	-	-	-	1	*1*
	Bulwer's Petrel	*Bulweria bulwerii*	6	4	1	1	*12*
	* White-chinned Petrel	*Procellaria aquinoctialis*	-	-	-	1	*1*
	Streaked Shearwater	*Calonectris leucomelas*	4	9	15	10	*38*
	Flesh-footed Shearwater	*Puffinus carneipes*	-	1	3	9	*13*
	Wedge-tailed Shearwater	*Puffinus pacificus*	8	13	16	20	*57*
	Short-tailed Shearwater	*Puffinus tenuirostris*	-	-	-	4	*4*
	* Little Shearwater	*Puffinus assimilis*	-	-	1	1	*1*
	Audubon's Shearwater	*Puffinus lherminieri*	1	-	1	-	*2*
	Wilson's Storm Petrel	*Oceanites oceanicus*	-	-	-	2	*2*
	* Wedge-rumped Storm Petrel	*Oceanodroma Tethys*	-	-	1	-	*1*
	Leach's Storm Petrel	*Oceanodroma leucorhoa*	-	-	1	7	*8*
	* Swinhoe's Storm Petrel	*Oceanodroma monorhis*	-	1	-	1	*2*
	Matsudaira's Storm Petrel	*Oceanodroma matsudairae*	12	20	16	20	*68*

Table 3.6 4: Pelagic Marine Bird Observations within the Study Area (continued)

Family	Common Name[1]	Scientific Name	MISTCS Survey Leg[2]				TOTAL
			Leg 1	Leg 2	Leg 3	Leg 4	
Tropicbirds (Family Phaethontidae)	Red-tailed Tropicbird	*Phaethon rubricauda*	5	13	5	11	*34*
	White-tailed Tropicbird	*Phaethon lepturus*	11	6	10	7	*34*
Gannets and boobies (Family Sulidae)	Masked Booby	*Sula dactylatra*	-	7	1	9	*17*
	Red-footed Booby	*Sula*	11	20	16	19	*66*
	Brown Booby	*Sula leucogaster*	5	9	16	18	*48*
Frigatebirds (Family Frigitatidae)	Great Frigatebird	*Fregata minor*	9	7	7	6	*29*
Skuas and jaegers (Family Stercorariidae)	Pomarine Jaeger	*Stercorarius pomarinus*	-	-	7	8	*15*
	Parasitic Jaeger	*Stercorarius parasiticus*	-	1	7	5	*13*
	Long-tailed Jaeger	*Stercorarius longicaudus*	1	2	11	17	*31*
Terns, noddies (Family Sternidae)	Gray-backed Tern	*Sterna lunata*	-	-	-	6	*6*
	Sooty Tern	*Sterna fuscata*	18	20	16	20	*74*
	Black Noddy	*Anous minutes*	6	10	11	9	*36*
	Brown Noddy	*Anous stolidus*	7	11	15	20	*53*
	White Tern	*Gygis alba*	16	20	16	20	*72*
Plovers (Family Charadriidae)	Pacific Golden Plover	*Pluvialis fulva*	-	1	-	-	*1*
Sandpipers, curlews, snipes (Family Scolopacidae)	Far Eastern Curlew	*Numenius madagascariensis*	-	-	1	-	*1*
	Common Sandpiper	*Actitis hypoleucos*	-	-	-	1	*1*

[1] Species marked with an asterisk (*) are believed sufficiently rare, unexpected, and without precedence in the Mariana Islands Sea Turtle and Cetacean Survey study area that in the absence of photo or specimen documentation and such sightings supported only by written field notes, should be regarded here as hypothetical.
[2] MISTCS study area shown in Figure 3.6-2.
Note: MISTCS = Mariana Islands Sea Turtle and Cetacean Survey
Source: U.S. Department of the Navy 2007

Table 3.6-5: Known Rookery/Nesting Locations on Department of Defense Owned or Leased Lands within the Mariana Islands Training and Testing Study Area

DoD Owned or Leased Property	Rookery/Nesting Location	Species Supported
Guam		
Naval Base Guam Main Base	North coast of Orote Peninsula, rocky offshore islets	Breeding for white terns
	Orote Island, rocky offshore islets	Brown noddies (approximately 150 individuals reported in 2005)
	Neye Island	Breeding location for black noddies, brown noddies, Pacific reef-herons, white terns, yellow bitterns[1]
	Portions of Main Base	Possible breeding for white terns and noddies on portions of the Main Base.
Andersen Air Force Base	Shoreline between Pati Point and Tagua Point	Breeding for black noddies and brown noddies
Tinian		
Tinian Military Lease Area	Puntan Masalok	Known breeding for black noddies, brown noddies, boobies
	Unai Dankulo	Known breeding for Pacific reef herons
	Puntan Lamanibot	Known breeding area for Pacific reef heron
Farallon de Medinilla		
Farallon de Medinilla	Cliffline habitats and Islets	Known breeding for black noddies, brown noddies, brown boobies, masked boobies, red-footed boobies, white terns, great frigatebirds
	Upland vegetated areas	

[1] Breeding activity at Neye Island is questionable due to the possible presence of brown treesnakes
Note: DoD = Department of Defense
Sources: National Oceanic and Atmospheric Administration (2005a, b, c, d, e), U.S. Department of the Navy (2013), Mosher (2013).

rightCommon marine bird species seen on Guam include residents and migrant visitors, such as the wandering tattler (*Tringa incana*), common sandpiper (*Actitis hypoleucos*), brown noddy, white tern (*Gygis alba*), black noddy (*Anous minutus*), and brown booby. Most common among the annual visitors to the island are the Pacific golden-plover (*Pluvialis fulva*), Mongolian plover (*Charadrius mongolus*), Siberian tattler (*Tringa brevipes*), whimbrel (*Numenius phaeopus*), ruddy turnstone (*Arenaria interpre*s), and cattle egret (*Bubulcus ibis*), which might have become established on Guam (U.S. Department of the Navy 2013a). To date, more than 80 migrant and vagrant species have been recorded on Guam.

3.6.2.6.2 Tinian

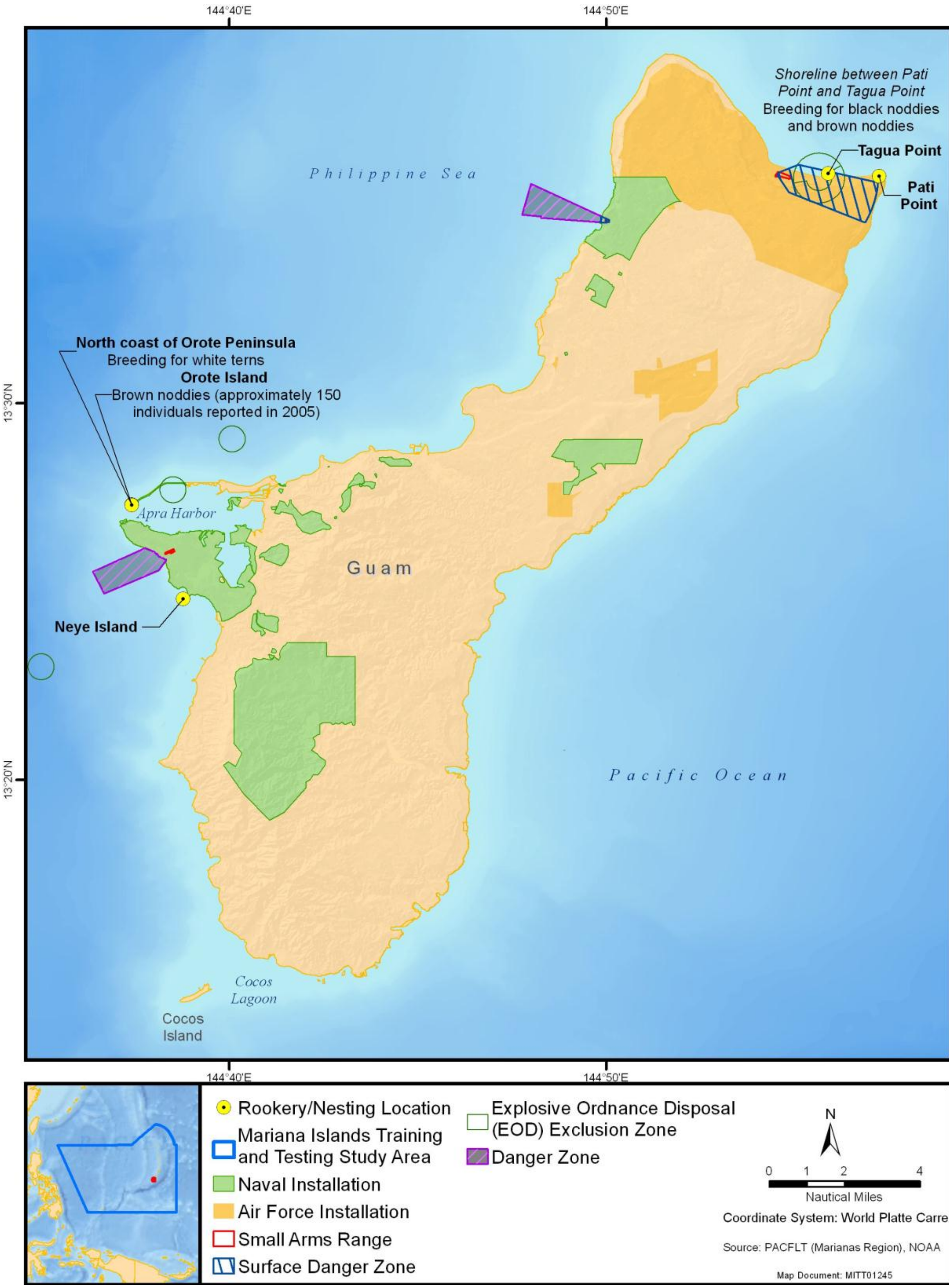
Tinian serves as an important stopover location for migratory birds. These birds use Tinian to rest and forage during their respective non-breeding seasons. For shorebirds such as common sandpipers, Pacific golden-plovers, ruddy turnstones, and whimbrels, exposed coral reef and open field habitats are likely common observation locations on Tinian. Navy biologists have recorded black noddies, brown noddies, white terns, brown boobies, masked boobies, red-footed boobies, Pacific reef herons, yellow bitterns, great frigatebirds, red-tailed tropicbirds, and white-tailed tropic birds on Tinian (U.S. Department of the Navy 2013a). Hagoi is a unique inland freshwater wetland area within the Military Lease Area. This wetland, however, is clogged with thick stands of *Phragmites karka*, which limits the use of Hagoi for migrant shorebirds and waterbirds. In 2008, a black-winged stilt was seen at Hagoi by Navy biologists and is considered a rare occurrence (U.S. Department of the Navy 2013a). Waterfowl, such as Eurasian wigeons and tufted ducks, and waterbirds, such as black-crowned night-herons and Swinhoe's snipe, are typically associated with standing water sources and may occur at the Hagoi wetland area. Gray-backed terns, sooty terns, and white terns also likely forage in the Hagoi Wetland as well as Tinian's near-shore waters (U.S. Department of the Navy 2013a).

Along the Military Lease Area coastline, Puntan Masalok (Masalok Point), rocky exposed coastlines of Unai Dankulo, Puntan Tahgong (Tahgong Point), and Puntan Lamanibot (Laminibot Point) have been identified as potential habitat for pelagic birds and shorebirds, including white-tailed tropicbirds, common sandpipers, Siberian tattlers, ruddy turnstones, wandering tattlers, whimbrels, black noddies, brown noddies, boobies, and Pacific reef herons. Environmental Sensitivity Index Maps (National Oceanic and Atmospheric Administration 2005a, b, c, d, e) show breeding activity at Puntan Masalok for black noddies, brown noddies, and boobies; Pacific reef herons breeding at Unai Dankulo and Puntan Lamanibot. Figure 3.6-4 shows the location of known breeding locations within military-leased properties on Tinian. The USFWS conducted shoreline surveys in 2008 and observed numerous Siberian tattlers and wandering tattlers, reef herons, black noddies, and white terns (including one large colony of 30-plus white terns roosting in mature langasat trees [*Barringtonia asiatica*]). No black noddy nesting areas were observed on Tinian during the survey. Most birds observed were along the western coastline that consists of flat coralline shelves along the water with large boulders in the bays and protection from the prevailing winds. White-tailed tropicbirds, black noddies, and white terns were noted in point transect surveys on Tinian and the white tern total population was estimated at approximately 18,000 birds (Kessler 2009).

3.6.2.6.3 Farallon de Medinilla

Although FDM never likely supported a permanent human settlement, FDM does have a history of exploitation for human consumption. At the turn of the 20th century, exotic feathers for the European, American, and Australian hat industry were in high demand. Historical records show that between 1897 and 1915 more than 3.5 million seabirds were killed on islands in the central Pacific Ocean, including FDM and other islands in the Marianas (Spennemann 1999). The Northern Marianas at the time were controlled by Germany, which purchased the islands from Spain in 1898 (Spennemann 1999). Germany supplied licenses to private companies for the harvest of native birds with little regulatory control. Tropic birds, brown boobies, frigatebirds, and white terns were especially sought after and hunted to the verge of extinction (Spennemann 1999). FDM was leased by Germany in 1909 for the exploitation of birds. By the end of the lease, which terminated in 1911, bird numbers were reduced to the point where further hunting became uneconomical. German control over the Northern Mariana islands was lost in 1914 when the islands were annexed by Japan (Spennemann 1999).

Breeding has been reported on FDM for seven seabird species (black noddies, brown noddies, brown boobies, masked boobies, red-footed boobies, white terns, and great frigatebirds) (Reichel 1991, Lusk et al. 2000, U.S. Department of the Navy 2013a). Booby species are the most readily identifiable due to their numbers and individual sizes. The other species-breeding locations are either dispersed or breeding activity is sporadic. Lusk et al. (2000) visited the island in November 1996 and confirmed breeding on FDM for the great frigatebird, while others have reported the great frigatebird as only roosting on FDM (Reichel 1991). Lusk estimated 25 birds, including several juveniles roosting with the main group or flying near shore. Several nests were observed, one with a single egg. The most recent report of a great frigatebird, however, was a single individual observed in December 2011 (U.S. Department of the Navy 2013b).



Note: The current status of Neye Island as a breeding colony is unknown.

Figure 3.6-3: Known Breeding Locations for Seabirds on Military Lands on Guam

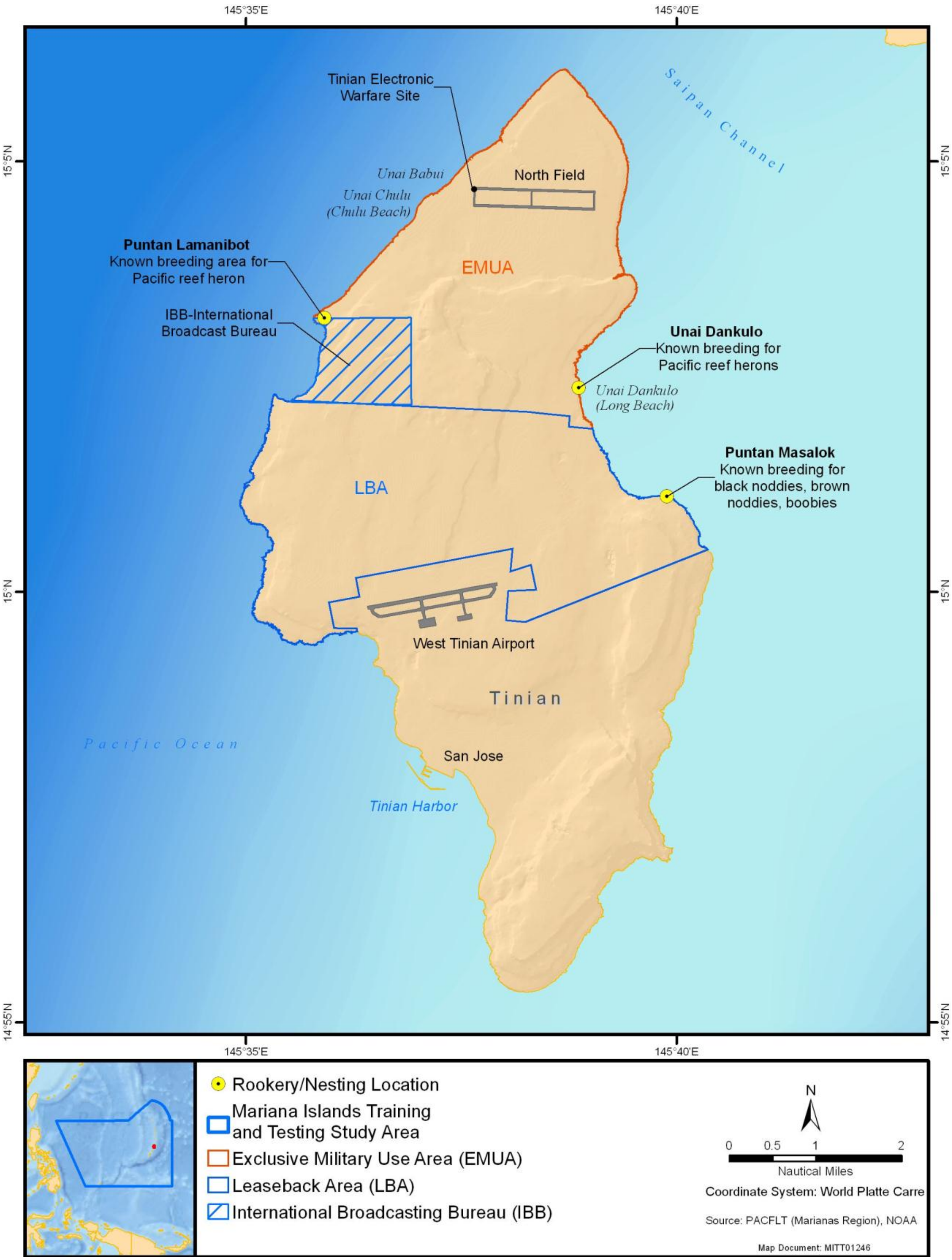


Figure 3.6-4: Known Breeding Locations for Seabirds on Military-Leased Areas on Tinian

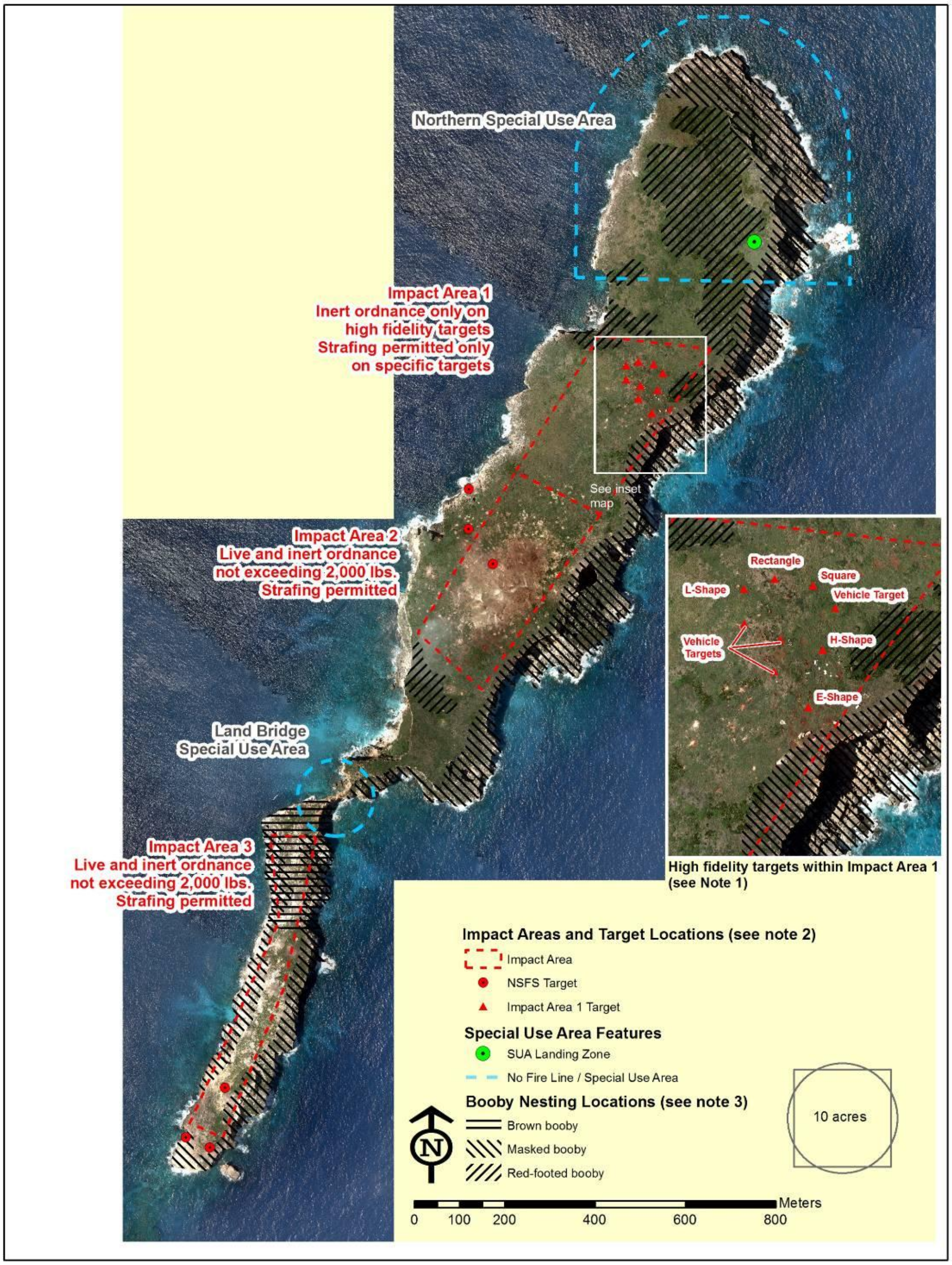
From 1997 through 2013, regular seabird surveys of FDM were conducted via helicopter. The surveys were conducted most months from 1997 to 2008 (125 times out of a total 144 months). From 2009 through 2013, the surveys were conducted on a quarterly basis. Over the entire 17-year period (204 months), aerial surveys of FDM were conducted 153 times. The three booby species were the most abundant seabirds on FDM and large enough to be observable from the helicopter. Navy surveyors have divided the island into five survey blocks, where each section runs from the outside edge (from the water) to the center of the island. As the chartered helicopter makes one pass by the east side and one pass by the west side of the island, each survey block is systematically searched (with the aid of image stabilizing binoculars) for the three booby species that may be roosting or nesting. Birds in flight are not counted. Great frigatebirds in flight or on the roost are noted when seen, as are turtles, marine mammals, and rare or unusual species for the island. Observations are also recorded during the transit to and from Saipan. After seabirds are counted the helicopter flies around the island again, and multiple photographs of the island are taken to document habitat condition and other noteworthy occurrences (U.S. Department of the Navy 2013b).

From 1997 through 2014, regular seabird surveys of FDM were conducted via helicopter. The survey entailed the chartered helicopter making one pass by east side and one pass by the west side of the island, during which, booby detections by species were recorded, with aid of image stabilizing binoculars. Other seabird species along with sea turtles and marine mammals are also noted (U.S. Department of the Navy 2013b). The surveys were conducted most months from 1997 to 2008 and on a quarterly basis from 2009 – 2014. The survey results are reported to the USFWS Pacific Islands Fish and Wildlife Office, in accordance with annual reporting requirements specified in recent Section 7 ESA consultations. The studies are also shared with local agencies within the CNMI.

The surveys have shown seasonal and annual fluctuations of masked boobies, red-footed boobies, and brown boobies. During the 159 counts conducted between February 1997 and August 2014 a total of 8,786 brown booby, 15,878 masked booby, and 57,304 red-footed booby were recorded. The numbers detected during each count ranged from 0 to 447 for brown booby, 6 to 404 for masked booby, and 42 to 915 for red-footed booby. Counts averaged 55.26 (± 87.67 SD) for brown booby, 99.86 (± 59.06) for masked booby, and 360.40 (± 184.75) for red-footed booby (Camp et al. 2014).

Figure 3.6-5 shows the location of rookeries for the three booby species. Lusk et al. (2000) first mapped the rookery locations, and the Navy has updated the locations based on observations made during the aerial surveys described above. Lusk et al. (2000) reported a small great frigatebird rookery; however, breeding has not been reported during any of the periodic surveys completed by the Navy.

Figure 3.6-6 summarizes the number of masked boobies observed on FDM during the helicopter-based surveys, Figure 3.6-7 summarizes the number of red-footed boobies observed, and Figure 3.6-8 summarizes the number of brown boobies observed (Camp et al. 2014). Results of statistical analyses of survey data collected from 1997 – 2014 on all three booby species demonstrated that definite conclusions cannot be reached regarding long-term population trends, i.e., the results are statistically non-significant.

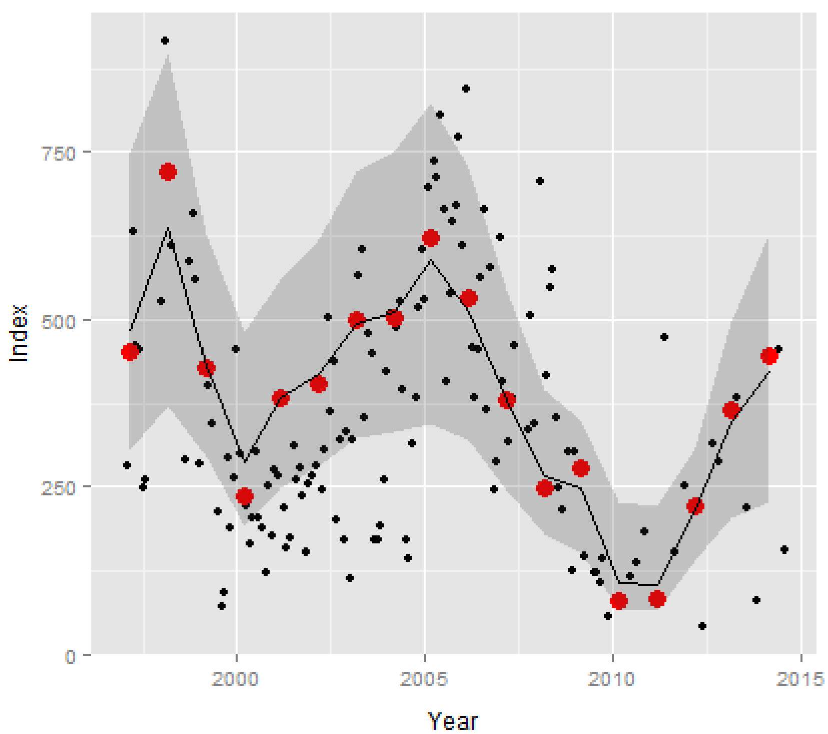


Note 1: Target vehicles, rectangular target, square target, and L-shaped target receive only lightweight inert ordnance not exceedingl100 pounds (lb.) Strafing prohibited. The H-shaped target may be targeted with inert ordnance not exceeding 500 lb. Strafing prohibited. The E-shaped target may be targeted with inert ordnance not exceeding 2,000 lb. Strafing authorized.
Note 2: Areas outside of designated Impact Areas are considered "No Fire Areas" in accordance with COMNAVMARIANASINST 3500.4A.
Note 3: Booby nesting locations are updated based on (1) observations of booby nesting during periodic aerial surveys (now conducted quarterly, (2) species-specific habitat preferences, and (3) information provided by Lusk et al. 2000.

Figure 3.6-5: Seabird Rookery Locations on Farallon de Medinilla

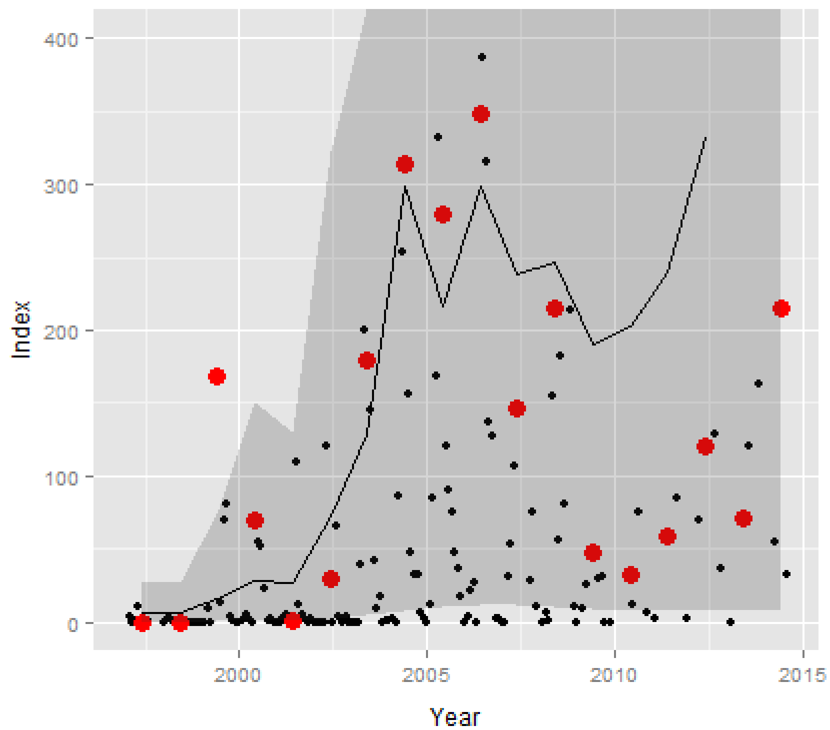
Note: This figure shows the masked booby trend in counts and evidence of trend based on state-space model. The black dots are count data collected between 1997 and 2014, red dots are the counts during the preferred month for assessing trends, the trend is represented by the black line, and the 95 percent credible interval trend uncertainty is the shaded region (from Camp et al. 2014)

Figure 3.6-6: Masked Booby Trend in Counts at FDM



Note: This figure shows the red-footed booby trend in counts and evidence of trend based on state-space model. The black dots are count data collected between 1997 and 2014, red dots are the counts during the preferred month for assessing trends, the trend is represented by the black line, and the 95 percent credible interval trend uncertainty is the shaded region (from Camp et al. 2014).

Figure 3.6-7: Red-footed Booby Trend in Counts at FDM



Note: This figure shows brown booby trend in counts and evidence of trend based on state-space model. The black dots are count data collected between 1997 and 2014, red dots are the counts during the preferred month for assessing trends, the trend is represented by the black line, and the 95 percent credible interval trend uncertainty is the shaded region which extends beyond the index range displayed (from Camp et al. 2014).

Figure 3.6-8: Brown Booby Trend in Counts at FDM

3.6.2.7 Short-Tailed Albatross (*Phoebastria albatrus*)

The short-tailed albatross (*Phoebastria albatrus*) was formerly in the genus *Diomedea* and known as Steller's albatross; it is the largest of the North Pacific albatrosses.

3.6.2.7.1 Status and Management

The short-tailed albatross is widely regarded as one of the rarest species of albatrosses and one of the world's rarest birds (Harrison 1983, International Union for the Conservation of Nature and Natural Resources 2010). The short-tailed albatross is listed as endangered under the ESA throughout its range. No critical habitat is designated for this species because little is known about its life in the open ocean (U.S. Fish and Wildlife Service 2005).

3.6.2.7.2 Habitat and Geographic Range

Short-tailed albatrosses are typically found in the open ocean and tend to concentrate along the edge of the continental shelves (U.S. Fish and Wildlife Service 2005). Upwelling zones are not only nutrient rich, but they also bring prey (e.g., squid and fish) typically found only in deeper water to the surface, where they become available to albatrosses. Upwelling occurs when the wind moves warm, nutrient poor water away from the area, which allows colder, nutrient rich water to rise to the surface of the ocean. Short-tailed albatross nest on isolated, windswept, offshore islands with restricted human access (U.S. Fish and Wildlife Service 2005). Their at-sea distribution includes the entire North Pacific Ocean north of about 20 degrees (°) north (N) latitude. Short-tailed albatrosses move seasonally around the North Pacific Ocean, with high densities observed during the breeding season (December through May) in Japan and throughout Alaska and along the west coast of North America during the non-breeding season (April through September) (U.S. Fish and Wildlife Service 2008b). Non-breeding subadults can be found in all areas throughout the year. They are seen in the North Pacific Subtropical Gyre (U.S. Fish and Wildlife Service 2005). Figure 3.6-9 shows the known regular range of the short-tailed albatross, as well as known nesting locations and islands where the short-tailed albatross is believed to be extirpated.

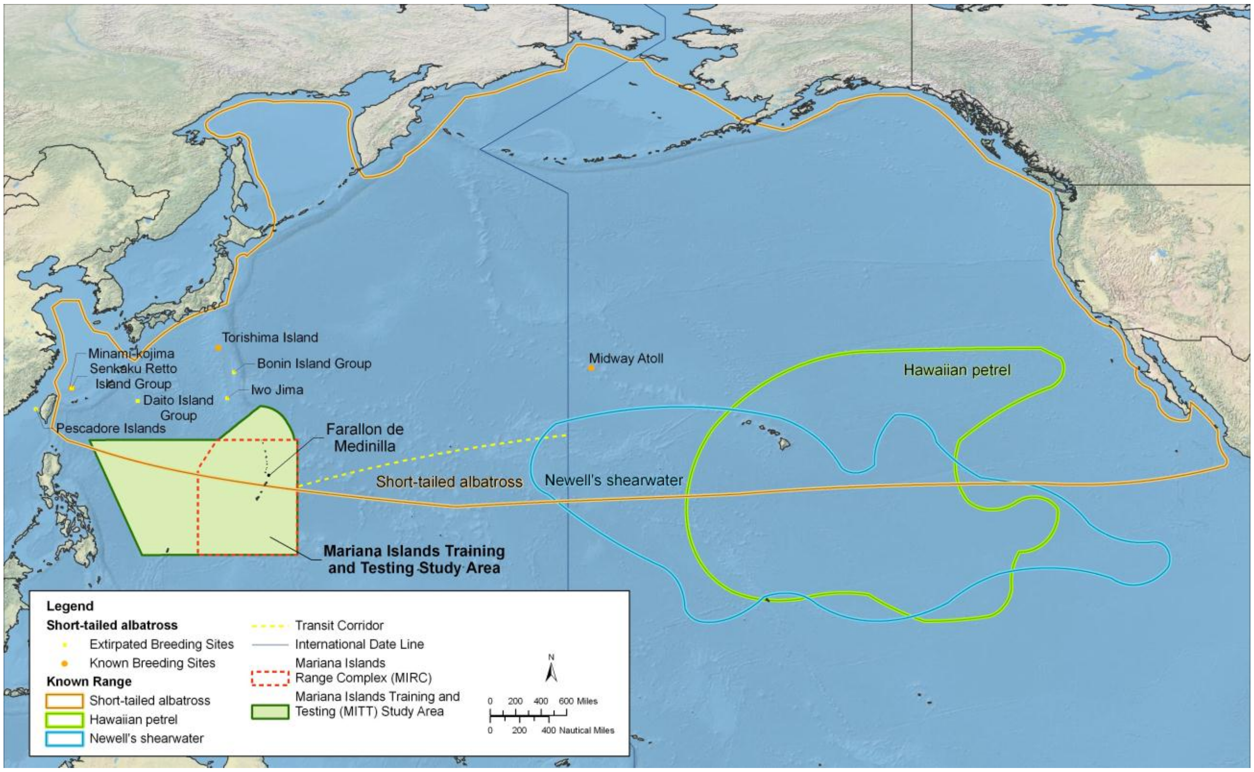
Short-tailed albatrosses nest in open, treeless areas with low, or absent vegetation. Short-tailed albatrosses spend much of their time feeding in shelf-break areas of the Bering Sea, the Aleutian island chain and in other Alaskan, Japanese, and Russian waters, as they require nutrient-rich areas of ocean upwelling for their foraging habitat (U.S. Fish and Wildlife Service 2008b).

3.6.2.7.3 Population and Abundance

Prior to its exploitation, the short-tailed albatross was possibly the most abundant of the three North Pacific albatross species (U.S. Fish and Wildlife Service 2005). By the 1950s, this species was nearly extirpated in the Pacific as populations were harvested by feather hunters. Presently, fewer than 2,000 short-tailed albatrosses are known to exist. The species is known to breed on four islands (Agreement on the Conservation of Albatrosses and Petrels 2012). Torishima, where 80–85 percent of short-tailed albatrosses breed, is an active volcano, and Tsubame-zaki, the natural colony site on the island, is susceptible to mud slides and erosion. An artificial colony has also been established in another area less prone to erosion on Torishima. As of the 2004–2005 season, four pairs have nested and fledged chicks at the artificial colony site. Most of the remaining short-tailed albatrosses breed at Minami-kojima in the Senkaku Islands, to the southwest of Torishima, where volcanism is not a threat (U.S. Fish and Wildlife Service 2005). Both islands are controlled by Japan; however, the Senkaku Islands (including Minami-kojima) are claimed by the People's Republic of China and Taiwan (Republic of China).

In late 2010 two short-tailed albatross nests were recorded, one each on Kure Atoll and Midway Atoll, both of which contained an egg that was incubated. The nest on Midway Atoll successfully fledged the first chick outside of Japan in June 2011, but the nest on Kure Atoll had failed by late December 2010. Short-tailed albatrosses have begun breeding on Kure Atoll again, and at the same nest site as in 2010, with the birds arriving to Kure Atoll in late October 2011 (Agreement on the Conservation of Albatrosses and Petrels 2012). On Midway, the pair returned in October 2011, with an egg observed on 14 November 2011 (BirdLife International 2012).

Two observations of short-tailed albatross were recorded during the 2007 Mariana Islands Sea Turtle and Cetacean Survey (U.S. Department of the Navy 2007). Breeding does not occur within the Mariana Islands, and there are no known nesting attempts on islands within the Mariana archipelago (U.S. Fish and Wildlife Service 2008b). Although short-tailed albatrosses have been observed in less productive waters far from regions of upwelling, the extremely rare observations in these areas suggest these birds may simply be moving between areas of favored habitat.



Notes and Sources: Short-tailed albatross pelagic range and breeding sites from U.S. Fish and Wildlife Service (2005, 2008b). Newell's shearwater range and from BirdLife International (2010a, b). Hawaiian petrel range from Birdlife International (2010b).

Figure 3.6-9: Pelagic Ranges and Breeding Locations for the Short-Tailed Albatross, Newell's Shearwater, and Hawaiian Petrel

3.6.2.7.4 Predator-Prey Interactions

Short-tailed albatrosses are surface feeders and scavengers, feeding more inshore than other North Pacific albatrosses. In Japan, their diet consists of shrimp, squid, and fish (including bonita, flying fish, and sardines); diet information is not available for birds in the Study Area (U.S. Fish and Wildlife Service 2005). Short-tailed albatross chicks are depredated by other birds (U.S. Fish and Wildlife Service 2005).

3.6.2.7.5 Species-Specific Threats

Short-tailed albatrosses have survived multiple threats to their existence. During the late 1800s and early 1900s, feather hunters clubbed to death an estimated five million of them, stopping only when the species was nearly extinct (U.S. Fish and Wildlife Service 2001). In the 1930s, nesting habitat on the only active nesting island in Japan was damaged by volcanic eruptions, leaving fewer than 50 birds by the 1940s. Loss of nesting habitat to volcanic eruptions, severe storms, and competition with black-footed albatrosses for nesting habitat continue to be natural threats to short-tailed albatrosses today. Human-induced threats include hooking and drowning on commercial longline gear, entanglement in derelict fishing gear, ingestion of plastic debris, contamination from oil spills, and potential predation by introduced mammals on breeding islands. In the past, introduced predators impacted populations on Kure and Midway. Rats have been eradicated from all major breeding areas, although rats and cats persist on Wake and some potential islands in the Mariana archipelago, which may hinder recolonization of these sites (U.S. Fish and Wildlife Service 2005).

3.6.2.8 Hawaiian Petrel (*Pterodroma sandwichensis*)

The Hawaiian petrel (*Pterodroma sandwichensis*) was recently split from the Galapagos petrel (*Pterodroma phaeopygia*) based on genetic and morphological evidence; before the split they were collectively known as the dark-rumped petrel (BirdLife International 2010c, U.S. Fish and Wildlife Service 2005).

3.6.2.8.1 Status and Management

The Hawaiian petrel nests only in Hawaii and is listed as endangered throughout its range under the ESA (U.S. Fish and Wildlife Service 2005); there is no designated critical habitat. The greatest threat to adult survival and breeding success is predation by introduced animals, such as mongooses, cats, and rats. In some cases, predation has caused more than 70 percent nesting failure, and management activities have focused on predator reduction (U.S. Fish and Wildlife Service 2005, 2008a).

3.6.2.8.2 Habitat and Geographic Range

Hawaiian petrels nest only in Hawaii, specifically in the main Hawaiian Islands, though there are specimen records from Japan, Philippines, and Moluccas at the western edge of the distribution, as well as the rare sightings along the west coast of North America. An incidental observation of a Hawaiian petrel was recorded during line transect surveys in the Mariana Islands in 2007 (U.S. Department of the Navy 2007). Hawaiian petrels range far to find their widely dispersed food sources (U.S. Fish and Wildlife Service 2008a). They feed primarily on squid, but also on fish, crustaceans, and plankton found at the surface, and they are also known to scavenge. They do not seem to dive or swim underwater, and are seen more frequently when the wind is blowing at least 12.5–25 miles (mi.) (20.1–40.2 kilometers [km]) per hour. Like other seabirds, Hawaiian petrels are long-lived and lay only a single egg per year, making them very susceptible to population declines. They are believed to be monogamous and show mate fidelity. During their March–October nesting season they return to the same nesting burrows year after year, entering and exiting their burrows only under the cover of night. Radar studies on Kauai indicate that birds come and go from breeding areas in greatest numbers 2 hours after dusk and 2 hours before dawn (BirdLife International 2010a). Currently threatened nesting habitat has forced them to adopt marginal, high elevation sites, but historically they occupied low-elevation sites easily accessible to the ocean. They range up to approximately 930 mi. (1,496.7 km) from the Hawaiian Islands during the breeding season, with only rare sightings in these waters from January through March. See Figure 3.6-9 for a map of the known regular pelagic range of the Hawaiian petrel.

3.6.2.8.3 Population and Abundance

The Hawaiian petrel formerly nested in very large numbers at multiple sites on all of the main islands in the Hawaiian chain except Niihau; however, hunting of nestlings, habitat modification, and the introduction of predators and disease-carrying mosquitoes eliminated the nesting populations closer to sea level so that remaining colonies are restricted to a few remote high elevation sites (U.S. Geological Survey 2008). The Haleakala National Park on Maui Island houses the largest known breeding population of 450 to 650 pairs, and Kauai is suspected of having as many as 1,600 breeding pairs. Small numbers have bred on the Island of Hawaii on both Mauna Loa and Mauna Kea volcanoes. Recent at-sea surveys estimate the population at approximately 20,000 individuals (BirdLife International 2010a). These birds may range thousands of miles from their nesting colonies, even during the breeding season (U.S. Fish and Wildlife Service 1983, 2005). Three Hawaiian petrels were observed during the 2007 Mariana Islands Sea Turtle and Cetacean Survey (U.S. Department of the Navy 2007). There are no records of occurrence on any of the islands within the Study Area.

3.6.2.8.4 Predator-Prey Interactions

Hawaiian petrels eat mostly squid (50 to 75 percent of their diet), fish, and crustaceans (International Union for Conservation of Nature and Natural Resources 2010). They forage both night and day, capturing their prey by resting on the water surface and dipping their bill and by aerial pursuit of flying fish (International Union for Conservation of Nature and Natural Resources 2010). The foraging member of a pair may fly up to 930 mi. (1,497 km) from the nesting island (U.S. Fish and Wildlife Service 2005). Adult and young Hawaiian petrels are preyed on by introduced animals such as mongooses, cats, and rats.

3.6.2.8.5 Species-Specific Threats

Threats to this endangered seabird include predation by introduced mammals, development, light attraction and collision, ocean pollution, and disturbance of its breeding grounds. The petrel does not have any natural defenses against predators such as rats, feral cats, and mongooses, and its burrows are very vulnerable. Collisions with artificial lights, utility poles, and fences kill Hawaiian petrels on some islands (International Union for Conservation of Nature and Natural Resources 2010).

3.6.2.9 Newell's Shearwater (*Puffinus auricularis newelli*)

The classification of the Newell's shearwater is in flux. It was, until recently, regarded by some authorities as a distinct species, *Puffinus newelli* (BirdLife International 2010b). The U.S. Fish and Wildlife Service (2005) identifies Newell's shearwater as a subspecies of Townsend's shearwater. Newell's shearwater is also known as Newell's dark-rumped shearwater.

3.6.2.9.1 Status and Management

Newell's shearwater is an ESA-listed threatened species, nesting only in the Hawaiian Islands. A federal recovery plan was finalized in 1983 (U.S. Fish and Wildlife Service 1983). In July 2010, the USFWS completed a status review for this species, and opted to not elevate the status to endangered. This species is currently monitored on the island of Kauai, where 75–90 percent of the Newell's shearwater population nests (U.S. Fish and Wildlife Service 2011a).

3.6.2.9.2 Habitat and Geographic Range

In breeding habitats, Newell's shearwaters favor mountain regions for nesting, often on inaccessible cliff areas or steep slopes (U.S. Fish and Wildlife Service 1983). These breeding habitats are restricted to the Hawaiian Islands, primarily on Kauai.

In pelagic habitats, Newell's shearwaters are well known by the Pacific tuna industry for their association with tuna and large billfish (U.S. Fish and Wildlife Service 2005). During the breeding season, low densities of birds occur short distances west and north of Hawaii (to about 25°N), and some Newell's can be found within a few hundred kilometers of their breeding colonies. This species is highly pelagic; found flying in areas of the ocean characterized by a deep thermocline and depths of more than 2,000 m (6,562 ft.). Newell's shearwaters can be found in the deep water regions of the Equatorial Countercurrent year-round, to the south of the Hawaiian Islands (to 25° south) and east of the Hawaiian Islands (to about 120° west) (U.S. Fish and Wildlife Service 2005). See Figure 3.6-9 for a map of the known regular pelagic range of the Newell's shearwater.

3.6.2.9.3 Population and Abundance

In 1995, the population of the Newell's shearwater was estimated at 84,000 birds (Spear et al. 1995), with approximately 75 percent occurring on Kauai, Hawaii (Ainley et al. 1997). This estimate included both breeding and non-breeding birds. Population models incorporating best estimates of breeding success and factoring in variables for mortality (e.g., predation, light attraction, and collision) predicted an annual population decline of approximately 60 percent over 10 years (U.S. Fish and Wildlife Service 2011a). During the 2007 Mariana Islands Sea Turtle and Cetacean Survey, no Newell's shearwaters were observed (U.S. Department of the Navy 2007). The majority of the survey effort (January through April of 2007) occurred outside of the breeding season when this species breeds in the Hawaiian Islands. This is the time of year the Newell's shearwater would most likely be found in the open ocean portions of the Study Area. Newell's shearwaters are considered rare visitors to Guam and the CNMI.

3.6.2.9.4 Predator-Prey Interactions

Although diet is not well known, evidence suggests that squid are a major dietary item. Newell's shearwaters capture food by pursuit-plunging (diving into water and swimming after prey), usually in company with multispecies feeding flocks associated with tuna (BirdLife International 2010b). This species is not attracted to discarded fish byproducts and does not follow ships (U.S. Fish and Wildlife Service 2005). Newell's shearwaters are preyed on by introduced animals at their breeding sites, such as cats and birds such as barn owls (Ainley et al. 1997). Nocturnal activity and cavity-nesting behaviors are their only defense against mammalian predators.

3.6.2.9.5 Species-Specific Threats

Historical threats included subsistence hunting by Polynesians and predation by rats, dogs, and pigs. Current threats include artificial lights (e.g., street and resort lights) along the coast that blind and disorient fledglings. Once on the ground, these fledglings are unable to fly and thousands are killed each year by cars, cats, and dogs. In addition, adults can collide with power facilities and associated utility wires and associated lines are in the direct path of known Newell's flight corridors. Additional threats are the loss and degradation of forested habitat caused by introduced plants and herbivores (U.S. Fish and Wildlife Service 2011a).

3.6.2.10 Great Frigatebird (*Fregata minor*)

3.6.2.10.1 Status and Management

The great frigatebird (*Fregata minor*) is not an ESA-listed species. This species, however, is protected under the MBTA and provisions set forth in 50 C.F.R. Part 21. The last record of great frigatebird nesting on FDM was reported in 1996 (Lusk et al. 2000); however, other surveys suggest that they are just roosting, not nesting (Reichel 1991). Great frigatebirds are noted when observed during quarterly aerial surveys over FDM.

3.6.2.10.2 Habitat and Geography

The great frigatebird has a wide distribution throughout the tropical Pacific, with Hawaii as the northernmost extent of their range. In the Central and South Pacific, colonies are found on most island groups from Wake Island to the Galapagos Islands to New Caledonia, with a few pairs nesting on Australian possessions in the Coral Sea. Colonies are also found on numerous Indian Ocean islands, including Aldabra, Christmas Island, and Mauritius (Pratt et al. 1987). Great frigatebirds undertake regular migrations across their range, including both seasonal trips and more infrequent widespread dispersals. They are likely most abundant within 50 mi. (80 km) of breeding and roosting sites (Clements 2000).

3.6.2.10.3 Population and Abundance

The world population of great frigatebirds is estimated to range between 500,000 and 1,000,000 birds and is comprised of five recognized distinct subspecies (U.S. Fish and Wildlife Service 2005). Great frigatebirds that breed in the western and central Pacific belong to the subspecies *F. m. palmerstoni* (U.S. Fish and Wildlife Service 2005). Most of this Pacific population is located in the Northwestern Hawaiian Islands, which supports an estimated 10,000 pairs (Lusk et al. 2000, Pratt et al. 1987). Niihau supports an estimated 3,500–4,500 pairs, and Layson Atoll supports 2,000–2,500 pairs. Other islands in the Pacific that support small colonies include Howland, Baker, Jarvis, Johnston Atoll, and Christmas Island (U.S. Fish and Wildlife Service 2005, Reichel 1991, Schreiber and Schreiber 1988). In the Marianas, two small colonies have also been reported on Maug and FDM (U.S. Fish and Wildlife Service 2005, Schreiber and Schreiber 1988).

The last record of great frigatebird nesting on FDM was reported in the mid-1990s. In November 1996, personnel from the USFWS and Brigham Young University (Hawaii) discovered a breeding colony on FDM estimated at 25 birds, including several juveniles roosting with the main colony or flying near shore. Nests were constructed in low trees 5–6.5 ft. (1.5–2 m) off the ground (Lusk et al. 2000). Since 1997, Navy biologists have conducted periodic aerial surveys by helicopter over FDM for the purpose of conducting bird counts of nesting brown, masked, and red-footed boobies. Other species of concern, such as the great frigatebird, are noted during these surveys. These surveys suggest that great frigatebird sightings are seasonally dependent, with most sightings reported between December and March, which coincides with their nesting seasons (U.S. Department of the Navy 2013b).

3.6.2.10.4 Predator-Prey Interactions

Great frigatebirds usually feed in mixed-species flocks over tuna schools, with a diet consisting primarily of flying fish and squid, which must be captured at or above the water surface. They do not rest on the water or plunge dive in pursuit of prey. There have been many reports of kleptoparasitism (a form of feeding in which one animal takes prey or other food from another) (Harrison 1983, Pratt et al. 1987).

3.6.2.10.5 Species-Specific Threats

The USFWS Seabird Conservation Plan (U.S. Fish and Wildlife Service 2005) lists habitat destruction, disturbance, and introduced predators to limit populations. The most important factor appears to be introduced predators, such as rats and feral cats, which have had devastating effects on island populations. For example, Polynesian rats have caused total nest failures on Kure Atoll (Harrison 1990). The eradication of feral cats from Howland, Baker, and Jarvis islands has resulted in a rebound in great frigatebird populations (Rauzon et al. 2002).

3.6.2.11 Masked Booby (*Sula dactylatra*)

3.6.2.11.1 Status and Management

The masked booby (*Sula dactylatra*) is protected under the MBTA and provisions set forth in 50 C.F.R. Part 21. The masked booby breeds on FDM. This breeding colony is reported as the largest breeding colony in Mariana Islands (Lusk et al. 2000). Masked booby population trends are measured during quarterly aerial bird counts at FDM by Navy biologists (U.S. Department of the Navy 2013b).

3.6.2.11.2 Habitat and Geography

Masked boobies breed on oceanic islands and atolls, tending to nest on open ground near cliff edges or on low sandy beaches. They have a pantropical distribution, and the largest colonies in the Pacific include Howland, Baker, and Jarvis islands, as well as locations in the Northwestern Hawaiian Islands (U.S. Fish and Wildlife Service 2005). Masked boobies forage in offshore and pelagic waters, and are most abundant in the vicinity of breeding islands; however, they can be encountered far out at sea. During nonbreeding periods, adults may visit sites 600–1,200 mi. (1,000–2,000 km) from breeding colonies (O'Brien and Davies 1990).

3.6.2.11.3 Population and Abundance

The world population is distributed widely and difficult to estimate, but is thought to be several hundred thousand birds and comprised of four recognized distinct subspecies (U.S. Fish and Wildlife Service 2005). Masked boobies that breed in the central and western Pacific belong to the distinct subspecies *S. d. personata*. The Northwestern Hawaiian Islands supports up to 2,500 pairs. Large colonies are also found on Jarvis (up to 1,200 pairs), Howland Island (over 1,500 pairs), and Baker Island (over 1,500 pairs) (U.S. Fish and Wildlife Service 2005). Smaller colonies also occur in American Samoa, Palmyra, and Johnston Atoll. Wake Island was recolonized by a banded bird from Johnston Atoll (Rauzon et al. 2002). In 2005, 600 masked booby pairs were reported in the Mariana Islands (U.S. Fish and Wildlife Service 2005).

Figure 3.6-6 is a scatter plot of masked booby observations recorded during FDM helicopter-based surveys. The masked booby population on FDM has exhibited multi-year fluctuations, but has remained relatively stable since monitoring began in 1997 (U.S. Department of the Navy 2013b). The peaks and dips in counts over the years suggest an average population of approximately 100 masked boobies on FDM.

3.6.2.11.4 Predator-Prey Interactions

Masked boobies feed by plunge diving and can be found more than 100 mi. (160 km) from land. They forage by themselves or in mixed-species flocks associated with schooling tuna. Most of their diet is fish, with flying fish and jacks as the most important prey species. Squid also make up a small portion of the diet.

3.6.2.11.5 Species-Specific Threats

The USFWS Seabird Conservation Plan (U.S. Fish and Wildlife Service 2005) lists habitat destruction, invasive weeds, disturbance, and introduced predators as the major threats to masked booby populations. Encroachment of invasive weeds has made suitable habitat unusable for masked boobies (Harrison 1983). Introduced predators, such as rats and cats have negatively impacted populations. Rebounding populations of masked boobies at Howard and Baker has been attributed to successful cat eradication activities (Rauzon et al. 2002). Military use of FDM has likely killed masked boobies, but the population trend has remained relatively stable since monitoring began in 1997 (

Figure 3.6-6) (U.S. Department of the Navy 2013b).

3.6.2.12 Major Marine Bird Group Descriptions

For taxonomic purposes, individual bird species may be grouped together in families, which is the taxonomic classification that contains at least one genus. The families of seabirds, shorebirds, and other birds that use the marine environment that are known to occur within the Study Area are described below. The species within each family that have been observed at sea or on land within the Study Area are discussed under each family heading. Families are listed in taxonomic order. Taxonomic and nomenclatural changes have been updated through the 50th supplement to the American Ornithological Union's Check-list of North American Birds (7th ed.) (Chesser et al. 2009).

3.6.2.12.1 Cormorants, Frigatebirds, Gannets, and Boobies (Order Pelecaniformes)

3.6.2.12.1.1 Phalacrocoracidae (Cormorants)

Cormorants are medium-sized diving birds with long, hook-tipped bills (Pratt et al. 1987). Only one species of cormorant breeds in the tropical Pacific, the pelagic cormorant, (*Phalacrocorax pelagicus*), which breeds around North Pacific coasts from Taiwan to California (Pratt et al. 1987). The only cormorant species confirmed within the Study Area is the little pied cormorant (*Phalacrocorax melanoleucos*), which is considered a rare visitor to the CNMI. No records are associated with Navy lease lands in the CNMI, including FDM.

3.6.2.12.1.2 Fregatidae (Frigatebirds)

Members of the Fregatidae family are large seabirds, with iridescent black feathers, a wingspan up to 7.5 ft. (2.3 m) and deeply-forked tails. The males inflate red-colored throat pouches to attract females during the mating season. Frigatebirds are distributed globally in tropical oceans. These birds do not swim and cannot walk well, and cannot take off from a flat surface, needing a slope or drop-off (e.g., a cliff) to take off. Frigatebirds are able to stay aloft for more than a week, landing only to roost or breed on trees or cliffs (Lusk et al. 2000).

The great frigatebird is discussed in more detail in Section 3.6.2.10 (Great Frigatebird [*Fregata minor*]). The last record of nesting activity was reported in 1996 (Lusk et al. 2000). Great frigatebirds are occasionally observed during Navy aerial surveys, but no evidence of continued nesting has been reported. If frigatebirds nest on FDM, it is likely infrequent. Maug supports a small colony of great frigatebirds (U.S. Fish and Wildlife Service 2005). Unlike the great frigatebird, the lesser frigatebird (*Fregata arial*) does not breed within the Study Area, although Pratt et al. (1987) reports rare sightings of the lesser frigatebird on Tinian.

3.6.2.12.1.3 Sulidae (Gannets and Boobies)

Members of the seabird family Sulidae are medium to large coastal seabirds that plunge-dive for fish. Three species of booby are found within the Study Area. FDM is the location of the largest nesting colony for the brown booby in the Mariana and Caroline Islands. The masked booby (*Sula dactylatra*) breeds on FDM, while the red-footed booby (*Sula sula*) breeds on FDM and Rota (U.S. Department of the Navy 2013a). Monthly aerial surveys via helicopter by Navy biologists over FDM for bird counts show distinct oscillations in the booby populations on this island (U.S. Department of the Navy 2008). The period from 1999 to 2002 was a low period, followed by increasing numbers recorded from 2003 through 2005. Decreases in booby numbers continued from 2006 through 2007.

3.6.2.12.2 Tropicbirds (Order Phaethontiformes)

3.6.2.12.2.1 Phaethontidae (Tropicbirds)

Tropicbirds are seabirds with predominantly white plumage and elongated central tail feathers. Their bills are large, powerful and slightly decurved, and they have large heads and short, thick necks. The three species within this family have a different combination of black markings on the face, back, and wings, distinctive to each species. Two of the three species of tropicbirds are known to occur within the Study Area (Pratt et al. 1987).

The red-tailed tropicbird (*Phaethon rubricauda*) and the white-tailed tropicbird (*Phaethon lepturus*) are known to occur on Tinian and FDM, as well as in open waters of the Study Area (U.S. Department of the Navy 2007). The red-tailed tropicbird is the rarest of all tropicbird species, but is widely distributed with colonies on islands from Hawaii to Easter Island and Mauritius. The white-tailed tropicbird is the smallest of the three species within the Phaethontidae family. It occurs in the tropical Atlantic, western Pacific, and Indian Oceans. Breeding locations are recorded from Guam, Rota, Tinian, and FDM. Both species were observed during the Mariana Islands Sea Turtle and Cetacean Survey (U.S. Department of the Navy 2007).

3.6.2.12.3 Albatrosses, Petrels, Shearwaters, and Storm Petrels (Order Procellariiformes)

3.6.2.12.3.1 Diomedeidae (Albatrosses)

Albatrosses range widely in the southern hemisphere and the North Pacific, although occasional vagrants are recorded in the North Atlantic (Pratt et al. 1987). Albatrosses are among the largest of flying birds, and great albatrosses (*Diomede*a spp.) have the largest wingspan of any extant birds.

Albatrosses are highly efficient in the air, using dynamic soaring and slope soaring to cover great distances with little exertion. They feed on squid, fish, and krill by scavenging, surface seizing, or diving. Albatrosses are colonial, mostly nesting on remote oceanic islands, often with several species nesting together. Pair bonds between males and females form over several years with the use of 'ritualized dances,' and will last for the life of the pair. A breeding season can take over a year from laying to fledging, with a single egg laid in each breeding attempt (Pratt et al. 1987).

Both albatross species (black-footed albatross and short-tailed albatross) occurring within the Study Area are considered vagrant migrants, are rarely documented more than once per year, and range throughout the North Pacific (Pratt et al. 1987). Black-footed albatrosses may have nested in the Marianas in historic times, with the only evidence derived from skins and eggs collected on Agrihan in the late 1800s. There are also unconfirmed reports of nesting in the early 20th century on Uracas and Asunción, and they are generally thought of as extirpated breeders in the Mariana Islands (Reichel 1991). Both albatross species were observed at sea, however, during the 2007 Mariana Islands Sea Turtle and Cetacean Survey (U.S. Department of the Navy 2007).

The black-footed albatross nests colonially on isolated islands of the Northwestern Hawaiian Islands (such as Laysan and Midway), and the Japanese islands of Torishima, Bonin, and Senkaku. Their range at-sea varies during the seasons (straying farther from the breeding islands when the chicks are older), and they make use of great areas of the North Pacific, feeding from Alaska to California and Japan. The USFWS has initiated a status review to determine if listing the black-footed albatross under the ESA is warranted (Agreement on the Conservation of Albatrosses and Petrels 2012).

The short-tailed albatross breeds almost exclusively on Torishima and Minami-kojima in the Senkaku Islands. Recent nesting has been reported on Kure and Midway Atolls (Agreement on the Conservation of Albatrosses and Petrels 2012). The short-tailed albatross’ range overlaps with the black-footed covering most of the northwestern and northeastern Pacific Ocean. The world population of short-tailed albatrosses is currently estimated at 2,000 birds (U.S. Fish and Wildlife Service 2008b). The short-tailed albatross is described in more detail in the ESA-listed species discussion in Section 3.6.2.7.1 (Short-Tailed Albatross Status and Management) within this section.

3.6.2.12.3.2 Procellariidae (Shearwaters and Petrels)

Shearwaters and petrels are medium-sized, long-winged seabirds most common in temperate and cold waters. Shearwaters and petrels come to islands and coastal cliffs to breed, with some breeding locations in the tropics. They are nocturnal at the colonial breeding sites, preferring moonless nights to minimize predation. Outside of the breeding season, they are pelagic (found in open ocean waters) and most are long-distance migrants. Shearwaters and petrels feed on fish, squid, and similar oceanic food. Numbers of shearwaters and petrels have been reduced due to predation by introduced species to islands, such as rats and cats. Some loss of birds also occurs from entanglement in fishing gear (Reed et al. 1985). The general problem of light attraction is worldwide among the Procellariiformes; at least 21 species of this family are known to be attracted to man-made lights (Reed et al. 1985). Fledglings typically take first flight at night, homing in on reflected natural light from the ocean. Artificial light can attract these fledglings to lighted infrastructure, causing exhaustion and increasing the probability of collision with buildings, utility poles, illuminated windows, and other structures.

Most species of this family observed within the Study Area are considered visitors (Pratt et al. 1987, U.S. Department of the Navy 2007). Shearwaters and petrels do not breed on DoD-owned or leased lands within the Study Area. After cats and rats were removed from Managaha Island, an islet off Saipan's eastern coast, a breeding colony of wedge-tailed shearwaters was established (Brooke 2012). Shearwaters and petrels primarily utilize offshore and coastal waters for foraging and are typically concentrated along upwelling boundaries and other water mass convergence areas (Spear et al. 1995, U.S. Fish and Wildlife Service 2005). The Hawaiian petrel, observed during the 2007 Mariana Islands Sea Turtle and Cetacean Survey (U.S. Department of the Navy 2007), is protected under the ESA, and is described in more detail in the ESA-listed species discussion within this section.

3.6.2.12.4 Phalaropes, Plovers, Gulls, Noddies, Terns, Skua, and Jaegers (Order Charadriiformes)

3.6.2.12.4.1 Charadriidae (Plovers)

Members of the Charadriidae family include plovers, which are generally considered shorebirds. Plovers are distributed through open country worldwide, mostly in habitats near water. Plovers hunt by sight, rather than by feel as longer-billed shorebirds do. Their diet includes insects, worms, and other invertebrates, depending on habitat (Pratt et al. 1987).

Seven plovers are known to winter in or visit the Study Area. No plovers are known to breed within the Study Area, and only two species are considered winter migrants; the other five are visitors to the Study Area. The Pacific golden plover (*Pluvialis fulva*) is known to occur on all islands within the Study Area, including Guam, Rota, Tinian, and FDM. The breeding habitat of the Pacific golden plover is arctic tundra from northernmost Asia into western Alaska. It nests on the ground in dry, open areas. Winter grounds are spread throughout the Pacific Basin, and migration routes follow the Central Pacific Flyway to reach the Mariana Islands (Pratt et al. 1987). Pacific golden plovers were observed in the open ocean on the 2007 Mariana Islands Sea Turtle and Cetacean Survey cruise (U.S. Department of the Navy 2007), and during the winter months are known to frequent open areas of the Navy owned and leased lands on Guam and the CNMI, as well as Andersen Air Force Base.

3.6.2.12.4.2 Larinae (Gulls)

Gulls are not common in the tropical Pacific (Pratt et al. 1987), preferring shallow water habitats in temperate and polar climates along coasts and inland rivers and lakes. Gulls that are observed in the Mariana Islands are generally associated with rare visitations and winter migrations. The common black-headed gull (*Larus ridibundus*) and salty-backed gull (*Larus schistisagus*) are the only gull species observed within the Study Area, with observations on Guam and Tinian (Pratt et al. 1987). Harrison

(1983) and Sibley (2000) note that the occurrence of the common black-headed gull is associated with harbors and bays.

3.6.2.12.4.3 Haematopodidae (Oystercatchers)

Oystercatchers are large, stocky shorebirds with distinct patterns of black and white with bright red bills, and are generally associated with rare visitations in the tropical Pacific. One Eurasian oystercatcher (*Haematopus ostralegus*) was observed and photographed on Guam in 1980 and remained on the island for at least a year (Pratt et al. 1987).

3.6.2.12.4.4 Sternidae (Terns and Noddies)

Terns and noddies are seabirds in the family Sternidae with worldwide distribution (Pratt et al. 1987). A recent taxonomic revision now separates terns and noddies out of the gull family Laridae (van Tuinen et al. 2004). Terns generally are medium to large birds, typically with gray or white plumage, often with black markings on the head. They have longish bills and webbed feet. Terns and noddies are lighter bodied and more streamlined than gulls, with long tails and long narrow wings. Terns and noddies hunt fish by diving, often hovering first for a few moments before a dive.

Ten species of this family are known to occur within the Study Area as residents or rare visitors. The brown noddy and black noddy are known to nest at FDM (U.S. Department of the Navy 2007); the black noddy also nests on Aguiguan (Commonwealth of the Northern Mariana Islands Division of Fish and Wildife 2005, Kessler 2009). Both of these species were also observed in open waters during the Mariana Islands Sea Turtle and Cetacean Survey (U.S. Department of the Navy 2007). The brown noddy is a tropical seabird with a worldwide distribution, ranging from Hawaii to the Tuamotu Archipelago and Australia in the Pacific Ocean, from the Red Sea to the Seychelles and Australia in the Indian Ocean, and in the Caribbean to Tristan da Cunha in the Atlantic Ocean. The brown noddy is colonial, usually nesting on cliffs or in short trees or shrubs, and occasionally nests on the ground. The female lays a single egg each breeding season. The brown noddy breeds on FDM, Rota, and Guam (U.S. Department of the Navy 2013a). Orote Island on Guam supports a large brown noddy nesting colony (approximately 150 birds). Additional roosts for brown noddies are found on at least two small emergent rock islands off the north and south coast of Orote Peninsula (Lusk et al. 2000).

The black noddy is smaller than the brown noddy with darker plumage, a whiter cap, a longer, straighter beak and shorter tail. The black noddy nests consist of a level platform, often created in the branches of trees using dried leaves covered with bird droppings. One egg is laid each season, and nests are re-used in subsequent years. The black noddy is distributed worldwide in tropical and subtropical seas, with colonies widespread in the Pacific Ocean and more scattered across the Caribbean, central Atlantic and in the northeast Indian Ocean. At sea, it is usually seen close to its breeding colonies within 50 mi. (80.5 km) of shore. Birds return to colonies, or other islands, in order to roost at night. The black noddy nests on Aguiguan, a small island south of Tinian (Commonwealth of the Northern Mariana Islands Division of Fish and Wildife 2005).

The gray-backed tern (*Sterna lunata*) has not been observed on land within the Study Area; however, this species was observed in open water during the 2007 Mariana Islands Sea Turtle and Cetacean Survey (U.S. Department of the Navy 2007). The gray-backed tern breeds on islands of the tropical Pacific Ocean. At the northern end of its distribution it nests in the Northwestern Hawaiian Islands (with the largest population occurring on Lisianski Island) and two small islets off Oahu; in the east as far as the Tuamotu Islands, with other colonies occurring in the Society Islands, the Line Islands, Phoenix Islands, Mariana Islands, and American Samoa. There are unconfirmed reports of breeding as far south as Fiji, and as far east as Easter Island. Outside of the breeding season the species is partly migratory, with birds from the Hawaiian Islands flying south. It is thought that birds in other parts of the Pacific are also migratory and disperse as far as Papua New Guinea, the Philippines, and Easter Island (U.S. Fish and Wildlife Service 2005).

The sooty tern (*Sterna fuscata*) utilizes areas of the Navy Main Base and Fena Reservoir on Guam (GovGuam Department of Aquatic and Wildlife Resources 2006, U.S. Department of the Navy 2013a), and was observed in open waters during the Mariana Islands Sea Turtle and Cetacean Survey (U.S. Department of the Navy 2007). Sooty terns are known to visit FDM (U.S. Department of the Navy 2013a). This tern is migratory and dispersive, wintering more widely through the tropical oceans. Compared to other terns, the sooty tern is more characteristically marine. Sooty terns breed in colonies on rocky or coral islands. Nests are simple and consist of a ground scrape or hole in which one to three eggs are laid. Sooty terns feed by picking fish from the surface in marine environments, often in large flocks, and rarely come to land except to breed. This species can stay out at sea (either soaring or floating on the water) for 3 to 10 years (Pratt et al. 1987).

The white tern (*Gygis alba*) has been observed on Andersen Air Force Base, Navy Main Base and Fena Reservoir on Guam. This tern species has also been observed on Tinian and FDM, as well as open waters within the Study Area (U.S. Department of the Navy 2007, 2013a). White terns nest throughout the CNMI and are considered common. This tern ranges widely across the Pacific and Indian Oceans, and also nests on some Atlantic islands. White terns nest on coral islands, usually on trees with thin branches but also on rocky ledges and on man-made structures. The white tern breeds on Guam, Rota, Tinian, Saipan, and FDM (U.S. Fish and Wildlife Service 2011a, b).

3.6.2.12.4.5 Glareolidae (Pratincoles)

Members of the Glareolidae family differ from most other shorebirds in that these species typically feed in the air (most shorebirds forage on the ground). Only one species, the Oriental pratincole (*Glareola maldivarum*), is thought to occur within the Mariana Islands. Pratt et al. (1987) lists two "hypothetical" observations on Guam and Saipan; the Oriental pratincole would be considered a rare visitor to the islands.

3.6.2.12.4.6 Stercorariidae (Skuas and Jaegers)

Members of the seabird family Stercorariidae are ground nesters in temperate and arctic regions and are long-distance migrants (Pratt et al. 1987). Outside the breeding season they feed on fish, animal entrails, and carrion. Many are partial kleptoparasites, chasing gulls, terns and other seabirds to steal their catches. The larger species in this family also regularly kill and eat adult birds, up to the size of great black-backed gulls (the largest of all gulls). On the breeding grounds they commonly eat lemmings, and the eggs and young of other birds.

The three species of the family Stercorariidae that are known to occur within the Study Area include the long-tailed jaeger (*Stercorarius longicaudus*), the parasitic jaeger (*Stercorarius parasiticus*), and the pomarine jaeger (*Stercorarius pomarinus*). None are known to breed on islands within the Study Area, and no observations of these birds have been recorded on land in the Mariana Islands. The long-tailed jaeger breeds in the high Arctic of Eurasia and North America, with major populations in Russia, Alaska, and Canada and smaller populations around the rest of the Arctic. It is a migrant, wintering in the south Atlantic and Pacific. The parasitic jaeger breeds on coasts of Alaska, as well as coastal and inland tundra regions of northern Canada. This species is also found in Greenland, Iceland, Scandinavia, and northern Russia. In the Pacific, parasitic jaegers winter at sea from southern California to southern Chile and

Australia (U.S. Geological Survey 2008). The pomarine jaeger is mostly a pelagic species occasionally observed inland. A large jaeger, the species is heavyset, having a thick neck with broad-based wings and a wing span that can reach 48 inches (in.) (1.2 m) (U.S. Geological Survey 2008).

3.6.2.12.4.7 Scolopacidae (Sandpipers and Curlews)

The majority of species within the Scolopacidae family eat small invertebrates picked out of mud or soil substrates. Different lengths of bills enable different species to feed in the same habitat, particularly on the coast, without direct competition for food. Sandpipers generally are found on shores and in wetlands around the world, breeding on the Arctic tundra to more temperate areas. Curlews foraging habits are similar to sandpipers, but the species is characterized by a long specialized bill (Pratt et al. 1987).

Twenty-eight species within the Scolopacidae family have been recorded as either winter migrants or rare visitors to Guam, Rota, Saipan, Tinian, and FDM (Pratt et al. 1987, U.S. Department of the Navy 2007). The common sandpiper breeds across most of Europe and Asia, and nests on the ground near fresh water. After breeding season, sandpipers migrate to Africa, southern Asia, Indonesia, and Australia. The common sandpiper forages by sight on the ground or in shallow water, picking up small food items such as insects, crustaceans, and other invertebrates (Pratt et al. 1987). The far eastern curlew (*Numenius madagascariensis*) spends its breeding season in northeastern Asia, including Siberia to the Kamchatka Peninsula, as well as Mongolia. Its breeding habitat comprises marshy and swampy wetlands and lakeshores. Wintering habitat is mostly associated with coastal Australia; however, some migrate to South Korea, Thailand, and New Zealand, preferring estuaries, beaches, and salt marshes. The common sandpiper and the far-eastern curlew were observed during the 2007 Mariana Islands Sea Turtle and Cetacean Survey (U.S. Department of the Navy 2007); however, these birds have not been observed on islands within the Study Area. Birds within this family associated with FDM include the ruddy turnstone (*Arenaria interpes*), a winter migrant, wandering tattler, and whimbrel (*Numernius phaeopus*); the latter two are noted as rare visitors to FDM (Lusk et al. 2000).

3.6.2.12.4.8 Recurvirostridae (Avocets and Stilts)

Members of the Recurvirostridae family are long legged, slender wading birds with black and white contrasting plumage. There are no records of Avocets within the Mariana Islands; however, the black-winged stilt (*Himantopus himantopus*) is known to be a rare visitor to Guam (Pratt et al. 1987) and to Saipan (U.S. Department of the Navy 2013a). This species of stilt, like all stilts, have red or pink legs and straight thin bills.

3.6.2.12.5 Wading Birds, Such as Ducks, Herons, and Wigeons (Order Anseriformes)

3.6.2.12.5.1 Anatidae (Waterfowl Birds: Swans, Ducks, and Geese)

Members of family Anatidae are considered waterbirds with webbed feet and broad flat bills. With the exception of the Mariana mallard, the Anatidae species are considered rare visitors to the Study Area (Pratt et al. 1987), and most observations are associated with palustrine (fresh water) and brackish wetlands of Guam (e.g., Fena Reservoir) and Hagoi on Tinian. Surveys in 2012 for migratory birds at Hagoi reported two pintail ducks (*Anas acuta*) in February and four additional observations in March. The Mariana mallard was last observed in 1979 and is now considered extinct. Mallards are known to hybridize with other members of genus *Anas*, and the Mariana mallard was believed to be a stabilized hybrid population with both common mallard (*Anas platyrhynchos*) and gray duck (*Anas superciliosa*) ancestry (Pratt et al. 1987).

3.6.2.12.5.2 Ardeidae (Herons and Bitterns)

Birds in the Ardeidae family include herons and bitterns. Herons and bitterns resemble birds in some other families, such as storks, ibises, and spoonbills, but differ by flying with their necks retracted, not outstretched. The members of this family are mostly associated with brackish and freshwater wetlands, and prey on fish, amphibians, and other aquatic species. Some members of this group nest colonially in trees, while others, notably the bitterns, use reedbeds on the ground (Pratt et al. 1987).

The 12 members of the Ardeidae family within the Study Area are commonly associated with wetland areas on Guam and Hagoi on Tinian, with occasional sightings on Rota and FDM. Two members of this family (Pacific reef heron and yellow bittern) are known to breed on Guam and the CNMI, including FDM. These two species are considered resident species year round in the Mariana Islands. The yellow bittern has short, yellow legs, with a chin marked by a narrow white stripe. They have brown beaks, gold-yellow colored eyes and the surrounding areas of their faces are normally greenish-yellow. Breeding habitats are closely associated with reedbeds, which are extensively found at Hagoi (composed primarily of *Phragmites karka*), though the yellow bittern has also been observed by Navy biologists nesting in tangantangan (*Leucaena leucocephala*) trees on Guam, including urban landscaped environments with trees and bushes. Pacific reef herons predominantly feed on varieties of nearshore fish, crustaceans, and mollusks. The species nests year round in colonies in mesic wooded areas, including mangroves (U.S. Department of the Navy 2013a).

3.6.2.12.6 Birds of Prey (Order Accipitriformes)

3.6.2.12.6.1 Accipitridae (Eagles, Hawks, Owls, and Ospreys)

The only member of the Accipitridae family to occur in the Mariana Islands is the osprey (*Pandion haliaetus*). Pratt et al. (1987) noted "old observations" from Guam. Ospreys have been observed periodically, with rare records from Rota in 1999 and Guam in 2000. As the largest bird of prey to visit the Marianas, it is unlikely that this bird could visit the Study Area without observation. Therefore, although occurrences of ospreys are possible on Guam and throughout the islands within the CNMI, ospreys can only be considered extremely rare visitors to the Study Area (Wiles 2005). Other rare visitors include the black kite (*Milvus migrans*), gray-faced buzzard (*Butastur indicus*), Chinese goshawk, European hobby, and short-eared owl.

3.6.2.12.6.2 Falconidae (Falcons)

Members of the Falconidae family are small-to medium-sized birds of prey with characteristically pointed wings and long tapering tails. Falcons are diurnal hunters and kill prey with their beaks. Of the 62 species of falcons, only two have been observed within the Mariana Islands (Vice and Vice 2004, Wiles et al. 2000, Wiles 2005). A peregrine falcon was observed in January 2000 at the Guam International Airport (GovGuam Department of Aquatic and Wildlife Resources 2006), and this species in general is believed to be a rare visitor to Guam. A Eurasian kestrel (*Falco tinnunculus*) was observed in December 2000 and January 2001 at the Guam International Airport feeding on Eurasian tree-sparrows (*Passer montainus*) and chasing other birds. Although falcons are not considered seabirds or shorebirds, these two species are generally associated with coastal habitats and feeds mostly on birds, particularly birds associated with marine or freshwater habitats (Wiles 2005, Pratt et al. 1987).

3.6.3 Environmental Consequences

This section presents the analysis of potential impacts on marine birds from implementation of the project alternatives, including the No Action Alternative, Alternative 1, and Alternative 2. Navy training and testing activities are evaluated for their potential impact on marine birds as groups of species characterized by distribution, body type, or behavior relevant to the stressor being evaluated. Activities are evaluated for their potential impact on all marine birds in general. In addition, specific analyses are provided for the three birds in the Study Area listed as endangered or threatened under the ESA and on two birds with important associations with FDM. As described in Section 3.6.2 (Affected Environment), birds are not distributed uniformly throughout the Study Area, but are closely associated with a variety of habitats, with coastal birds and shorebirds concentrated along nearshore habitats and seabirds with patchy (uneven) distributions in offshore and open ocean areas.

The alternatives for training and testing activities were examined to determine if the Proposed Action would produce one or more of the following impacts:

- A direct or indirect impact on marine birds or marine bird populations from mortality attributed to military training and testing activities taking place within the Study Area.
- A direct or indirect impact on marine bird populations from destruction or disturbance of foraging habitat attributed to military training and testing activities taking place within the Study Area.
- A direct or indirect impact on seabird populations from destruction or disturbance of seabird breeding colonies, foraging areas, or roosting areas attributed to military training and testing activities taking place within the Study Area. The only marine birds that breed within the study area are certain species of seabirds.

The consequences of the proposed military readiness activities on non-federally listed migratory seabirds, shorebirds, or other birds that use the marine environment or on modification of their habitat are evaluated based on the criteria described in the Final Rule authorizing DoD to incidentally take migratory seabirds during military readiness activities (50 C.F.R. Part 21, 28 February 2007), which states that military readiness activities are authorized to take migratory birds provided they do not result in a significant adverse effect on a population of a migratory seabird species. Section 3.6.1.2 (Migratory Bird Treaty Act Species and 50 Code of Federal Regulations Part 21.15 Requirements) discusses this regulatory framework in more detail.

General characteristics of all Navy stressors were introduced in Section 3.0.5.3 (Identification of Stressors for Analysis), and general susceptibilities of living resources to stressors were introduced in Section 3.0.5 (Overall Approach to Analysis). Stressors vary in intensity, frequency, duration, and location within the Study Area. Certain activities take place in specific locations or depth zones within the Study Area (see Section 3.0.5, Overall Approach to Analysis), outside of the range or foraging abilities of birds. Therefore, seafloor device strike, cable and wire entanglement, parachute entanglement, and ingestion of munitions were not carried forward in this analysis for birds.

The stressors applicable to seabirds and shorebirds vary in intensity, frequency, duration, and location within the Study Area. The stressors applicable to marine birds in the Study Area and analyzed below include the following:

- Acoustic (sonar and other active acoustic sources; explosives; swimmer defense airguns; weapons firing, launch, and impact noise; vessel noise; and aircraft noise)
- Energy (electromagnetic devices)
- Physical disturbance and strike (aircraft and aerial targets, vessels, in-water devices, military expended materials, ground disturbance, and wildfires)
- Ingestion (munitions and military expended materials other than munitions)

- Secondary (impacts associated with sediments, water quality, and air quality)

The specific analysis of the training and testing activities presented in this section considers the relevant components and associated data within the geographic location of the activity and the resource (see Tables 2.8-1 and 2.8-4).

3.6.3.1 Acoustic Stressors

This section evaluates the potential for acoustic stressors to impact birds during training and testing activities in the Study Area. These stressors are associated with sonar and other active acoustic sources; explosives; weapons firing, launch, and impact noise; aircraft noise; and vessel noise. Categories of potential impacts from exposure to explosions and sound are direct trauma, hearing loss, auditory masking, behavioral reactions, and physiological stress. Potential negative nonphysiological consequences to birds from acoustic and explosive stressors include disturbance of foraging, roosting, or breeding; degradation of foraging habitat; and degradation of seabird breeding colonies.

If a seabird is close to an intense noise source, it could suffer auditory fatigue. Auditory fatigue manifests itself as hearing sensitivity loss over a portion of hearing range, called a noise-induced threshold shift. A threshold shift may be either permanent threshold shift (PTS) or temporary threshold shift (TTS). Studies have examined hearing loss and recovery in only a few species of birds, and none studied hearing loss in seabirds (e.g., Hashino et al. 1988; Ryals et al. 1999; Ryals et al. 1995; Saunders and Dooling 1974). A bird may experience PTS if exposed to a continuous sound over 110 A-weighted decibels (dBA) re 20 µPa sound pressure level in air or blast noise over 140 dB re 20 µPa sound pressure level in air (Dooling and Therrien 2012). Unlike other species, birds have the ability to regenerate hair cells in the ear, usually resulting in considerable anatomical, physiological, and behavioral recovery within several weeks. Still, intense exposures are not always fully recoverable, even 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 noise exposures by regulating inner ear pressure, an ability that may protect ears while in flight (Ryals et al. 1999). Diving birds have adaptations to protect the middle ear and tympanum from pressure changes during diving that may affect hearing (Dooling and Therrien 2012). Auditory fatigue can impair an animal'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; or predators.

Numerous studies have documented that birds respond to anthropogenic noise, including aircraft overflights, weapons firing, and explosives (Larkin et al. 1996; National Park Service 1994; Plumpton et al. 2006). Studies generally indicate that birds hear in-air sounds over a very limited range between 1 and 5 kHz, but specific species hearing can extend to higher and lower frequencies (Beason 2004). The manner in which birds respond to noise depends on several factors, including life-history characteristics of the species, characteristics of the noise source, loudness, onset rate, distance from the noise source, presence or absence of associated visual stimuli, and previous exposure (Larkin et al. 1996; National Park Service 1994; Plumpton et al. 2006). Researchers have documented a variety of behavioral responses of birds to noise, such as alert behavior, startle response, flying or swimming away, diving into the water, and increased vocalizations. While they are difficult to measure in the field, some of these 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).

Chronic stress due to disturbance may compromise the general health and reproductive success of birds, but a physiological stress response does not necessarily indicate negative consequences to individual birds or to populations (Larkin et al. 1996; National Parks 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, increased blood pressure, or changes in available glucose and blood levels of corticosteroids (Manci et al. 1988). It is possible that individuals would return to normal almost immediately after exposure, and the individual's metabolism and energy budget would not be affected in the long term. Studies also have shown that birds can become habituated to noise following frequent exposure and cease to respond behaviorally to the noise (Larkin et al. 1996; National Park Service 1994; Plumpton et al. 2006). However, the likelihood of habituation depends on many factors, including species of bird (Bowles et al. 1991) and frequency of and proximity to exposure. Raptors have been shown to shift their terrestrial home range when concentrated military training activity was introduced to the area (Andersen et al. 1990). 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).

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 and Temple 1986). Chronic stress due to disturbance can compromise the general health of birds, but stress is not necessarily indicative of negative consequences to individual birds or to populations (Larkin et al. 1996, National Parks Service 1994). For example, the reported behavioral and physiological responses of birds to noise exposure are within the range of normal adaptive responses to external stimuli, such as predation, that birds face on a regular basis. Unless repeatedly exposed to loud noises or simultaneously exposed to multiple stressors, it is possible that individuals would return to normal almost immediately after exposure, and the individual's metabolism and energy budget would not be affected. 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 Parks Service 1994, Plumpton et al. 2006). Little is known about physiological stress responses of birds that have habituated to noise.

The types of seabirds exposed to sound-producing activities or explosive detonations depend on where training and testing activities occur relative to the coast. Seabirds can be divided into three groups based on breeding and foraging habitat: (1) those species such as albatrosses, petrels, frigatebirds, tropicbirds, boobies, noddies and some terns that forage over the ocean and nest on oceanic islands; (2) species such as pelicans, cormorants, and some terns that nest along the coast and forage in nearshore areas; and (3) those few species such as skuas, jaegers, and several tern species that nest and forage in inland habitats and come to the coastal areas during nonbreeding seasons (Schreiber and Burger 2002).

The area from the beach to about 10 nm offshore provides foraging areas for breeding terns, skimmers, and pelicans; a migration corridor and winter habitat for terns, cormorants, and boobies; and supports nonbreeding and transient pelagic seabirds. Offshore pelagic waters support nonbreeding and transient pelagic seabirds, boobies, and several tern species (Davis et al. 2000, Hunter et al. 2006). Pelagic seabirds are generally widely distributed, but they tend to congregate in areas of higher productivity and prey availability (Haney 1986). Such areas in the Marianas are expected around upwellings and current convergences, which concentrate nutrients to attract seabird prey species.

Birds transiting an area could be exposed to sounds from sources near the water surface or from airborne sources. While foraging birds will be present near the water surface, transiting birds may fly at various altitudes. 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 so high that they are barely visible through binoculars (Lincoln et al. 1998).

Seabirds use a variety of foraging behaviors that could expose them to underwater sound. Most seabirds plunge-dive from the air into the water or perform aerial dipping (the act of taking food from the water surface in flight); others surface-dip (swimming and then dipping to pick up items below the surface) or jump-plunge (swimming, then jumping upward and diving under water). Birds that feed at the surface by surface or aerial dipping with limited to no underwater exposure include petrels, jaegers, and phalaropes. Birds that plunge dive typically submerge for no more than a few seconds, and any exposure to underwater sound would be very brief and occur during rapid pressure changes and proliferation of air bubbles, which would limit exposure time while submerged. Birds that plunge-dive include albatrosses, most tern species, masked boobies, shearwaters, and tropicbirds. Other birds pursue prey under the surface, swimming deeper and staying underwater longer than other plunge-divers. Birds that exhibit this foraging behavior include cormorants, petrels, and shearwaters. Some of these birds may stay underwater for up to several minutes and reach depths between 50 ft. (15 m) and 550 ft. (168 m) (Alderfer 2003, Durant et al. 2003, Jones 2001, Lin 2002, Ronconi 2001). Birds that forage near the surface would be exposed to underwater sound for shorter periods of time, and some exposures may be reduced by phase cancellation near the surface (see Section 3.0.4, Acoustic and Explosives Primer). Sounds generated under water during training and testing would be more likely to impact birds that pursue prey under the surface, although as previously stated, little is known about seabird hearing ability underwater. Birds that forage in the open ocean often forage more actively at night, when prey species are more likely to be near the surface and naval training and testing is more limited.

3.6.3.1.1 Impacts from Sonar and Other Active Acoustic Sources

Sonar and other underwater active non-impulse acoustic sources could be used throughout the Study Area. Information regarding the impacts from sonar on seabirds and the ability for seabirds to hear underwater is virtually unknown. The exposure to these sounds by seabirds, other than pursuit diving species, is likely to be very limited due to spending a very short time under water (plunge-diving or surface-dipping) or foraging only at the water surface. In addition, acoustic effects near the water's surface may reduce potential sound exposure of shallow diving birds. Pursuit divers may remain under water for minutes, increasing the chance of underwater sound exposure.

Assuming that a bird disturbed by an underwater sound is likely to react to the stressor by swimming to the surface, a physiological impact, such as hearing loss, would likely occur if a bird is close to an intense sound source. In general, birds are less susceptible to both TTS and PTS than mammals (Saunders and Dooling 1974), so an underwater sound exposure would have to be intense and of a sufficient duration to cause TTS or PTS. Returning to the surface would limit extended or multiple sound exposures underwater; however, foraging and hunting behaviors could be interrupted. There have been no studies documenting diving seabirds' reactions to sonar.

If seabirds that forage underwater are attracted to the presence of a ship equipped with and using active acoustic sources, the diving seabirds could be exposed to underwater sound. Some birds commonly follow vessels for increased potential of foraging success as the propeller wake brings prey to the surface (Hyrenbach 2001, 2006; Melvin et al. 2001). Based on opportunistic foraging by seabirds in wakes of moving ships, any noise generated behind ships does not preclude feeding behaviors. Further, most hull-mounted sonars do not project sound aft of ships, 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 it is expected that they would not be impacted by high frequency sources such as those used in mine warfare. As stated in Section 3.6.2.3 (Bird Hearing), the few hearing studies on birds suggests that greatest hearing sensitivity for birds is between 1 and 4 kHz, with an upper limit of 15 kHz, and a lower limit of 20 Hz. The greatest hearing sensitivity of birds would be within the lower portion of the mid-frequency sonar active sonar system frequency range (1–10 kHz). See Section 2.3.1.1 (What is Sonar?) for a general discussion of sonar.

3.6.3.1.1.1 No Action Alternative

Training Activities

Training activities under the No Action Alternative include activities that produce non-impulse underwater sound from the use of sonar and other active acoustic sources. These activities could occur throughout the Study Area. The number of activities and their proposed locations are presented in Table 2.8-1 of Chapter 2 (Description of Proposed Action and Alternatives). Use of sonar and other active acoustic sources during training activities is discussed in Section 3.0.4 (Acoustic and Explosives Primer). Table 3.0-8 provides a summary of active acoustic hours for each source class category.

Diving birds would be more likely to be exposed to underwater sound in foraging areas. These foraging areas are expected to co-occur with upwellings, which bring nutrients upward through the water column attracting seabird prey species. Therefore, seabirds are more likely to be exposed to underwater sound pressure where sonar overlaps open ocean areas that provide conditions for optimal foraging. Sonar and other active acoustic sources would not be regularly used in near-shore areas that could be used by foraging shorebirds, except during maintenance and for navigation in areas around Naval Base Guam Apra Harbor.

Exposures to acoustic sources sufficiently intense (i.e., of a certain duration or within close proximity) to cause physiological impacts are unlikely. Diving birds may not respond to an underwater sound or may not have the hearing range to detect some sources. However, it is likely that few seabirds would be affected by sonar and other underwater active acoustic sources because sources are used intermittently during a training activity, training activities are dispersed in space and time, and seabirds spend a portion of their time submerged. If a diving seabird does react to an underwater sound source, it is expected to result in a short-term behavioral response, such as a startle or surfacing; and surfacing would eliminate further exposures. Due to the limited duration of training activities and widespread availability of foraging habitat, any sound exposures would be minimal and would not permanently displace an animal from a foraging area. Occasional short-term, behavioral impacts, if they occur, are not expected to result in substantial changes to behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness) to most individuals; therefore, population-level impacts are not expected.

Short-tailed albatrosses are rare vagrant migrants that forage in offshore, open ocean waters. Short-tailed albatross remain one of the world's most endangered birds (U.S. Fish and Wildlife Service 2005). Considering the rarity of this species in general and the lack of frequent sightings, chances for its potential interactions with training activities within the Study Area would be extremely low. Birds of this family follow wakes of ships, especially vessels associated with fishing activities (smells attract the birds). Following of ships by seabirds is also believed to increase when the ships dispose of food waste. Pursuant with the Office of the Chief of Naval Operations Instruction 5090.1D, Navy ships are permitted to discharge food waste at sea, but only greater than 3 nm offshore. There are further restrictions on the discharge of food waste for submarines, such as ensuring that food waste does not reach the surface. The spatial and temporal variability of both the occurrence of a short-tailed albatross and the training activities conducted within offshore locations near foraging areas presents a negligible chance that a direct or indirect impact would occur to this species because of training activities that use non-impulse sound sources.

Hawaiian petrels are also rare migrants that forage in offshore open ocean waters. Petrels forage near the sea surface, and can range 930 mi. (1,500 km) from the Hawaiian Islands; however, the range shrinks for part of the year to surround the Hawaiian Islands, primarily during the breeding season from March through October. There have been no observations of Hawaiian petrels at FDM, and other species of the Procellerridae family have not been observed on or around the island. The described training activities would present no measurable chance for interaction with this species. Considering the rarity of this species and the lack of frequent sightings within the MITT Study Area, chances for its potential interactions with training exercises would be extremely low. The probability of direct or indirect impacts on individuals or populations remains low. The spatial and temporal variability of both the occurrence of a Hawaiian petrel and the training activities conducted within offshore locations near foraging areas presents a negligible chance of direct or indirect impact on this species.

Newell's shearwaters are also rare migrants that forage in offshore open ocean waters. Petrels forage near the sea surface, and can range 1,500 mi. (2,414 km) from the Hawaiian Islands, which overlaps with the MITT Study Area; however, the range shrinks for part of the year to surround the Hawaiian Islands during breeding season (April through November). Considering the rarity of this species and the lack of frequent sightings within the MITT Study Area, chances for its potential interactions with training exercises would be extremely low. The probability of direct impacts on individuals or populations remains low. The spatial and temporal variability of both the occurrence of a Newell's shearwater and the training activities conducted within offshore locations near foraging areas presents a negligible chance of direct or indirect impact on this species.

Masked boobies are expected to forage in pelagic waters that may co-occur with Navy training activities that use sonar and other active acoustic sources. A plunge diver, this species may be found in waters greater than 100 mi. (161 km) from land. A submerged masked booby has a very limited exposure time to underwater sound. Based on the available literature for hearing abilities of seabirds while under water, masked boobies are not expected to hear very well under water. Further, exposure to underwater sound would only occur under rapid pressure changes, reducing the actual exposure time to sound. It is unlikely that active acoustic sources used in training activities would disrupt foraging activities of masked boobies. Because of the decreased importance of sound cues for seabirds under water to locate prey, brief exposure time, dispersed locations of Navy training activities, and the availability of pelagic foraging habitats for masked boobies, there would be no adverse population level effects on this species associated with sonar and other active acoustic sources.

Great frigatebirds are also expected to forage in pelagic waters that co-occur with Navy training activities that use sonar and other active acoustic sources. The great frigatebird, however, does not plunge dive and feeds by capturing prey species (primarily fish and squid) at or above the water surface. Therefore, the great frigatebird would not typically be exposed to underwater sound, and the use of sonar and other active acoustic sources would have no adverse population-level effects.

Pursuant to the ESA, the use of sonar and other active acoustic sources during training activities under the No Action Alternative would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the impacts from sonar and other active acoustic sources during training activities described under the No Action Alternative would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

Testing Activities

Testing activities potentially using non-impulse acoustic sources under the No Action Alternative is restricted to the North Pacific Acoustic Lab Philippine Sea Experiment (Table 2.8-4). Research vessels, acoustic test sources, side scan sonar, ocean gliders, the existing moored acoustic topographic array and distributed vertical line array, and other oceanographic data collection equipment will be used to collect information on the ocean environment and sound propagation. Currently, the array is being used to passively collect oceanographic and acoustic data in the region.

Exposure to seabirds would only occur if a seabird was diving under water at sufficient depths and in sufficient proximity to the sound source. The likelihood of exposure is very small because of the intermittent acoustic exposures in this limited area, and the limited time a seabird would spend under the surface. Because most impacts would be short-term, potential impacts are not expected to result in substantial changes to foraging activity by diving seabirds and would not adversely impact populations of diving seabirds.

Pursuant to the ESA, the use of sonar and other active acoustic sources during testing activities under the No Action Alternative would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the impacts from sonar and other active acoustic sources during testing activities described under the No Action Alternative would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

3.6.3.1.1.2 Alternative 1

Training Activities

The number of annual training activities that produce in-water sound from the use of sonar and other active acoustic sources during training under Alternative 1 would increase compared to the No Action Alternative, plus new sources would be used with the introduction of the Littoral Combat Ship. Use of sonar and other active acoustic sources during training activities is discussed in Section 3.0.4 (Acoustic and Explosives Primer).

Based on the increased activities under Alternative 1 versus the No Action Alternative, there is an increased probability of more seabirds exposed while underwater to underwater sound generated from sonar and other active acoustic sources. Although the quantity of underwater acoustic stressors would increase, any impacts on seabirds would likely be limited to short-term behavioral reactions by diving seabirds as described under the No Action Alternative. Due to the reasons described in Section 3.6.3.1.1.1 (No Action Alternative), any sound exposures would be minimal and are unlikely to have a long-term impact on an individual or a population.

Pursuant to the ESA, the use of sonar and other active acoustic sources during training activities under Alternative 1 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the impacts from sonar and other active acoustic sources during training activities described under Alternative 1 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

Testing Activities

Testing activities under Alternative 1 that produce in-water sound from the use of sonar and other active non-impulse acoustic sources that fall within the hearing range of birds would increase compared to the No Action Alternative. The number of activities and their proposed locations are presented in Tables 2.8-2 and 2.8-4 of Chapter 2 (Description of Proposed Action and Alternatives). Use of sonar and other active acoustic sources is discussed in Section 3.0.4 (Acoustic and Explosives Primer).

Based on the increased activities under Alternative 1 versus the No Action Alternative and the additional testing locations, there is an increased probability of more seabirds exposed while underwater to underwater sound generated from sonar and other active acoustic sources. Although the quantity of underwater acoustic stressors would increase, any impacts on seabirds would likely be limited to short-term behavioral reactions by diving seabirds, as described under the No Action Alternative for training. Due to the reasons described in Section 3.6.3.1.1.1 (No Action Alternative), any sound exposures would be minimal and are unlikely to have a long-term impact on an individual or a population.

Pursuant to the ESA, the use of sonar and other active acoustic sources during testing activities under Alternative 1 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the impacts from sonar and other active acoustic sources during testing activities described under Alternative 1 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

3.6.3.1.1.3 Alternative 2

Training Activities

The number and location of training activities under Alternative 2 are identical to training activities under Alternative 1. Therefore, impacts and comparisons to the No Action Alternative would also be identical to those described in Section 3.6.3.1.1.3 (Alternative 2).

Pursuant to the ESA, the use of sonar and other active acoustic sources during training activities under Alternative 2 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the impacts from sonar and other active acoustic sources during training activities described under Alternative 2 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

Testing Activities

Section 3.0.4 (Acoustic and Explosives Primer) describes the use of sonar and other underwater active acoustic sources during testing activities under Alternative 2. Use of sonar and other active acoustic sources would increase under Alternative 2 versus the No Action Alternative. The proposed testing activities would also increase over Alternative 1 by approximately 10 percent. Sonar and other active acoustic sources would be used in waters throughout the MITT Study Area, in the same locations described under Alternative 1. Although the quantity of underwater acoustic stressors would increase, any impacts on seabirds would likely be limited to short-term behavioral reactions by diving seabirds, as described under the No Action Alternative. Due to the reasons described in Section 3.6.3.1.1.1 (No Action Alternative), any sound exposures would be minimal and are unlikely to have a long-term impact on an individual or a population.

Pursuant to the ESA, the use of sonar and other active acoustic sources during testing activities under Alternative 2 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the impacts from sonar and other active acoustic sources during testing activities described under Alternative 2 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

3.6.3.1.2 Impacts from Explosives and Swimmer Defense Airguns

The potential for birds to be exposed to explosions depends on several factors, including the presence of birds at, beneath, or above the water surface near the detonation; location of the detonation at, below, or above the water surface; size of the explosive; and distance from the detonation. Explosions are associated with detonations of explosive missiles and projectiles in air; explosive grenades, bombs, missiles, rockets, and projectiles at or near the sea surface; mine neutralization charges on the bottom and in the water column; explosive torpedoes near the surface and in the water column; explosive sonobuoys in the water column; other small charges used at various depths during testing; and explosive munitions dropped on land at FDM, such as bombs, missiles, rockets, and projectiles. Section 3.0.4 (Acoustic and Explosives Primer) describes the shock waves and acoustic waves imparted to a surrounding medium by an explosive detonation and how these waves propagate. Because airguns are an impulsive source, with the potential for similar non-traumatic impacts as explosives, they are considered in this section.

3.6.3.1.2.1 Underwater Explosives

Detonations near the water surface or underwater could impact diving birds and birds on the water surface. A seabird close to an explosive detonation could be killed or injured. Blast injuries are usually most evident in the gas-containing organs, such as those of the respiratory and gastrointestinal systems. Blasts can also damage pressure-sensitive components of the auditory system. Most detonations of explosive projectiles near the water surface would release a large portion of the explosive energy into the air.

Detonations that occur underwater, such as explosive ordnance demolition activities, could injure, kill, or disturb diving birds, particularly pursuit divers that spend more time underwater than other foraging birds (Danil and St. Ledger 2011). Studies show that birds are more susceptible to underwater explosions when they are submerged versus on the surface (Yelverton et al. 1973). Detonations are estimated to have lethal impacts on seabirds in water if the impulse exceeds 36 pounds (lb.) (16.3 kilograms [kg]) per square inch (psi)-milliseconds (msec) (psi-msec) (248 Pascal [Pa]-second [sec]) for birds underwater and 100 psi-msec (690 Pa-sec) just below the water surface for birds at the water surface (Yelverton et al. 1973). These impulse levels correspond to the level at which 1 percent of animals would not be expected to survive. Exposures to higher impulse levels would have greater likelihoods of mortality. No injuries would be expected for birds underwater at blast pressures below 6 psi-msec (41 Pa-sec) and for birds on the surface at blast pressures below 30 psi-msec (207 Pa-sec) (Yelverton et al. 1973). Actual ranges to impacts would be based on several factors, including charge size, depth of the detonation, and how far the bird is beneath the water surface. Due to surface image interference (see Section 3.0.4, Acoustic and Explosives Primer), peak pressures due to underwater explosions may be substantially reduced near the surface, reducing potential for injury to birds on the surface and shallow-diving birds.

Because of the differences in acoustic transmission in water and in air, an effect called the Lloyd mirror reflects underwater sound at the water surface so that it does not pass into the air (see Section 3.0.4, Acoustic and Explosives Primer). Sounds generated by most small underwater explosives and airguns, therefore, are unlikely to disturb seabirds above the water surface. If a detonation is sufficiently large or is near the water surface, however, pressure will be released at the air-water interface. Birds above this pressure release could be injured or killed. Cavitation zones near the surface can also disturb or injure birds at or near the surface (see Section 3.0.4, Acoustic and Explosives Primer).

3.6.3.1.2.2 Explosions On Land and In-Air

Explosives detonated at or just above the water surface, such as those used in anti-surface warfare, would create blast waves and acoustic waves that would propagate through both the water and air. The pressure waves could injure or kill birds while either in flight or at the water surface. Experiments that exposed birds to blast waves in air provided a relationship between charge size, distance from detonation, and likelihood of bird injury or mortality (Damon et al. 1974). Table 3.6-6 shows the safe distance from a detonation in air beyond which no injuries to birds would be expected for a representative list of ordnance.

Table 3.6-6: Range to No Injury from Detonations in Air for Birds

Sample Ordnance	Net Explosive Weight	Range to No Injury
76 mm round	0.6–2 lb.	22 ft. (7 m)[1]
5 in. projectiles	6–10 lb.	32 ft. (10 m)[1]
Rolling Airframe Anti-Air Missile	21–60 lb.	70 ft. (21 m)[1]
MK 84	1,000 lb.	900 ft. (274 m)[2]

[1] Damon et al. 1974
[2] U.S. Department of Defense 2004a
Notes: ft. = feet, in. = inches, lb. = pound(s), m = meters, mm = millimeters

Detonations on land at FDM would create blast waves and acoustic waves in air and also transmitted through the ground. Studies focusing on responses of birds on land to explosive noise have shown varied reactions ranging from no response to behavioral (e.g., flushing, cessation of foraging) and physiological responses (e.g., increased heart and respiration rates). Red-cockaded woodpeckers (*Picoides borealis*) successfully raised young near an active bombing range in Mississippi; while other birds at other sites did not. Oahu elepaio (*Chasiempis sandwichensis ibidis*) did not respond in statistically significant or biologically meaningful ways to noise generated by training with 155- and 105-millimeter (mm) howitzers, 60 and 81 mm mortars, hand grenades, and demolition of unexploded ordnance (VanderWerf 2000). Prairie falcons (*Falco mexicanus*) responded to blasts from ongoing civilian construction where the nests sites were not normally exposed to blasting; however, one northern harrier (*Circus cyaneus*) appeared to preferentially hunt near a location where 24 lb. (10.9 kg) bombing occurred. Anecdotal observations indicate the burrowing owl (*Athene cunculariajloridana*) persists at Eglin Air Force Base on a bombing range where a variety of inert ordnance (rockets, missiles, and bombs, including a 21,700 lb. [9,842.9 kg] massive ordnance air blast bomb) has been used over the last 24 years (U.S. Fish and Wildlife Service 2010).

Behavioral responses (startle response, alert or alarm response, and flushing) to noise are often examined as these response actions result in: birds expending excess energy that is not directed towards reproduction; nest exposure increasing the risk of predation, nest cooling or nest heating which can result in egg and juvenile mortality; or accidentally kicking eggs or juveniles out of the nest. Behavioral responses can also include lower breeding densities in suitable habitats that are subject to noise; therefore, suitable habitat may become otherwise unsuitable due to noise.

Detonations in air during anti-air warfare training and testing would typically occur at much higher altitudes (greater than 3,000 ft. [915 m] above sea level) where seabirds and migrating birds are less likely to be present, although some activities target incoming missile threats at lower altitudes.

At distances beyond those to injury, an explosive detonation would likely cause a startle reaction, as the exposure would be brief and any reactions are expected to be short-term. Startle impacts range from altering behavior (e.g., stop feeding or preening), minor behavioral changes (e.g., head turning), or a flight response. The range of impacts could depend on the charge size, distance from the charge, and the bird's life activity at the time of the exposure.

Birds have been observed taking interest in surface objects related to detonation activities and subsequently being killed by a detonation (Greene et al. 1985). Fleeing response to an initial explosion may reduce seabird exposure to any additional explosions that occur within a short timeframe. However, seabirds could also be attracted to an area to forage if an explosion resulted in a fish kill. This would only be a concern for activities that involved multiple explosions in the same area within a single activity, such as firing exercises, which involves firing multiple high-explosive 5 in. rounds at a target area; bombing exercises, which could involve multiple bomb drops separated by several minutes; or underwater detonations, such as multiple explosive ordnance demolition charges.

Explosive ordinance demolitions also occur on land; however, explosive devices are detonated under controlled conditions, such as using clear zones and demolition pits. These activities occur at Andersen Air Force Base and the Naval Base Guam Naval Munitions Storage facility, in areas that are not generally associated with seabirds or shorebirds. Therefore, only explosions that occur on land at FDM are included for analysis.

3.6.3.1.2.3 No Action Alternative

Training Activities

Training activities under the No Action Alternative use explosives in air, at the water surface, underwater, and on land at FDM. The number of training activities using explosives and their proposed locations are presented in Table 2.8-1 of Chapter 2 (Description of Proposed Action and Alternatives). Appendix A (Training and Testing Activities Descriptions) lists the training activities that use ordnance on FDM. The number of ordnance use on FDM is summarized in Table 3.0-22. On land, explosives used at FDM would range from medium caliber to explosive rounds, and explosive bombs no greater than 1,000 lb. net explosive weight (NEW).

Training activities using explosives would not occur within approximately 3 nm of shore, while lower weight explosives (up to 10 lb. NEW) would occur at underwater detonation sites within Apra Harbor (Outer Apra Harbor Underwater Detonation Site), Piti Point Floating Mine Neutralization Site, and Agat Bay (Agat Bay Floating Mine Neutralization Site). Percussive noise would also be generated in the air (but close to the surface) within the Small Arms Firing Area. The underwater detonations sites within Apra Harbor, Piti Point Floating Mine Neutralization Site, Agat Bay Floating Mine Neutralization Site, and the Small Arms Firing Area are within the nearshore environment of Guam that is likely a primary foraging habitat for seabird species that roost and breed on the island. Figure 2.7-1 shows the location of surface danger zones, exclusion zones around underwater detonation sites, and extended surface danger zones. The training activity areas shown in Figure 2.7-1 do not include fish aggregating devices, artificial reefs, shipwrecks, abandoned vessels, or buoys (e.g., navigational buoys, meteorological buoys) that attract seabird prey species and offer perch sites. Section 3.11 (Cultural Resources) discusses shipwrecks and other submerged resources that may also serve to aggregate fish and therefore seabirds. The Navy routinely avoids locations of known obstructions, including submerged cultural resources such as historic shipwrecks. These avoidance measures prevent damage to sensitive Navy equipment and vessels, ensure the accuracy of training and testing exercises, and limit the possibility of large numbers of seabirds being exposed to explosions.

In open ocean areas further from shore, some surface detonations could occur near areas with the potential for relatively high concentrations of seabirds near upwellings and current conversions, including Firing, Bombing, and Missile Exercises in the Study Area including transit corridors. Any impacts on individual seabirds may be greater in these areas because of the higher NEW explosives used in the training exercises in open ocean areas relative to nearshore areas. Most explosives in air would occur at altitudes above those where most birds would be expected to be present, although some airborne detonations could startle or induce other behavioral responses in foraging birds at lower altitudes. Detonations on land at FDM could directly impact seabirds and migrant shorebirds. As stated in Section 3.6.2.5 (At-Sea Observations of Seabirds and Shorebirds), FDM is the only land training area that supports seabird rookeries and strike warfare training.

While the impacts of explosions on seabirds under the No Action Alternative cannot be quantified due to limited data on seabird density, lethal injury to some seabirds could occur. At sea, detonations of bombs with larger NEWs, any activity employing static targets that may attract seabirds to the detonation site, or multiple detonations that attract seabirds to possible fish kills could be more likely to cause seabird mortalities or injuries. Timing of multiple detonations at the same location may impact birds differently. For example, detonations that occur within a few seconds or minutes of each other may kill or injure fewer birds than detonations that occur within a longer timeframe and allow sufficient time for more seabirds to congregate and feed on fish kills. Any impacts related to startle reactions, displacement from a preferred area, or reduced foraging success in offshore waters would likely be short-term and infrequent. Because most activities would consist of a limited number of detonations, exposures would not occur over long durations, and activities occur at varying locations, it is expected there would be an opportunity to recover from an incurred energetic cost and individual birds would not be repeatedly exposed to explosive detonations. Although a few individuals may experience long-term impacts and potential mortality, population-level impacts are not expected.

On land at FDM, impacts would range from behavioral responses to direct mortality. As stated previously, behavioral responses may include birds expending excess energy that is not directed toward reproduction; nest exposure, increasing the risk of predation; nest cooling or nest heating, which can result in egg and juvenile mortality; or accidentally kicking eggs or juveniles out of the nest. Behavioral responses can also include lower breeding densities in suitable habitats that are subject to noise; therefore, suitable habitat may become otherwise unsuitable due to noise. Lower breeding densities on FDM may result from repetitive explosive noise that spans several seconds or minutes for a single activity and is dispersed throughout a year's worth of training.

Within and adjacent to FDM impact areas (shown in relation to rookery locations in Figure 3.6-5), individual and group mortality of birds is possible depending on several factors, such as the presence of seabirds near the detonation, location of the detonation, size of the explosive, and distance from the detonation. Detonations create blast waves and acoustic waves in air and are also transmitted through the ground, although some of the sound could be attenuated by surrounding vegetation. Noise can result from direct munitions impacts (one object striking another), blasts (explosions that result in shock waves), and bow shock waves (pressure waves from projectiles flying through the air). Noise on FDM during training exercises may be continuous (i.e., lasting for a long time without interruption) or impulse (i.e., short duration). Continuous impulses (helicopter rotor noise, bursts from rapid-fire weapons) represent an intermediate type of sound and, when repeated rapidly, may resemble continuous noise.

Some seabirds and shorebirds on FDM subject to continuous or repetitive loud noise would likely experience stress and vascular alteration (including structural damage) in the ear, such as tympanum rupture, bone fracture, other damage to the ear, and deterioration of brain cells. These impulse noises can cause physical damage at lower intensity than continuous or rapidly repeating noises due to the ear reflex mechanism. Sound levels over 85 dBA are considered harmful to inner ear hair cells; 95 dBA is considered unsafe for prolonged periods; and extreme damage occurs as a result of brief exposure to 140 dBA (Hamby 2004). Hearing loss in birds is difficult to characterize because birds, unlike mammals, regenerate inner ear hair cells, even after substantial loss (Corwin and Cotanche 1988; Stone and Rubel 2000). Recovery from metabolic ear stress can often occur after 10 hours (mammals) post loud impulse noise, even before ear structures are fully recovered. Repeated trauma may prolong the course of hearing sensitivity recovery; however, longer-term recovery from hearing loss is generally expected in birds due to cell regeneration.

High-frequency sounds (sometimes referred to as ultrasound, which exceeds the hearing range of humans) may be generated from munitions explosions and projectile strikes on FDM. This type of sound diminishes very rapidly in air with distance from the source, and seabirds or shorebirds close enough to be adversely affected by the ultrasound produced by military training are likely close enough to be adversely affected by shrapnel, flying rock, or direct strikes. Therefore, ultrasound receives little attention in the terrestrial environment and it should be assumed that if a seabird or seabird nest was close enough to experience impacts from ultrasound, the seabird would likely be impacted directly by the actual munitions (U.S. Fish and Wildlife Service 2010).

Infrasound, which is present in blast and helicopter noise, is generally considered to be below 20 Hz (too low to be heard by humans) and attenuates less in air than audible sound, which means these noises could affect seabirds and shorebirds at longer distances on FDM. Seabirds may use infrasound for communication; however, the extent to which birds are affected by infrasound is speculative (U.S. Fish and Wildlife Service 2010). Infrasound can result in damage to the ears, which may affect the species' ability to hear and may also mask biologically meaningful infrasonic communication between individuals.

Aerial and shore bombardment activities have been conducted at FDM since October 1971. According to the Navy's EIS completed for FDM in 1975, the quantity of ordnance delivered on FDM was approximately 22 tons per month during the peak of training operations during the Vietnam War. These munitions consisted primarily of air-delivered 500 and 750 lb. bombs, but also included approximately sixty 3 in. Naval projectiles fired per month during shore bombardment exercises. Assuming this rate of munitions usage for a period of 42 months (October 1971 through March 1975), approximately 1,019 standard tons of air and surface delivered ordnance was dropped on FDM. The 1975 EIS indicated that training operations at FDM following the Vietnam War effort were likely to reduce loading to 40 tons of aerial munitions delivered per year, with similar shore bombardment totals and the use of four to five air-to-surface "bullpup" missiles per year. The entire land portion of FDM was utilized for aerial and shore bombardment until 1999, when specific impact zones were designated, as well as other protective measures (prohibiting ordnance inert or live ordnance releases north of a "no fire line" and establishing firing direction restrictions) shown in Figure 3.6-5 (U.S. Department of the Navy 2008). The intent of establishing the no fire line was to prohibit any targeting of the relatively higher stature forest located in the northern portion of the island. Between 2005 and 2009, the tonnage of munitions targeted at the impact zones on FDM amounted to an annual average of 214 tons per year, with a decrease to an average of 205 tons per year from 2010 through 2012. The expenditures fluctuate from year to year. It should be noted that the USFWS in 2010 authorized an ordnance assemblage that allowed for 863 tons per year.

The best available data for measuring the impacts of explosives on seabird populations on FDM comes from the helicopter-based surveys for masked booby, red-footed booby, and brown booby. Since 1997, the Navy has conducted these surveys on a monthly basis through 2009 and on a quarterly basis through the present. The population trends (shown in

Figure 3.6-6, Figure 3.6-7, and Figure 3.6-8) show annual and seasonal fluctuations, but relatively stable numbers of individuals for the three booby species over the long-term. Despite the likely injury and mortality to individual seabirds and eggs, and habitat degradation due to the continued military use of FDM, the island continues to be a valuable, important, and productive rookery location in the Mariana archipelago (U.S. Fish and Wildlife Service 2005, Lusk et al. 2000, Reichel 1991).

Other factors associated with the military use of the island may benefit seabirds, such as restricting access to the island and nearshore areas surrounding FDM. FDM and its nearshore area have been an off-limits area to all personnel (both civilian and military) due to safety concerns over unexploded ordnance since 1983, per the lease agreement signed between the U.S. government and the CNMI for military use of the island (United States of America and Commonwealth of the Northern Mariana Islands 1983). Excluding access to land prevents poaching of eggs, a major threat to seabirds identified in the USFWS Pacific Islands Seabird Conservation Plan (U.S. Fish and Wildlife Service 2005). Further, restricting availability of waters from the nearshore of FDM through the issuance of Notices to Mariners (NTM) may decrease fishing pressure and provide refugia for seabird prey species, thereby increasing the availability and ease for seabirds to capture prey near FDM. Further, some degree of habituation to noise generated by munitions use should be expected when the proximity of explosions to seabirds is sufficiently far to not cause injury or death. Based on the continued use of FDM as a breeding location, the relatively stable numbers of individuals of booby species on FDM observed by Navy biologists since the late 1990s, and the varied responses of seabirds to explosions in the literature, some degree of habituation is likely for seabirds at FDM.

Short-tailed albatrosses are rare vagrant migrants that forage in offshore, open ocean waters. Albatrosses forage near the sea surface, utilizing pressure differences created by ocean swells to aid in soaring; they are known to land on islands or offshore rocks. Aviation, ocean, and land training within the MITT Study Area that overlaps areas potentially containing short-tailed albatross includes vessels traveling offshore, ordnance impacting foraging locations, and airspace below 1,000 ft. (305 m).

Short-tailed albatross remains one of the world's most endangered birds (U.S. Fish and Wildlife Service 2008b). Considering the rarity of this species in general and the lack of frequent sightings, chances for its potential interactions with training exercises would be extremely low. Birds of this family follow wakes of ships, slightly increasing the potential for interaction with aircraft carriers, especially during the launching or landing of aircraft; however, the probability of direct impacts on individuals or populations remains low. The spatial and temporal variability of both the occurrence of a short-tailed albatross and the training activities conducted within offshore locations near foraging areas presents an improbable chance that a direct or indirect impact would occur to this species.

Hawaiian petrels are also rare migrants that forage in offshore open ocean waters. Petrels forage near the sea surface, and can range 930 mi. (1,500 km) from the Hawaiian Islands, which overlaps with the MITT Study Area; however, the range shrinks for part of the year to surround the Hawaiian Islands. Aviation, ocean, and land training within the MITT Study Area that overlaps with areas potentially containing the Hawaiian petrel includes vessels traveling offshore, ordnance impacting foraging locations (FDM), and airspace below 1,000 ft. (305 m). There have been no observations of Hawaiian petrels at FDM, and other species of the Procellerridae family have not been observed on or around the island. The described training activities would present no measurable chance for interaction with this species. Considering the rarity of this species and the lack of frequent sightings within the MITT Study Area, chances for its potential interactions with training exercises would be extremely low. The probability of direct or indirect impacts on individuals or populations remains low. The spatial and temporal variability of both the occurrence of a Hawaiian petrel and the training activities conducted within offshore locations near foraging areas presents a negligible improbable chance of direct or indirect impact on this species.

Newell's shearwaters are also rare migrants that forage in offshore open ocean waters. These birds forage near the sea surface and can range 1,500 mi. (2,414 km) from the Hawaiian Islands, which overlaps with the MITT Study Area; however, the range shrinks for part of the year to surround the Hawaiian Islands during breeding season (April through November). Ranges for the Newell's shearwater, as with other pelagic seabirds, increase with El Niño events. Aviation, ocean, and land training within the MITT Study Area that overlaps with areas potentially containing the Newell's shearwater includes vessels traveling offshore, ordnance impacting foraging locations (FDM), and airspace below 1,000 ft. (305 m). Although there have been no sightings for the Newell shearwater on FDM, Pratt et al. (1987) reported sightings on Guam, Rota, Saipan, and Tinian; therefore, occurrence at FDM is possible during the non-breeding season (December through March). It should be noted that FDM is far outside the known pelagic range for the Newell's shearwater (see Figure 3.6-9). Considering the rarity of this species and the lack of frequent sightings within the MITT Study Area, chances for its potential interactions with training exercises would be extremely low. The probability of direct impacts on individuals or populations remains low. The spatial and temporal variability of both the occurrence of a Newell's shearwater and the training activities conducted within offshore locations near foraging areas presents an improbable chance of direct or indirect impact on this species.

Masked boobies are expected to forage in pelagic waters that may co-occur with Navy training activities that use explosives. Masked boobies at sea, like other seabirds discussed above, may be subject to injury and death when in close proximity to explosions near the surface, on the surface, or in air. Because of the brief exposure time of explosions at sea, the dispersed locations of Navy training activities that occur in the open ocean, and the availability of pelagic foraging habitats for masked boobies, there is low potential for masked boobies to be subject to the effects of explosives in pelagic foraging habitats. The masked booby has a well-documented breeding history on FDM, an important rookery location for this species. As discussed above, breeding seabirds on FDM including the masked booby would be subject to various forms of sound and pressure waves generated by explosives. Response to these noise types and levels depends on a variety of factors, such as the distance of a masked booby to the explosion and the life stage of the bird. The response types exhibited by the masked booby may include behavioral responses that result in spending excess energy that is not directed towards reproduction; nest exposure, increasing the risk of predation; nest cooling or nest heating, which can result in egg and juvenile mortality; or accidentally kicking eggs or juveniles out of the nest. Direct mortality and injury of masked boobies likely occurs when in close proximity to impact zones on FDM. The preferred breeding areas for this species are not located within the impact zones in the interior portion of the island (see Figure 3.6-5). This species prefers to nest on open or rocky ground often near cliff edges, and Lusk et al. (2000) speculated that the military use of FDM in the interior portions of the island has created additional suitable nesting habitat for this species. Although the masked booby may be subject to short and long-term impacts of explosives use at FDM and individuals likely suffer injury and mortality from explosions, FDM continues to support a relatively stable rookery. Surveys conducted since 1997 by the Navy show periodic and seasonal fluctuations in masked booby populations at FDM, as shown in

Figure 3.6-6, but have remained stable over the monitoring period. Based on the long-term use and stability of the masked booby breeding population on FDM and the wide geographic range and abundance of the masked booby (discussed in Section 3.6.2.11, Masked Booby [*Sula dactylatra*]), the direct and indirect effects of explosions on FDM are unlikely to represent a significant adverse impact on the population of the masked booby.

Great frigatebirds are expected to forage in pelagic waters that may co-occur with Navy training activities that use explosives. Great frigatebirds at sea, like other seabirds discussed above, may be subject to injury and death when in close proximity to explosions near the surface, on the surface, or in air. Because of the brief exposure time of explosions at sea, the dispersed locations of Navy training activities that occur in the open ocean, and the availability of pelagic foraging habitats for great frigatebirds, there is low potential for great frigatebirds to be subject to the effects of explosives in pelagic foraging habitats. Because of the small number of great frigatebirds within the Mariana archipelago relative to other locations (e.g., 20,000 great frigatebirds are estimated to nest in the Hawaiian archipelago), and because great frigatebirds are thought to be most abundant within 50 mi. (80 km) of breeding and roosting sites (U.S. Fish and Wildlife Service 2005), the chances of a great frigatebird subject to explosive impacts associated with Navy training activities at sea is small. Direct mortality and injury of great frigatebirds roosting or breeding likely occurs when in close proximity to impact zones on FDM. Surveys conducted by Navy biologists since 1997 suggest that great frigatebirds may occasionally nest on FDM, and sightings of individuals are generally associated with winter months (U.S. Department of the Navy 2013b). It is possible that military use of FDM since 1971 has degraded nesting habitats for the great frigatebird (this species nests in trees and bushes in nests made out of sticks). Lusk et al. (2000) delineated the small colony along the western coast of FDM (see Figure 3.6-5), but more nesting habitat would likely have been available to the great frigatebird prior to bombing of these interior formerly forested areas. The great frigatebird, however, has likely not bred in the Mariana archipelago in large numbers. Reichel (1991) surveyed available historic estimates for this species, and found only accounts for roosting and, with the exception of Maug, no breeding records in the Mariana archipelago. FDM was not a confirmed breeding site for the great frigatebird until the late 1990s (Lusk et al. 2000). It should be noted that the location of the small colony of frigatebirds identified by Lusk is outside of the closest impact area (Impact Area 2) shown in Figure 3.6-5. Compared to the numbers of great frigatebirds estimated throughout the entire species range (estimated between 500,000 and 1,000,000 birds), and the apparent low numbers of great frigatebirds from historic times through the present, the direct and indirect effects of explosions on FDM would not represent a significant adverse impact on the population of the great frigatebird.

Pursuant to the ESA, the use of explosives during training activities under the No Action Alternative would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the use of explosives during training activities under the No Action Alternative would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

Testing Activities

The No Action Alternative does not contain any testing activities that use explosives.

3.6.3.1.2.4 Alternative 1

Training Activities

The number of explosive detonations under Alternative 1 would increase over the No Action Alternative. Training would generally occur in the same areas as under the No Action Alternative. Specific training activities using explosives and their proposed locations are presented in Table 2.8-1 of Chapter 2 (Description of Proposed Action and Alternatives). Use of explosives and the number of detonations in each source class are provided in Table 3.0-9. Throughout the Study Area, use of explosives would increase from approximately 1,600 explosions under the No Action Alternative to approximately 10,550 explosions. Most of these explosions are from medium-caliber explosive shells, which would occur in waters greater than 12 nm from shore.

In water, training activities using explosives would not typically occur within approximately 3 nm of shore, while lower NEW explosives (up to 20 lb. NEW) would occur at underwater detonation sites at Agat Bay Floating Mine Neutralization Site. Explosives up to 10 lb. NEW would be authorized at Piti Point Floating Mine Neutralization Site and Apra Harbor Underwater Detonation Site.

Appendix A (Training and Testing Activities Descriptions) lists the training activities that use ordnance on FDM. The number of ordnance use on FDM for Alternative 1 is summarized in Table 3.0-22. At FDM, the use of explosive munitions in bombs would increase by a factor of three, and grenades and mortars would increase by a factor of six. Large caliber projectiles with explosive rounds (explosives class E3 [0.6–2.0 lb.]) would increase by approximately 20 percent, while the use of medium caliber projectiles with explosive rounds (explosives class E2 [> 0.25–0.5 lb. NEW]) would decrease by approximately 20 percent, relative to the No Action Alternative. The largest increases proposed under Alternative 1 are with small caliber rounds, a 15-fold increase in small caliber non-explosive rounds. The proposed changes in ordnance use reflect the increased importance of FDM as a training area for close air support type training activities. Although the training mission of FDM would shift toward an emphasis on close air support under Alternative 1, the same training restrictions in place under the No Action Alternative would be implemented. For instance, the live fire and inert range boundaries would remain the same, as would firing direction restrictions to minimize the impact on rookery locations, and the location of the no-fire line would remain the same. In addition, the population trend monitoring for the masked booby, red-footed booby, and brown booby would also continue under Alternative 1.

For the same reasons provided in Section 3.6.3.1.1.1 (No Action Alternative), long-term impacts and potential mortality to a few individuals, and other short-term startle reactions to dispersed training activities that occur in the open ocean, are not expected to result in population-level impacts. ESA-listed seabird species are not known to occur at FDM, therefore, impacts on the short-tailed albatross, Hawaiian petrel, and Newell's shearwater are only possible at sea. These species, however, are rare vagrants in the MITT Study Area. The chances of collocation of activities at sea that use explosives and ESA-listed seabird species transiting the area are negligible. As with the No Action Alternative, explosions on FDM under Alternative 1 may kill or injure individual masked boobies (and other breeding and roosting seabird species) and induce behavioral changes that in turn cause injury or mortality. Based on the long-term use and stability of the masked booby breeding population on FDM and the wide geographic range and abundance of the masked booby (discussed in Section 3.6.2.11, Masked Booby [*Sula dactylatra*]), the direct and indirect effects of explosions on FDM are unlikely to represent a significant adverse impact on the population of the masked booby under Alternative 1. Direct mortality and injury of great frigatebirds roosting or breeding would likely occur under Alternative 1 when a great frigatebird is in close proximity to impact zones on FDM while explosions occur. Compared to the numbers of great frigatebirds estimated throughout the entire species range (estimated between 500,000 and 1,000,000 birds), and the apparent low numbers of great frigatebirds from historic times through the present, the direct and indirect effects explosions on FDM would not represent a significant adverse impact on the population of the great frigatebird under Alternative 1.

Pursuant to the ESA, the use of explosives during training activities under Alternative 1 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the use of explosives during training activities under Alternative 1 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

Testing Activities

Alternative 1 would introduce activities that use explosives as part of air to surface missile testing, anti-submarine warfare tracking testing (using Maritime Patrol Aircraft and sonobuoys), torpedo testing, mine countermeasure (MCM) mission package testing, anti-surface warfare mission package testing, kinetic energy weapon testing (also known as the rail gun), and swimmer defense and diver deterrent testing activities. All explosives used in testing activities occur at sea. Therefore, this device is not expected to result in any impacts on marine birds and will not be further analyzed in this document. The number of activities and their proposed locations are presented in Tables 2.8-2 and 2.8-3 of Chapter 2 (Description of Proposed Action and Alternatives). Use of explosives and the number of detonations in each source class are provided in Table 3.0-8.

While the impacts of explosions on seabirds under Alternative 1 cannot be quantified due to limited data on seabird density, lethal injury to some seabirds could occur. Detonations of torpedoes during testing activities may employ static targets that attract seabirds to the detonation site or fish kills from multiple detonations that attract seabirds to possible fish kills could be more likely to kill or injure seabirds. Any impacts related to startle reactions, displacement from a preferred area, or reduced foraging success in offshore waters would likely be short-term and infrequent. Because testing activities that use explosives would consist of a limited number of detonations, exposures would not occur over long durations, and activities occur at varying locations, it is expected there would be an opportunity to recover from an incurred energetic cost and individual birds would not be repeatedly exposed to explosive detonations. Although a few individuals may experience long-term impacts and potential mortality, population-level impacts are not expected.

Short-tailed albatrosses, Hawaiian petrels, and Newell's shearwaters are rare vagrants in the MITT Study Area. The southern portion of the short-tailed albatross range is likely the northern edge of the North Equatorial Current, which overlaps with the MITT Study Area. The ranges of the Hawaiian petrel and Newell's shearwater overlap with the MITT Study Area outside of these species' breeding seasons. They are considered rare vagrant migrants in the MITT Study Area, foraging in offshore, open ocean waters. Testing activities that use explosives have the potential to intersect with transiting short-tailed albatrosses through testing areas; however, the rarity of this species in general and the lack of frequent sightings, chances for its potential interactions with testing activities would be extremely low. Birds of this family follow wakes of ships, slightly increasing the potential for interaction with vessels involved in testing activities that use explosives. The spatial and temporal variability of both the occurrence of a short-tailed albatross and the testing activities conducted within offshore locations near foraging areas presents an improbable chance that a direct or indirect impact would occur to this species.

As shown in Figure 3.6-9, the known ranges of Hawaiian petrels and Newell's shearwaters may overlap with the transit corridor and do not overlap with land training areas or surrounding coastal areas. They were observed in 2007 during cruise surveys in pelagic areas for marine mammals and sea turtles (U.S. Department of the Navy 2007). As with the short-tailed albatross, the rarity of Hawaiian petrels and Newell's shearwaters within the MITT Study Area and the lack of frequent sightings, chances for potential interactions with testing activities that use explosives would be extremely low. None of the testing activities proposed under Alternative 1 involve land training areas; therefore, there would be no impacts on seabirds that nest and roost on FDM or other rookery locations within the Marianas. Masked boobies, great frigatebirds, and other species that visit, roost, or breed within the Study Area would only be exposed to explosions used during testing activities in the open ocean. Because of the availability of pelagic foraging grounds, a tendency for seabirds to use nearshore environments where large explosions are not used as part of testing activities, the widely dispersed locations of testing activities that use explosions, and the widely dispersed locations of seabirds within the Study Area, the chances of injury or harm to seabirds is extremely low. Any mortality or injury of individual seabirds would not represent a significant adverse impact on any population of seabird species.

Under the ESA, the use of explosives during testing activities under Alternative 1 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the use of explosives during testing activities under Alternative 1 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

3.6.3.1.2.5 Alternative 2

Training Activities

The number of specific training activities under Alternative 2 using explosives and their proposed locations are presented in Table 2.8-1 of Chapter 2 (Description of Proposed Action and Alternatives). Use of explosives and the number of detonations in each source class are provided in Table 3.0-9. Throughout the Study Area, use of explosives under Alternative 2 would increase from approximately 1,600 explosions under the No Action Alternative to approximately 10,800 explosions. Alternative 2 would increase the total number of explosive events by about 300 explosions. As with Alternative 1, most of these explosions are from medium-caliber explosive shells, which would occur in waters greater than 12 nm from shore.

In water, training activities using explosives would not typically occur within approximately 3 nm of shore, while lower NEW explosives (up to 20 lb. NEW) would occur at underwater detonation sites at Agat Bay Floating Mine Neutralization Site. Explosives up to 10 lb. NEW would be authorized at Piti Point Floating Mine Neutralization Site and Apra Harbor Underwater Detonation Site.

Appendix A (Training and Testing Activities Descriptions) lists the training activities that use ordnance on FDM. The number of ordnance use on FDM is summarized in Table 3.0-22. At FDM, the use of explosive munitions in bombs would increase by a factor of three, and grenades and mortars would increase by a factor of six. Large caliber projectiles with explosive rounds (explosives class E3 [0.6 to 2.0 lb.]) would increase by approximately 20 percent, while the use of medium caliber projectiles with explosive rounds (explosives class E2 [> 0.25–0.5 lb. NEW]) would decrease by approximately 20 percent, relative to the No Action Alternative. The largest increases proposed under Alternative 2 are with small caliber rounds, a 15-fold increase in small caliber non-explosive rounds. The proposed changes in ordnance use reflect the increased importance of FDM as a training area for close air support type training activities.

Although the impacts on birds are expected to increase under Alternative 2 compared to the No Action Alternative, the expected impacts on any individual bird would remain the same. For the same reasons provided in Section 3.6.3.1.1.1 (No Action Alternative), long-term impacts and potential mortality to a few individuals, and other short-term startle reactions to dispersed training activities, are not expected to result in population-level impacts.

ESA-listed seabird species are not known to occur at FDM, therefore, impacts on the short-tailed albatross, Hawaiian petrel, and Newell's shearwater are only possible at sea. These species, however, are rare vagrants in the MITT Study Area. The chances of collocation of activities at sea that use explosives and ESA-listed seabird species transiting the area are negligible. As with the No Action Alternative and Alternative 1, explosions on FDM under Alternative 2 may kill or injure individual masked boobies (and other breeding and roosting seabird species) and induce behavioral changes that in turn cause injury or mortality. Based on the long-term use and stability of the masked booby breeding population on FDM and the wide geographic range and abundance of the masked booby (discussed in Section 3.6.2.11, Masked Booby [*Sula dactylatra*]), the direct and indirect effects of explosions on FDM are unlikely to represent a significant adverse impact on the population of the masked booby under Alternative 2. Direct mortality and injury of great frigatebirds roosting or breeding would likely occur under Alternative 2 when a great frigatebird is in close proximity to impact zones on FDM while explosions occur. Compared to the numbers of great frigatebirds estimated throughout the entire species range (estimated between 500,000 and 1,000,000 birds), and the apparent low numbers of great frigatebirds from historic times through the present, the direct and indirect effects of explosions on FDM would not represent a significant adverse impact on the population of the great frigatebird under Alternative 2.

Pursuant to the ESA, the use of explosives during training activities under Alternative 2 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the use of explosives during training activities under Alternative 2 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

Testing Activities

As with Alternative 1, Alternative 2 would introduce activities that use explosives as part of air to surface missile testing, anti-submarine warfare tracking testing (using Maritime Patrol Aircraft and sonobuoys), torpedo testing, MCM mission package testing, kinetic energy weapon testing, and anti-surface warfare mission package testing. All explosions used in testing activities occur at sea. The number of specific activities and their proposed locations are presented in Tables 2.8-2 and 2.8-3 of Chapter 2 (Description of Proposed Action and Alternatives). Use of explosives and the number of detonations in each source class are provided in Table 3.0-9. Compared to Alternative 1, Alternative 2 testing activities require more explosives, and most of the increases are in relatively small explosive classes between 0.1 and 5 lb. NEW.

While the impacts of explosions on seabirds under Alternative 2 cannot be quantified due to limited data on seabird density, lethal injury to some seabirds could occur. Detonations of torpedoes during testing activities may employ static targets that attract seabirds to the detonation site or fish kills from multiple detonations that attract seabirds to possible fish kills could be more likely to cause kill or injure seabirds. Any impacts related to startle reactions, displacement from a preferred area, or reduced foraging success in offshore waters would likely be short-term and infrequent. Because testing activities that use explosives would consist of a limited number of detonations, exposures would not occur over long durations, and activities occur at varying locations, it is expected there would be an opportunity to recover from an incurred energetic cost and individual birds would not be repeatedly exposed to explosive detonations. Although a few individuals may experience long-term impacts and potential mortality, population-level impacts are not expected.

Short-tailed albatrosses, Hawaiian petrels, and Newell’s shearwaters are rare vagrants in the MITT Study Area. The southern portion of the short-tailed albatross range is likely the northern edge of the North Equatorial Current, which overlaps with the MITT Study Area. The ranges of the Hawaiian petrel and Newell’s shearwater overlap with MITT Study Area outside of these species’ breeding seasons, are rare vagrant migrants that forage in offshore, open ocean waters. Testing activities that use explosives have the potential to intersect with transiting short-tailed albatrosses through training areas; however, the rarity of this species in general and the lack of frequent sightings, chances for its potential interactions with testing exercises would be extremely low. Birds of this family follow wakes of ships, slightly increasing the potential for interaction with vessels involved in testing activities that use explosives. The spatial and temporal variability of both the occurrence of a short-tailed albatross and the testing activities conducted within offshore locations near foraging areas presents an improbable chance that a direct or indirect impact would occur to this species.

As shown in Figure 3.6-9, the known ranges of Hawaiian petrels and Newell’s shearwaters may overlap with the transit corridor and do not overlap with land training areas or surrounding coastal areas. They were observed in 2007 during cruise surveys in pelagic areas for marine mammals and sea turtles (U.S. Department of the Navy 2007). As with the short-tailed albatross, the rarity of Hawaiian petrels and Newell’s shearwaters within the MITT Study Area and the lack of frequent sightings, chances for potential interactions with testing activities would be extremely low.

Pursuant to the ESA, the use of explosives during testing activities under Alternative 2 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the use of explosives during testing activities under Alternative 2 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

3.6.3.1.3 Impacts from Aircraft and Vessel Noise

Various types of fixed-wing aircraft, helicopters, and vessels are used in most training and testing activities throughout the Study Area. Therefore, seabirds and other migratory birds could be exposed to airborne noise associated with fixed-wing aircraft overflights (subsonic and supersonic), helicopter activities, and vessels throughout the Study Area. See Section 3.0.5.3 (Identification of Stressors for Analysis) for a description of aircraft noise generated during training and testing activities.

3.6.3.1.3.1 Fixed-Wing Aircraft

Responses to airborne noise could include short-term behavioral or physiological reactions, such as alert response, startle response, or temporary increase in heart rate, which are likely to be more acute for sonic boom exposures. Maximum behavioral responses by crested tern (*Sterna bergii*) to aircraft noise were observed at sound level exposures greater than 85 dBA re 20 µPa. While the experiment provided good control on simulated aircraft noise levels, preliminary 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). Raptor and wading bird species have responded minimally to jet (100–110 dBA re 20 µPa) and propeller plane (92 dBA re 20 µPa) overflights, respectively (Ellis 1981). Jet flights greater than 1,640 ft. (500 m) distance from raptors were observed to elicit no response (Ellis 1981). However, herring gulls (*Larus argentatus*) significantly increased their aggressive interactions within the colony and their flights over the colony during overflights with received sound levels of 101–116 dBA re 20 µPa (Burger 1981). The impacts of low-level military training flights on wading bird colonies in Florida were estimated using colony distributions and turnover rates. There were no demonstrated impacts of military activity on wading bird colony establishment or size (Black et al. 1984). Fixed-winged jet aircraft disturbance did not seem to adversely affect waterfowl observed during a study in coastal North Carolina (Conomy et al. 1998).

Most activities using fixed-wing aircraft occur at distances greater than 12 nm offshore. Birds could be exposed to elevated noise levels while foraging or migrating in these open water environments. Most fixed-wing sorties would occur greater than 3,000 ft. (915 m) altitude and would be associated with air combat maneuver training, tracking exercises, and aircraft testing. Typical altitudes would range from 5,000 to 30,000 ft. (1,524 to 9,144 m), and typical airspeeds would range from very low (less than 100 knots) to high subsonic (less than 600 knots). Sound exposure levels at the sea surface from most air combat maneuver overflights are expected to be less than 85 dBA re 1 µPa, based on an F/A-18 aircraft flying at an altitude of 5,000 ft. (1,524 m) and at a subsonic airspeed of 400 knots. Exceptions include sorties associated with air-to-surface ordnance delivery and sonobuoy drops from 500 to 5,000 ft. (152 to 1,524 m) altitude. Bird exposure to fixed-wing aircraft noise would be brief (seconds) as an aircraft quickly passes overhead. Noise from fixed-wing aircraft at airfields (e.g., military airfields on Guam, Tinian North Field, and use of Saipan International Airport) may displace migrating shorebirds from wintering habitat because these species often favor open grasslands and paved surfaces associated with tarmacs.

Some air combat maneuver training would involve high altitude, supersonic flight, which would produce sonic booms, but such airspeeds would be infrequent. Boom duration is generally less than 300 milliseconds. Sonic booms would cause birds to startle, but the exposure would be brief, and any reactions are expected to be short-term. Startle impacts range from altering behavior (e.g., stop feeding or preening), minor behavioral changes (e.g., head turning), or at worst, a flight response. Because most fixed-wing flights are not supersonic and both seabirds and aircraft are transient in any area, exposure of seabirds in the open ocean to sonic booms would be infrequent. It is unlikely that individual seabirds would be repeatedly exposed to sonic booms in the open ocean.

Birds could sensitize or habituate to repeated exposures to sonic booms and aircraft noise. Habituation seems unlikely in the open water portions of the Study Area given the widely dispersed nature of the operations and the relative infrequency of the activities. Repeated exposures could occur to populations that are not transient, such as nesting birds. It is possible that birds could habituate and no longer exhibit behavioral responses, as has been documented for some impulse noise sources (Ellis 1981, Russel Jr. et al. 1996) and aircraft noise (Conomy et al. 1998). It is also possible that birds could sensitize from routinely flushing when hearing the noise to completely abandoning an area. Austin et al. (1970) reported near-total nest failure of sooty terns nesting in the Dry Tortugas islands within the Navy's Key West Range Complex in the Gulf of Mexico. Birds in this area were regularly exposed to sonic booms during the 1969 nesting season. In previous seasons, the birds were reported to react to the occasional sonic booms by rising immediately in a "panic flight," circling over the island, and then usually settling down on their eggs again. Researchers had no evidence that sonic booms caused physical damage to the sooty tern eggs, but hypothesized that the strong booms occurred often enough to disturb the sooty terns' incubating rhythm and cause nest desertion. The 1969 sooty tern nesting failure also prompted additional research to test the hypothesis that sonic booms could cause bird eggs to crack or otherwise affect bird eggs or embryos. However, the findings of the additional research were contrary to this hypothesis (Bowles et al. 1991, Bowles et al. 1994, Teer and Truett 1973, Ting et al. 2002). That same year, the colony also contained approximately 2,500 brown noddies, whose young hatched successfully. While it was impossible to conclusively determine the cause of the 1969 sooty tern nesting failure, actions were taken to curb planes breaking the sound barrier within range of the Tortugas, and much of the excess vegetation was cleared (another hypothesized contributing factor to the nesting failure). Similar nesting failures have not been reported since the 1969 failure.

3.6.3.1.3.2 Helicopters

Unlike fixed-wing aircraft, helicopters typically operate below 1,000 ft. (305 m) altitude and often as low as 75–100 ft. (23–30 m) altitude. This low altitude increases the likelihood that birds would respond to noise from helicopter overflights. Helicopters travel at slower speeds (less than 100 knots), which increases durations of noise exposure compared to fixed-wing aircraft. In addition, some studies have suggested that birds respond more to noise from helicopters than from fixed-wing aircraft (Larkin et al. 1996). Helicopter flights are generally limited to locations closer to the coast, unless deployed onboard ships. Helicopter flights, therefore, are more likely to impact greater numbers of seabirds that forage in coastal areas than those that forage in open ocean areas. Nearshore areas of the coast are the primary foraging habitat for many seabird species. Noise from low-altitude helicopter overflights may elicit short-term behavioral or physiological responses, such as alert responses, startle responses, or temporary increases in heart rate, in exposed birds.

Touch-and-go landings, bombing runs, and helicopter sorties are impulse activities that repeat at short enough intervals to constitute a continuous exposure. In a literature review of waterfowl response to aircraft, avian response to aircraft was (cautiously) generalized as more intense with helicopters than fixed-wing aircraft, and stronger with slower fixed-wing aircraft than fast fixed-wing aircraft (Plumpton et al. 2006). Increasing horizontal distance resulted in lower response than increasing altitude (Plumpton et al. 2006). Raptors have varied behaviors in response to helicopters and responded similarly to explosions: by remaining on a nest, flushing from an area, and attacking the helicopter. American black ducks (*Anas rubripes*) reacted to 39 percent of military aircraft overflights on their first day of exposure, but after 2 weeks, they responded only 6 percent of the time (Conomy et al. 1998). However, wood ducks (*Aix sponsa*) in the same study continued to respond to aircraft noise (Conomy et al. 1998). Survival of captive black duck chicks was lower in a noisy area than control area; however adults were largely unaffected. Sandhill cranes (*Grus canadensis*) were noted to stay on their nests when helicopter activity was within 131 ft. (40 m) above them and bald eagles remained on their nests until helicopters approached closely (distance not defined). On FDM, adult birds (presumably various species of seabirds) flushed from their nests in response to helicopter landings; however, some returned to their nests within 15 minutes after the disturbance stopped (Lusk et al. 2000).

Foraging marine birds (seabirds, shorebirds, and other birds that use the marine environment) would be present below the altitude of fixed-wing flights, but could potentially be exposed to nearby noise from helicopters at lower altitudes. Altitudes at which birds fly can vary greatly based on the type of bird, where they are flying (over water or over land), and other factors such as weather. Approximately 95 percent of bird flight during migrations occurs below 10,000 ft. (3,048 m) with the majority below 3,000 ft. (915 m) (Lincoln et al. 1998). While there is considerable variation, the favored altitude for most small birds appears to be between 500 ft. (152 m) and 1,000 ft. (305 m). Aircraft noise from helicopters at airfields (e.g., military airfields on Guam and Tinian North Field, and use of Saipan International Airport) may displace migrating shorebirds from wintering habitat because these species often favor open grasslands and paved surfaces associated with tarmacs.

3.6.3.1.3.3 Vessels

Naval combat vessels are designed to be quiet to avoid detection; therefore, any disturbance to birds is expected to be due to visual, rather than acoustic, stressors. Other training and testing support vessels, such as rigid hull inflatable boats, use outboard engines that can produce substantially more noise even though they are much smaller than warships. Noise due to watercraft with outboard engines or noise produced by larger vessels operating at high speeds may briefly disturb some birds while foraging or resting at the water surface. However, the responses due to both acoustic and visual exposures are likely related and difficult to distinguish. Although loud, sudden noises can startle and flush birds, Navy vessels are not expected to result in major acoustic disturbance of seabirds in the Study Area. Noise from Navy vessels is similar to or less than those of the general maritime environment. Birds respond to the physical presence of a vessel, regardless of the associated noise. The potential is very low for noise generated by Navy vessels to impact seabirds, and such noise would not result in major impacts on seabird populations.

3.6.3.1.3.4 No Action Alternative

<u>Training Activities</u>

Training activities under the No Action Alternative include fixed- and rotary-wing aircraft overflights and vessel movements throughout the Study Area. Most helicopter training would occur adjacent to areas at Naval Base Guam Apra Harbor, Andersen Air Force Base, Tinian landing beaches, and some transits to FDM and to training areas and drop zones at sea.

Birds using wetlands, mud flats, beaches, and other shoreline habitats or shallow coastal foraging areas would be exposed to noise from nearshore helicopter training and aircraft in transit to offshore training areas. The presence of dense aggregations of sea ducks, other seabirds, and migrating land birds is a potential concern during low-altitude helicopter activities. Although birds may be more likely to react to helicopters than to fixed-wing aircraft, Navy helicopter pilots avoid large flocks of birds to protect aircrews and equipment, thereby reducing disturbance to birds as well.

Pelagic seabirds within the Study Area that forage offshore may have greater presence where currents converge and upwellings attract prey to a concentrated area. In these productive areas aircraft overflights may cause more behavioral disturbances in these areas. A seabird in the open ocean would be exposed for a few seconds to fixed-wing aircraft noise as the aircraft quickly passes overhead. Seabirds foraging or migrating through a training area in the open ocean may respond by avoiding areas of concentrated aircraft noise. Exposures to most seabirds would be infrequent, based on the brief duration and dispersed nature of the overflights.

Although noise associated with vessel movements would be produced during most sea-based training activities, the most acute noise exposure would be expected from small craft using outboard engines. Any vessel noise disturbance is expected to be very brief and inconsequential. Any reactions may be due more to visual detection of an approaching vessel than to acoustic disturbance.

Occasional startle or alert reactions to aircraft and vessels are not likely to disrupt major behavior patterns (such as migrating, breeding, feeding, and sheltering) or to result in serious injury to any seabirds. Helicopter overflights would be more likely to elicit responses than fixed-wing aircraft, but the general health of individual birds would not be compromised. For these reasons, the impact of noise produced by aircraft and vessels on seabirds under the No Action Alternative would be minor and short-term. Short-term impacts on individual birds are not expected to impact seabird populations.

Seabirds and shorebirds birds may be exposed to sonic booms infrequently while flying or foraging in the Study Area or while feeding, perching, or nesting on FDM. Anecdotally, birds typically take flight while roosting or nesting during quarterly helicopter-based booby population surveys over FDM; birds that are stationary and not on the wing are counted (U.S. Department of the Navy 2013b). Although no studies are available specific to seabird responses to low-level overflights over FDM, other studies of shorebird responses to military aircraft overflights are helpful. Black, et al. (1984), studied the effects of low-altitude (less than 500 ft. [152 m] above ground level) military training flights with sound levels from 55 to 100 dBA on wading bird colonies (i.e., great egret, snowy egret, tricolored heron, and little blue heron). The training flights involved three or four aircraft, which occurred once or twice per day. This study concluded that the reproductive activity—including nest success, nestling survival, and nestling chronology—was independent of F-16 overflights. Dependent variables were more strongly related to ecological factors, including location and physical characteristics of the colony and climatology. Another study on the effects of circling fixed-wing aircraft and helicopter overflights on wading bird colonies found that at altitudes of 195 ft. (59 m) to 390 ft. (119 m), there was no reaction in nearly 75 percent of the 220 observations. Ninety percent displayed no reaction or merely looked toward the direction of the noise source. Another 6 percent stood up, 3 percent walked from the nest, and 2 percent flushed (but were without active nests) and returned within 5 minutes (Kushlan 1978). These studies, coupled with anecdotal observations on FDM during quarterly seabird monitoring surveys, suggest that aircraft overflights do not have harmful effects on nesting and roosting seabirds on FDM, and that the behavioral responses are short term. Chronic stress, nest abandonment, or population-level impacts are not expected to occur. It should be noted that population trends of the masked booby, red-footed booby, and brown booby have experienced seasonal and annual fluctuations, but the long term trends for these species have remained stable (U.S. Department of the Navy 2013b).

Short-tailed albatrosses, Hawaiian petrels, and Newell's shearwaters are rare vagrants in the MITT Study Area. The southern portion of the short-tailed albatross range is likely the northern edge of the North Equatorial Current, which overlaps with the MITT Study Area. The ranges of the Hawaiian petrel and Newell's shearwater overlap with MITT Study Area outside of these species' breeding seasons, are rare vagrant migrants that forage in offshore, open ocean waters. Aviation training under 1,000 ft. (305 m) and vessels may intersect with transiting short-tailed albatrosses through training areas; however, the rarity of this species in general and the lack of frequent sightings, chances for its potential interactions with training exercises would be extremely low. Further, albatrosses use dynamic soaring, a technique of flying close to the water surface that takes advantage of the wave fronts. The birds surge forward just ahead of a wave, then climb before the wave dips (Pennycuick 1982). The sound of the waves and soaring close to the wave front would likely make aircraft noise unnoticeable. Further, with the exception of helicopter-based search and rescue training activities, a helicopter flying at wave height is unlikely to continue to generate noise for any lengthy period. Birds of this family follow wakes of ships, slightly increasing the potential for interaction with aircraft carriers, especially during the launching or landing of aircraft; however, the probability of direct impacts on individuals or populations remains low. The spatial and temporal variability of both the occurrence of a short-tailed albatross and the training activities conducted within offshore locations near foraging areas presents an improbable chance that a direct or indirect impact would occur to this species.

As shown in Figure 3.6-9, the known ranges of Hawaiian petrels and Newell's shearwaters may overlap with the transit corridor and do not overlap with land training areas or surrounding coastal areas. They were observed in 2007 during cruise surveys in pelagic areas for marine mammals and sea turtles (U.S. Department of the Navy 2007). Aviation training under 1,000 ft. (305 m) and vessels may intersect with transiting Newell's shearwaters and Hawaiian petrels through training areas. Because of the rarity of these species in general and the lack of frequent sightings within the Study Area, chances of potential interactions with training exercises would be extremely low.

Pursuant to the ESA, aircraft and vessel noise generated during training activities under the No Action Alternative would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), aircraft and vessel noise generated during training activities under the No Action Alternative would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

Testing Activities

As described in Table 2.4-4, the No Action Alternative includes one annual testing event conducted by the Office of Naval Research, which is a continuation of a series of experiments for the North Pacific Acoustic Laboratory Philippine Sea Experiment. The intent of these experiments is to study deep-water acoustic propagation and ambient sound in the northern Philippine Sea. Completion of these experiments involves the use of surface and subsurface vessels. No aircraft are used as part of this testing activity.

Pursuant to the ESA, vessel noise generated during testing activities under the No Action Alternative would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), vessel noise generated during testing activities under the No Action Alternative would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

3.6.3.1.3.5 Alternative 1

Training Activities

Training activities under Alternative 1 would increase fixed- and rotary-wing aircraft overflights and vessel movements throughout the Study Area. Specific activities associated with aircraft overflights are listed in Table 2.8-1. Most helicopter training would occur adjacent to areas at Naval Base Guam Apra Harbor, Andersen Air Force Base, Tinian landing beaches, and some transits to FDM and to training areas and drop zones at sea. Concentrations of vessel movements throughout the Study Area are discussed in Section 3.0.5.3.1.5 (Vessel Noise).

Although noise associated with vessel movements would be produced during most sea-based training activities, the most acute noise exposure would be expected from small craft using outboard engines. Any vessel noise disturbance is expected to be very brief and inconsequential. Any reactions may be due more to visual detection of an approaching vessel than to acoustic disturbance.

Under Alternative 1, seabirds and migratory birds may be exposed to more sonic booms infrequently while flying or foraging in the Study Area or while feeding, perching, or nesting on FDM. Seabirds that roost and breed on FDM would be exposed to more noise from overflights, especially from aircraft used in close air support training activities. At FDM, the number of fixed-wing sorties would increase by a factor of five and rotary wing sorties would increase by 33 percent, relative to the No Action Alternative. The expected duration of each exposure would likely last a few seconds as the aircraft conducts reconnaissance, targeting, and weapons firing (for close air support, the typical munitions would be small- and medium-caliber rounds). Aircraft overflights are expected to elicit short-term behavioral responses in nesting birds at FDM. Based on studies from other nesting bird areas, any period away from the nest would last a few seconds to a few minutes, which is likely not long enough for opportunistic predation of a nest, for example, by rats on FDM.

Occasional startle or alert reactions to aircraft and vessels are not likely to disrupt major behavior patterns (such as migrating, breeding, feeding, and sheltering) or to result in serious injury to any seabirds. Helicopter overflights would be more likely to elicit responses than fixed-wing aircraft, but the general health of individual birds would not be compromised. For these reasons, the impact of noise produced by Navy aircraft and vessels on seabirds under Alternative 1 would be minor and short-term. Short-term impacts on individual birds are not expected to impact seabird populations.

Short-tailed albatrosses, Hawaiian petrels, and Newell's shearwaters are rare vagrants in the MITT Study Area. The southern portion of the short-tailed albatross range is likely the northern edge of the North Equatorial Current, which overlaps with the MITT Study Area. The ranges of the Hawaiian petrel and Newell's shearwater overlap with MITT Study Area outside of these species' breeding seasons, are rare vagrant migrants that forage in offshore, open ocean waters. Aviation training under 1,000 ft. (305 m) and vessels may intersect with transiting short-tailed albatrosses through training areas. Because of the rarity of these species in general and the lack of frequent sightings within the Study Area, chances of potential interactions with training exercises would be extremely low. Birds of this family follow wakes of ships, slightly increasing the potential for interaction with aircraft carriers, especially during the launching or landing of aircraft; however, the probability of direct impacts on individuals or populations remains low. The spatial and temporal variability of both the occurrence of a short-tailed albatross and the training activities conducted within offshore locations near foraging areas presents an improbable chance that a direct or indirect impact would occur to this species.

As shown in Figure 3.6-9, the known ranges of Hawaiian petrels and Newell's shearwaters may overlap with the transit corridor and do not overlap with land training areas or surrounding coastal areas. They were observed in 2007 during cruise surveys in pelagic areas for marine mammals and sea turtles (U.S. Department of the Navy 2007). Aviation training under 1,000 ft. (305 m) and vessels may intersect with transiting Newell's shearwaters and Hawaiian petrels through training areas. Because of the rarity of these species in general and the lack of frequent sightings within the Study Area, chances of potential interactions with training exercises would be extremely low.

Pursuant to the ESA, aircraft and vessel noise generated during training activities under Alternative 1 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), aircraft and vessel noise generated during training activities under Alternative 1 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

Testing Activities

New vessels proposed for testing under Alternative 1, such as the Littoral Combat Ship, are all fast-moving and designed to operate in nearshore waters. Overall sound levels may increase in these environments. The number of specific activities and proposed locations are discussed in further detail in Tables 2.8-2 and 2.8-4 of Chapter 2 (Description of Proposed Action and Alternatives), Section 3.0.5.3.1.5 (Vessel Noise), and Section 3.0.5.3.1.6 (Aircraft Overflight Noise).

Under Alternative 1, 159 activities involving vessel movements are proposed. The testing activities under the No Action Alternative only require one activity per year involving vessel movements. Under Alternative 1, 320 activities involving aircraft movements are proposed, compared to no events under the No Action Alternative. Nearshore waters around rookery and roosting locations will likely support the highest number of seabirds. The response to aircraft and vessel noise would be limited to short-term behavioral responses (moving to a different foraging area, or cessation of foraging activities). It should be noted that the majority of these nearshore testing activities would likely occur around Guam because of the close proximity to Apra Harbor. The high-speed nearshore vessel mission package testing would not occur in nearshore waters adjacent to important rookery locations (e.g., rookery locations on northern islands, FDM, I'Chenchon Bird Sanctuary on Rota). Similarly, there are no testing activities involving aircraft that would fly at altitudes sufficiently low to disturb birds at these rookery locations, including FDM.

As shown in Figure 3.6-9, the known ranges of Hawaiian petrels and Newell's shearwaters may overlap with the transit corridor and do not overlap with land training areas or surrounding coastal areas. They were observed in 2007 during cruise surveys in pelagic areas for marine mammals and sea turtles (U.S. Department of the Navy 2007). Aviation testing under 1,000 ft. (305 m) and vessels may intersect with transiting Newell's shearwaters and Hawaiian petrels through training areas. Because of the rarity of these species in general and the lack of frequent sightings within the MITT Study Area, chances of potential interactions with testing exercises would be extremely low.

Pursuant to the ESA, aircraft and vessel noise generated during testing activities under Alternative 1 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), aircraft and vessel noise generated during testing activities under Alternative 1 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

3.6.3.1.3.6 Alternative 2

Training Activities

The location of training activities under Alternative 2 is identical to training activities under Alternative 1. There are only slight increases in aircraft and vessel movements compared to Alternative 1; therefore, impacts and comparisons to the No Action Alternative would also be identical to those described in Section 3.6.3.1.3.5 (Alternative 1). Under Alternative 2, marine birds may be exposed to more sonic booms infrequently while flying or foraging in the Study Area or while feeding, perching, or nesting on FDM. Seabirds that roost and breed on FDM would be exposed to more noise from overflights, especially from aircraft used in close air support training activities. At FDM, the number of fixed-wing sorties would increase by a factor of five and rotary wing sorties would increase by 33 percent, relative to the No Action Alternative. The expected duration of each exposure would likely last a few seconds as the aircraft conducts reconnaissance, targeting, and weapons firing (for close air support, the typical munitions would be small- and medium-caliber rounds). Aircraft overflights are expected to elicit short-term behavioral responses in nesting birds at FDM. Based on studies from other nesting bird areas, any period away from the nest would last a few seconds to a few minutes, which is likely not long enough for opportunistic predation of a nest, for example, by rats on FDM. The known ranges of Hawaiian petrels and Newell's shearwaters may overlap with the transit corridor and do not overlap with land training areas or surrounding coastal areas. They were observed in 2007 during cruise surveys in pelagic areas for marine mammals and sea turtles (U.S. Department of the Navy 2007). Aviation testing under 1,000 ft. (305 m) and vessels may intersect with transiting Newell's shearwaters and Hawaiian petrels through training areas under Alternative 2. Aircraft and vessel noise would have no effect on ESA-listed seabird species. This conclusion is based on the rare occurrence of these species within the MITT Study Area, and absence from breeding grounds and rookery sites located within the Study Area, particularly at FDM. This conclusion is consistent with the 2010 Biological Opinion issued by the USFWS Pacific Island Field Office for training within the MIRC.

Pursuant to the ESA, aircraft and vessel noise generated during training activities under Alternative 2 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), aircraft and vessel noise generated during training activities under Alternative 2 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

Testing Activities

Testing activities proposed under Alternative 2 would increase aircraft flights and vessel movements compared to both the No Action Alternative and Alternative 1, leading to an increase in aircraft- and vessel-related noise in some portions of the Study Area. Under Alternative 2, 181 activities involving vessel movements are proposed. The testing activities under the No Action Alternative include only one activity per year involving vessel movements. Under Alternative 2, 362 activities involving aircraft movements are proposed, compared to no events under the No Action Alternative. Although overall aircraft and vessel noise would increase over the No Action Alternative, impacts on individual birds would be similar. Based on the increased activities under Alternative 2, more birds could be exposed to sound; the number of times an individual bird is exposed could also increase. Similar to the No Action Alternative for training, the responses would be limited to short-term behavioral or physiological reactions, and the general health of individual birds would not be compromised. Short-term impacts on individual birds are not expected to impact seabird populations. Although noise due to aircraft and vessels would increase over Alternative 1, the types of impacts on short-tailed albatrosses, Hawaiian petrels, Newell's shearwater, masked boobies, great frigatebirds, and other marine bird species that visit and breed within the Study Area would be no different from those under Alternative 1.

Pursuant to the ESA, aircraft and vessel noise generated during testing activities under Alternative 2 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), aircraft and vessel noise generated during testing activities under Alternative 2 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

3.6.3.2 Energy Stressors

This section analyzes the potential impacts of the various types of energy stressors that can occur during training and testing activities within the Study Area. This section includes analysis of the potential impacts from electromagnetic devices.

3.6.3.2.1 Impacts from Electromagnetic Devices

Several different types of electromagnetic devices are used during training and testing activities throughout the Study Area, as described in Chapter 2 (Description of Proposed Action and Alternatives). Electromagnetic training and testing activities include an array of magnetic sensors used in MCM operations in the Study Area. Some electromagnetic devices, such as a vessel radar and radio, are devices that could impact seabirds above the water. Towed electromagnetic device impacts on seabirds would only occur underwater and would only impact diving species or species on the surface in the immediate area where the device is deployed. There is no information available on how birds react to electromagnetic fields underwater.

Electromagnetic devices are used primarily in towed-mine neutralization and port security training. Similar testing activities include the use of electromagnetic devices (e.g., mine detection/neutralization and electromagnetic activities [e.g., Littoral Combat Ship mission package testing. In most cases, such as mine detection/neutralization, the device simply mimics the electromagnetic signature of a vessel passing through the water. None of the devices emit any type of electromagnetic "pulse." The kinetic energy weapon is also included as an electromagnetic testing activity. As stated previously, electromagnetic energy is not analyzed for impacts on marine birds because the electromagnetic energy generated for this testing activity is confined to the ship and will not impact marine birds.

Seabirds and other migratory birds are known to use the Earth's magnetic field as a navigational cue during seasonal migrations (Akesson and Hedenstrom 2007, Fisher 1971, Wiltschko and Wiltschko 2003). Birds use numerous other orientation cues to navigate in addition to magnetic fields. These include position of the sun, celestial cues, visual cues, wind direction, and scent (Akesson and Hedenstrom 2007, Fisher 1971, Haftorn et al. 1988, Wiltschko and Wiltschko 2003). It is believed that by using a combination of these cues birds are able to successfully navigate long distances. A magnetite-based (magnetic mineral) receptor mechanism in the upper beak of birds provides information on position and compass direction (Wiltschko and Wiltschko 2003). Electromagnetic devices send out electromagnetic signals into the environment to which birds are able to detect and respond.

Some electromagnetic devices such as a vessel radar and radio are devices that could impact birds above the water. Towed electromagnetic device impacts on birds would only occur underwater and would only impact diving species or species on the surface in the immediate area where the device is deployed. There is no information available on how birds react to electromagnetic fields underwater.

Studies conducted on electromagnetic sensitivity in birds have typically been associated with land, and little information exists specifically on seabird response to electromagnetic changes at sea. Results from a study conducted by Larkin and Sutherland (1977) showed that during nocturnal flights, birds were capable of sensing electromagnetic fields emitted from an antenna in Wisconsin used for the Navy's Project Seafarer. This study suggests that birds reacted to low intensity electromagnetic fields and changed their flight altitudes more frequently when the antenna was operational. Another study on the effects of extremely low-frequency electromagnetic fields on breeding and migrating birds around the Navy's extra-low-frequency communication system antenna in Wisconsin found no evidence that bird distribution or abundance was impacted by electromagnetic fields produced by the antenna (Hanowski et al. 1993).

Possible impacts on birds from electromagnetic fields above water include behavioral responses such as temporary disorientation and change in flight direction (Larkin and Sutherland 1977, Wiltschko and Wiltschko 2003) and flight altitude (Larkin and Sutherland 1977). Many bird species return to the same stopover, wintering, and breeding areas every year and often follow the exact same or very similar migration routes (Akesson and Hedenstrom 2007). However, ample evidence exists that displaced birds can successfully reorient and find their way when one or more cues are removed (Haftorn et al. 1988). For example, Haftorn et al. (1988) found that after removal from their nests and release into a different area, snow petrels (*Pagodrama nivea*) were able to successfully navigate back to their nests even when their ability to smell was removed. Furthermore, Wiltschko and Wiltschko (2003) report that electromagnetic pulses administered to birds during an experimental study on orientation do not deactivate the magnetite-based receptor mechanism in the upper beak altogether but instead cause the receptors to provide altered information, which in turn causes birds to orient in different directions. However, these impacts were temporary, and the ability of the birds to correctly orient themselves eventually returned.

3.6.3.2.1.1 No Action Alternative

Training Activities

Under the No Action Alternative, there are no training activities that involve the use of electromagnetic devices.

Testing Activities

Under the No Action Alternative, there are no testing activities that involve the use of electromagnetic devices.

3.6.3.2.1.2 Alternative 1

Training Activities

As indicated in Section 3.0.5.3.2.1 (Electromagnetic Devices), training activities involving electromagnetic devices under Alternative 1 occur up to five times annually as part of Mine Countermeasure Exercise – Towed Sonar exercises and Civilian Port Defense activities. Table 2.8-1 lists the number and location of training activities that use electromagnetic devices. Exposure of birds would be limited to those foraging at or below the surface (e.g., terns, cormorants, loons, petrels, or grebes) because that is where the devices are used. Birds that forage inshore or located at FDM or other rookery locations in the Mariana archipelago would not be exposed to these electromagnetic stressors because electromagnetic devices are not used in areas close to shore and are used only underwater. Also, the electromagnetic fields generated would be distributed over time and location, and any influence on the surrounding environment would be temporary and localized. More importantly, the electromagnetic devices used are typically towed by a helicopter, and it is likely that any birds in the vicinity of the approaching helicopter would be dispersed by the sound and disturbance generated by the helicopter (Section 3.6.3.1.3, Impacts from Aircraft and Vessel Noise) and move away from the device before any exposure could occur.

In the unlikely event that a bird is temporarily disoriented by an electromagnetic device, it would still be able to re-orient using their internal magnetic compass to aid in navigation (Wiltschko et al. 2011). Therefore, any temporary disorientation experienced by birds from electromagnetic changes caused by training activities in the Study Area may be considered a short-term impact and would not hinder bird navigation abilities. Impacts on birds from potential exposure to electromagnetic fields would be temporary and inconsequential based on:

- Relatively low intensity of the magnetic fields generated (0.2 microtesla at 656 ft. [200 m] from the source)
- Very localized potential impact area
- Temporary duration of the activities (hours)
- Occurring only underwater

Short-tailed albatrosses, Hawaiian petrels, and Newell's shearwaters are rare vagrants in the MITT Study Area. The southern portion of the short-tailed albatross range is likely the northern edge of the North Equatorial Current, which overlaps with the MITT Study Area. The ranges of the Hawaiian petrel and Newell's shearwater overlap with MITT Study Area outside of these species' breeding seasons, are rare vagrant migrants that forage in offshore, open ocean waters.

Vessels and aircraft which deploy devices that generate electromagnetic fields may intersect with transiting short-tailed albatrosses through training areas; however, the rarity of this species in general and the lack of frequent sightings, chances for its potential interactions with training exercises would be extremely low. Birds of this family follow wakes of ships, slightly increasing the potential for proximity to ships generating electromagnetic fields. As discussed in Section 3.0.5.3.2.1, most electromagnetic fields are shielded and contained within the ship. The spatial and temporal variability of both the occurrence of a short-tailed albatross and the training activities conducted within offshore locations near foraging areas presents an improbable chance that a direct or indirect impact would occur to this species.

As shown in Figure 3.6-9, the known ranges of Hawaiian petrels and Newell's shearwaters may overlap with the transit corridor and do not overlap with land training areas or surrounding coastal areas. They were observed in 2007 during cruise surveys in pelagic areas for marine mammals and sea turtles (U.S. Department of the Navy 2007). Electromagnetic devices would have no effect on ESA-listed seabird species. This conclusion is based on the rare occurrence of these species within the Study Area, and absence from breeding grounds and rookery sites located within the Study Area, particularly at FDM. This conclusion is consistent with the 2010 Biological Opinion issued by the USFWS Pacific Island Field Office for training within the MIRC.

Pursuant to the ESA, the use of electromagnetic devices during training activities under Alternative 1 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the use of electromagnetic devices during training activities under Alternative 1 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

Testing Activities

Mission package testing for new ship systems includes the use of electromagnetic devices (e.g., magnetic fields generated underwater to detect mines). Under Alternative 1, the Naval Sea Systems Command would engage in up to 32 MCM mission package testing activities. As discussed previously, seabirds may experience temporary behavioral changes (e.g., changes in altitude, orientation shifts) when they enter an electromagnetic field; however, normal behavior is expected to resume when the energy source reduces in power or is turned off, or simply when the bird leaves the area. These events are expected to occur within the at-sea portions of the Study Area, which does not overlap with the normal range of the Hawaiian petrels or Newell's shearwater (see Figure 3.6-9).

There is some overlap of the short-tailed albatross range with the Study Area; however, due to the rarity of this species in general and the lack of frequent sightings, chances for its potential interactions with testing activities would be extremely low. Birds of this family follow wakes of ships, slightly increasing the potential for proximity to ships generating electromagnetic fields. The spatial and temporal variability of both the occurrence of a short-tailed albatross and the testing activities conducted within offshore locations near foraging areas presents an improbable chance that a direct or indirect impact would occur to this species.

Pursuant to the ESA, the use of electromagnetic devices during testing activities under Alternative 1 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the use of electromagnetic devices during testing activities under Alternative 1 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

3.6.3.2.1.3 Alternative 2

Training Activities

As indicated in Section 3.0.5.3.2.1 (Electromagnetic Devices), training activities involving electromagnetic devices under Alternative 2 occur up to five times annually as part of Mine Countermeasure – Towed Sonar and Civilian Port Defense activities. Table 2.8-1 lists the number and location of training activities that use electromagnetic devices. The location and number of electronic warfare exercises under Alternative 2 are the same as Alternative 1; therefore, the conclusions for Alternative 2 are the same as for Alternative 1.

Pursuant to the ESA, the use of electromagnetic devices during training activities under Alternative 2 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the use of electromagnetic devices during training activities under Alternative 2 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

Testing Activities

The Naval Sea Systems Command would engage in up to 36 MCM mission package testing activities under Alternative 2. Marine birds that co-occur with these activities would have the potential to be exposed to the electromagnetic fields. Although there is a slight increase in the use of electromagnetic devices, the use of electromagnetic devices is not expected to cause more than a short-term behavioral disturbance to seabirds or have any population-level effects.

Mission package testing for new ship systems includes the use of electromagnetic devices (e.g., magnetic fields generated underwater to detect mines). As with Alternative 1, these events under Alternative 2 are expected to occur within the at-sea portions of the Study Area, which does not overlap with the normal range of the Hawaiian petrels or Newell's shearwater (see Figure 3.6-9). There is some overlap of the short-tailed albatross range with the Study Area; however, due to the rarity of this species in general and the lack of frequent sightings, chances for its potential interactions with testing activities would be extremely low. Birds of this family follow wakes of ships, slightly increasing the potential for proximity to ships generating electromagnetic fields. The spatial and temporal variability of both the occurrence of a short-tailed albatross and the testing activities conducted within offshore locations near foraging areas presents an improbable chance that a direct or indirect impact would occur to this species. Birds that roost or breed within the Study Area would only be exposed when these birds are foraging or transiting through an area where testing is occurring. Despite the slight increase in the use of electromagnetic devices under Alternative 2, the use of electromagnetic devices is not expected to cause more than a short-term behavioral disturbance to the masked booby, great frigatebird, and any other seabird or shorebird that visits, roosts, or breeds within the Study Area.

Pursuant to the ESA, the use of electromagnetic devices during testing activities under Alternative 2 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the use of electromagnetic devices during testing activities under Alternative 2 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

3.6.3.3 Physical Disturbance and Strike Stressors

This section describes the potential impacts on birds by aircraft and aerial target strikes, vessels (disturbance and strike), military expended material strike, ground disturbance, and wild fires at FDM. For a list of Navy activities that involve this stressor refer to Section 3.0.5.3.3 (Physical Disturbance and Strike Stressors). Aircraft include fixed-wing and rotary-wing aircraft; vessels include various sizes and classes of ships, submarines, and other boats; towed devices, unmanned surface vehicles, and unmanned underwater vehicles; military expended material includes non-explosive practice munitions, target fragments, decelerators or parachutes, and other objects.

Physical disturbance and strike risks, primarily from aircraft, have the potential to impact all taxonomic groups found within the Study Area (Table 3.6-3) if birds are in the same area with aircraft, vessels, and military expended material. Impacts of physical disturbance include behavioral responses such as temporary disorientation, change in flight direction, and avoidance response behavior. Physical disturbances (discussed in Section 3.6.3.1.3, Impacts from Aircraft and Vessel Noise) may elicit short-term behavioral or physiological responses such as alert response, startle response, cessation of feeding, fleeing the immediate area, and a temporary increase in heart rate. These disturbances can also result in abnormal behavioral, growth, or reproductive impacts in nesting birds and can cause foraging and nesting birds to flush from or abandon their habitats or nests. Aircraft strikes often result in bird mortalities or injuries.

Although birds likely hear and see approaching vessels and aircraft, they cannot avoid all collisions. Nighttime lighting on vessels, specifically high-powered searchlights used for navigation in icy waters off of Greenland has caused birds to become confused and collide with Navy vessels, cargo vessels, and trawlers (Merkel and Johansen 2011). Birds are known to be attracted to lights which can lead to collisions (Gehring et al. 2009, Poot et al. 2008). High-speed collisions with large objects can be fatal to birds. Training and testing activities around concentrated numbers of birds would cause greater disturbance and increase the potential for strikes.

3.6.3.3.1 Impacts from Aircraft and Aerial Targets

Aircraft and aerial target strikes could occur during training and testing activities that use aircraft, particularly in nearshore areas, where birds are more concentrated in the Study Area. Training and testing activities where aircraft are used typically occur further offshore.

Wildlife aircraft strikes are a serious concern for the Navy because these incidents can harm aircrews as well as damage equipment and injure or kill wildlife (Bies et al. 2006). Since 1981, Naval Aviators reported 16,550 bird strikes at a cost of $350 million. About 90 percent of wildlife/aircraft collisions involve large birds or large flocks of smaller birds (Federal Aviation Administration 2003), and more than 70 percent involve gulls, waterfowl, or raptors.

Part of aviation safety during training and testing activities is the implementation of the Bird/Animal Aircraft Strike Hazard program. The Bird/Animal Aircraft Strike Hazard program manages risk by addressing specific aviation safety hazards associated with wildlife near airfields through coordination among all the entities supporting the aviation mission (U.S. Department of Defense 2012). The Bird/Animal Aircraft Strike Hazard program consists of, among other things, identifying the bird/animal species involved and the location of the strikes to understand why the species is attracted to a particular area of the airfield or training route. By knowing the species involved, managers can understand the habitat and food habits of the species. A Wildlife Hazard Assessment identifies the areas of the airfield that are attractive to the wildlife and provides recommendations to remove or modify the attractive feature. Recommendations may include the removal of unused airfield equipment to eliminate perch sites, placement of anti-perching devices, wiring of streams and ponds, removal of brush/trees, use of pyrotechnics, and modification of the grass mowing program (U.S. Department of Defense 2012).

Air Force Instruction 91-202 requires Andersen Air Force Base to implement a Bird/Animal Aircraft Strike Hazard Plan. The Andersen Air Force Base Bird/Animal Aircraft Strike Hazard plan provides guidance for reducing the incidents of bird strikes in and around areas where flying training is being conducted. At Andersen Air Force Base, the only regular location of fixed wing take offs and landings, a sound cannon is deployed on the runway to discourage birds from accumulating on or near the runway. The plan is reviewed annually and updated as needed. Bird/Animal Aircraft Strike Hazard plans are not required around Northwest Field and Orote Air Field on Guam, and North Field on Tinian.

Though bird strikes can occur anywhere aircraft are operated, Navy and Air Force data indicate they occur more often over land (Air Force Safety Center 2007, Navy Safety Center 2009, U.S. Department of Defense 2012). Bird strike potential is greatest in foraging or resting areas, in migration corridors, and at low altitudes. For example, birds can be attracted to airports because they often provide foraging and nesting resources (Federal Aviation Administration 2003, U.S. Department of Defense 2012).

For the majority of fixed-wing activities, flight altitudes would be above 3,000 ft. (914 m), with the exception of sorties associated with air-to-surface bombing exercises and sonobuoy drops. Typical flight altitudes during air-to-surface bombing exercises are from 500 to 5,000 ft. (152 to 1,524 m) above ground level. Most fixed-wing aircraft flight hours (greater than 90 percent) occur at distances greater than 12 nm offshore.

Helicopter flights would occur closer to the shoreline where sheltering, roosting, and foraging of birds occur. Helicopters can hover and fly low and would be used to tow electromagnetic devices as well as for other military activities at sea. This combination would make a potential helicopter strike to a bird possible. Additional details on typical altitudes and characteristics of aircraft used in the Study Area are provided in Section 3.0.5.3.1.6 (Aircraft Overflight Noise) and in Appendix A (Training and Testing Activities Descriptions).

In addition to manned aircraft, aerial targets such as unmanned drones and expendable rocket powered missiles, could also incur a bird strike but the probability is low. No data about bird strikes to drones or expendable rocket-powered missiles are available.

Approximately 95 percent of bird flight during migration occurs below 10,000 ft. (3,048 m), with the majority below 3,000 ft. (914 m) (Air Force Safety Center 2007, Navy Safety Center 2009, U.S. Department of Defense 2012). Bird and aircraft encounters are more likely to occur during aircraft takeoffs and landings than when the aircraft is engaged in level flight. In a study that examined 38,961 bird and aircraft collisions, Dolbeer (2006) found that the majority (74 percent) of collisions occurred below 500 ft. (152 m). Air Force data support this statistic, showing that approximately 70 percent of collisions at Air Force-administered airfields occur below 500 ft. (152 m) (U.S. Department of Defense 2012). Collisions, however, have been recorded at elevations as high as 12,139 ft. (3,700 m) (Dove and Goodroe 2008).

The potential for bird strikes to occur in offshore areas is relatively low because activities are widely dispersed and occur at relatively high altitudes (above 3,000 ft. [914 m] for fixed-wing aircraft) where seabird occurrences are generally low.

In general, bird populations consist of hundreds or thousands, ranging across a large geographical area. In this context, the loss of several or even dozens of birds due to physical strikes may not constitute a population-level effect, although some species gather in large flocks. Bird exposure to strike potential would be relatively brief as an aircraft quickly passes overhead. Seabirds actively avoid interaction with aircraft; however, disturbances of various seabird species may occur from aviation operations on a site-specific basis. As a standard operating procedure, aircraft avoid large flocks of birds to minimize the safety risk involved with a potential bird strike.

3.6.3.3.1.1 No Action Alternative

Training Activities

Training activities under the No Action Alternative include fixed- and rotary-wing aircraft overflights. Certain portions of the Study Area, such as areas near Navy and Air Force airfields, installations, and ranges are used more heavily by Navy and Air Force aircraft than other portions as described in further detail in Table 2.8-1 in Chapter 2 (Description of Proposed Action and Alternatives).

Bird exposure to strike potential would be relatively brief as an aircraft quickly passes. Birds actively avoid interaction with aircraft; however, disturbances or strike of various bird species may occur from aircraft on a site-specific basis. At FDM, close air support training and other aircraft training would occur at low altitudes, and helicopter and fixed wing overflights may occur over rookery locations at Apra Harbor and Andersen AFB on Guam. Low altitude aircraft overflights would not occur over any other rookery location within the Mariana Islands. As a standard operating procedure, aircraft avoid large flocks of birds to minimize the personnel safety risk involved with a potential bird strike. Some bird and aircraft strikes and associated bird mortalities or injuries could occur in the Study Area under the No Action Alternative; however, no long-term or population-level impacts are expected. It should be noted that low level helicopter flights at FDM occur on a quarterly basis since 2010 and on a monthly basis between 1997 and 2009 for seabird monitoring surveys. These surveys have never recorded a strike of a bird from an aircraft. Further, there has never been a reported aircraft strike of a bird during training activities over FDM, which involve more tactical maneuvers and relatively faster flight speeds. Although there is limited potential for a strike of a seabird by an aircraft over rookery locations (particularly at FDM) the injury or mortality of a single individual seabird would not adversely impact populations of the masked booby, great frigatebird, or other marine bird species that visit, roost, or breed within the Study Area.

Aircraft flight lines at sea may overlay transiting short-tailed albatrosses through training areas; however, due to the rarity of this species in general and the lack of frequent sightings, chances for its potential interactions with training exercises would be extremely low. Further, the altitude of aircraft at sea is likely much higher than a transiting or foraging albatross. Birds of this family follow wakes of ships, slightly increasing the potential for proximity to ships generating electromagnetic fields. The spatial and temporal variability of both the occurrence of a short-tailed albatross and the training activities conducted within offshore locations near foraging areas presents an improbable chance that a direct or indirect impact would occur to this species. Because the highest risk for bird strike is during take offs and landings, there would be no risk to short-tailed albatross because this species does not approach land areas.

As shown in Figure 3.6-9, the known ranges of Hawaiian petrels and Newell's shearwaters may overlap with the transit corridor and do not overlap with land training areas or surrounding coastal areas. They were observed in 2007 during cruise surveys in pelagic areas for marine mammals and sea turtles (U.S. Department of the Navy 2007). The potential for these two species to co-occur with aircraft and aerial target training activities within the MITT Study Area is extremely low.

Pursuant to the ESA, the use of aircraft and aerial targets during training activities under the No Action Alternative would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the use of aircraft and aerial targets during training activities under the No Action Alternative would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

Testing Activities

As described in Table 2.4-4, the No Action Alternative includes one annual testing event conducted by the Office of Naval Research, which is a continuation of a series of experiments for the North Pacific Acoustic Laboratory Philippine Sea Experiment. The intent of these experiments is to study deep-water acoustic propagation and ambient noise in the northern Philippine Sea. Completion of these experiments involves the use of surface and subsurface vessels. No testing activities involving aircraft or aerial targets are included in the No Action Alternative.

3.6.3.3.1.2 Alternative 1

Training Activities

Training activities under Alternative 1 include an increase in aircraft flight hours from the No Action Alternative in the same areas. By way of example, the number of sorties leaving Andersen Air Force Base and carriers at sea would increase less than 300 percent relative to the No Action Alternative, as part of strike warfare (air to ground) training at FDM. The types of activities, locations, and types of aircraft would not differ from the No Action Alternative.

For reasons stated in Section 3.6.3.3.1.1 (No Action Alternative), disturbance or strike from aircraft or aerial targets are not expected to have lasting impacts on the survival, growth, recruitment, or reproduction of bird populations.

Aircraft flight lines at sea under Alternative 1 may overlay transiting short-tailed albatrosses through training areas; however, the rarity of this species in general and the lack of frequent sightings, chances for its potential interactions with training exercises would be extremely low. Further, the altitude of aircraft at sea is likely much higher than a transiting or foraging albatross. Birds of this family follow wakes of ships, slightly increasing the potential for proximity to ships from which aircraft and aerial targets are launched. The spatial and temporal variability of both the occurrence of a short-tailed albatross and the training activities conducted within offshore locations near foraging areas presents an improbable chance that a direct or indirect impact would occur to this species. Because the highest risk for bird strike is during take offs and landings, there would be no risk to short-tailed albatross because this species does not approach land areas in the Mariana Islands.

As shown in Figure 3.6-9, the known ranges of Hawaiian petrels and Newell's shearwaters may overlap with the transit corridor and do not overlap with land training areas or surrounding coastal areas. They were observed in 2007 during cruise surveys in pelagic areas for marine mammals and sea turtles (U.S. Department of the Navy 2007). The potential for these two species to co-occur with aircraft and aerial target training activities within the MITT Study Area is extremely low.

Pursuant to the ESA, the use of aircraft and aerial targets during training activities under Alternative 1 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the use of aircraft and aerial targets during training activities under Alternative 1 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

Testing Activities

Testing activities under Alternative 1 would introduce rotary wing aircraft and fixed wing aircraft. Under Alternative 1, 320 activities involving aircraft movements are proposed, compared to zero events under the No Action Alternative. The types of activities, locations, and types of aircraft would not differ from training activities. These activities would not occur over FDM or other important rookery locations in the Mariana Islands.

For reasons stated in Section 3.6.3.3.1.1 (No Action Alternative), disturbance or strike from aircraft or aerial targets are not expected to have lasting impacts on the survival, growth, recruitment, or reproduction of bird populations.

Aircraft flight lines at sea under Alternative 1 may overlay transiting short-tailed albatrosses through training areas; however, the rarity of this species in general and the lack of frequent sightings, chances for its potential interactions with testing exercises would be extremely low. Further, the altitude of aircraft at sea is likely much higher than a transiting or foraging albatross. Birds of this family follow wakes of ships, slightly increasing the potential for proximity to ships as the ship move through an area. The spatial and temporal variability of both the occurrence of a short-tailed albatross and the testing activities conducted within offshore locations near foraging areas presents an improbable chance that a direct or indirect impact would occur to this species. Because the highest risk for bird strike is during take offs and landings, there would be no risk to short-tailed albatross because this species does not approach land areas in the Marianas.

As shown in Figure 3.6-9, the known ranges of Hawaiian petrels and Newell's shearwaters may overlap with the transit corridor and do not overlap with land training areas or surrounding coastal areas. They were observed in 2007 during cruise surveys in pelagic areas for marine mammals and sea turtles (U.S. Department of the Navy 2007). The potential for these two species to co-occur with aircraft and aerial target training activities within the MITT Study Area is extremely low.

Pursuant to the ESA, the use of aircraft and aerial targets during testing activities under Alternative 1 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the use of aircraft and aerial targets during testing activities under Alternative 1 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

3.6.3.3.1.3 Alternative 2

Training Activities

Training activities under Alternative 2 include an increase in aircraft flight hours from the No Action Alternative in the same areas. By way of example, the number of sorties leaving Andersen Air Force Base and carriers at sea would increase by slightly more than 300 percent relative to the No Action Alternative, as part of strike warfare (air to ground) training at FDM. The types of activities, locations, and types of aircraft would not differ from the No Action Alternative.

For reasons stated in Section 3.6.3.3.1.1 (No Action Alternative), disturbance or strike from aircraft or aerial targets are not expected to have lasting effects on the survival, growth, recruitment, or reproduction of bird populations.

Aircraft flight lines at sea under Alternative 2 may overlay transiting short-tailed albatrosses through training areas; however, the rarity of this species in general and the lack of frequent sightings, chances for its potential interactions with training exercises would be extremely low. Further, the altitude of aircraft at sea is likely much higher than a transiting or foraging albatross. Birds of this family follow wakes of ships, slightly increasing the potential for proximity to ships from which aircraft and aerial targets are launched. The spatial and temporal variability of both the occurrence of a short-tailed albatross and the training activities conducted within offshore locations near foraging areas presents an improbable chance that a direct or indirect effect would occur to this species. Because the highest risk for bird strike is during take offs and landings, there would be no risk to short-tailed albatross because this species does not approach land areas in the Marianas.

As shown in Figure 3.6-9, the known ranges of Hawaiian petrels and Newell's shearwaters may overlap with the transit corridor and do not overlap with land training areas or surrounding coastal areas. They were observed in 2007 during cruise surveys in pelagic areas for marine mammals and sea turtles (U.S. Department of the Navy 2007). The potential for these two species to co-occur with aircraft and aerial target training activities within the MITT Study Area is extremely low.

Pursuant to the ESA, the use of aircraft and aerial targets during training activities under Alternative 2 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the use of aircraft and aerial targets during training activities under Alternative 2 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

Testing Activities

Under Alternative 2, 362 activities involving aircraft movements are proposed, compared to zero events under the No Action Alternative. Compared to Alternative 1, Alternative 2 would include 42 additional activities involving aircraft movements. The types and number of testing activities involving aircraft in Alternative 2 are similar to Alternative 1. Therefore, the conclusions for Alternative 2 are the same as for Alternative 1.

Pursuant to the ESA, the use of aircraft and aerial targets during testing activities under Alternative 2 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the use of aircraft and aerial targets during testing activities under Alternative 2 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

3.6.3.3.2 Impacts from Vessels and In-Water Devices

The majority of the training and testing activities under all the alternatives involve vessels and a few of the activities involve the use of in-water devices.

Direct collisions with most Navy vessels are unlikely but do occur, especially at night. Other impacts would be the visual and behavioral disturbance from a vessel. Birds respond to moving vessels in various ways. Some birds, including certain species of gulls, storm petrels, and albatrosses, commonly follow vessels (Hyrenbach 2001, 2006); while other species such as frigatebirds and sooty terns seem to avoid vessels (Hyrenbach 2006). There could be a slightly increased risk of impacts during the winter, or fall/spring migrations when migratory birds are concentrated in coastal areas. However, despite this concentration, most birds would still be able to avoid collision with a vessel. Vessel movements could elicit short-term behavioral or physiological responses (e.g., alert response, startle response, fleeing the immediate area, temporary increase in heart rate). However, the general health of individual birds would not be compromised.

The possibility of collision with an aircraft carrier or surface combatant vessels (or a vessel's rigging, cables, poles, or masts) could increase at night, especially during inclement weather. Birds can become disoriented at night in the presence of artificial light, and lighting on vessels may attract some birds (U.S. Fish and Wildlife Service 2005, 2011a), increasing the potential for harmful encounters. Lighting on boats and vessels have also contributed to bird fatalities in open-ocean environments when birds are attracted to these lights, usually in inclement weather conditions (Merkel and Johansen 2011). This could be a scenario that Navy vessels could face, especially during the migration season when migrating birds are using celestial clues during night time flight. Other harmful seabird-vessel interactions are commonly associated with commercial fishing vessels because seabirds are attracted to concentrated food sources around these vessels (Melvin and Parrish 1999, Melvin et al. 2001). However, these concentrated food sources are not associated with Navy vessels.

Navy aircraft carriers, surface combatant vessels, and amphibious warfare ships are minimally lighted for tactical purposes. Under normal cruising conditions, vessels that are 50 m (164 ft.) in length or greater typically exhibit a masthead light (visible out to 6 nm), sidelights and aft lights (both visible out to 3 nm). Vessels that are 12–50 m (39–164 ft.) in length typically exhibit a masthead light (visible out to 5 nm), and sidelights and aft lights (visible out to 2 nm). These lighting regulations are in accordance with Rule 22, Part C, Section III of the International Regulations for Preventing Collisions at Sea. Solid white lighting appears more problematic for birds, especially nocturnal migrants (Gehring et al. 2009, Poot et al. 2008). Navy vessel lights are mostly solid, but sometimes may not appear solid because of the constant movement of the vessel (wave action), making vessel lighting potentially less problematic for birds in some situations.

Procrocellariiformes, in particular, Newell's shearwater and Hawaiian petrel fledglings are particularly susceptible to light attraction, which can cause exhaustion and increase potential for collision with land-based structures (Reed et al. 1985). The collision may cause mortality or injury which increases potential for predation. These two species are considered rare vagrants in the Study Area. Further, because nesting for these species only occurs in the Hawaiian Islands, fledglings would not be found within the Study Area.

In addition to vessels, towed devices and unmanned vehicles are also used; however, no documented instances of birds being struck by in-water devices exist. It would be anticipated that most bird species would move away from an unmanned vehicle or a towed device.

The other type of vessel movements in the Study Area with the potential to strike a bird is those used during amphibious landings. These amphibious warfare vessels have the potential to impact shorebirds and seabirds by disturbing or striking individual animals. Amphibious vessel movements could elicit short-term behavioral or physiological responses such as alert response, startle response, cessation of feeding, fleeing the immediate area, nest abandonment, and a temporary increase in heart rate. Amphibious vessels have the potential to disturb foraging shorebirds, seabird nesting on landing beaches is not expected to occur primarily because of predation by introduced brown treesnakes (on Guam). However, the general health of individual birds would not be compromised, unless a direct strike occurred. It is highly unlikely that a shorebird/seabird would be struck in this scenario because most foraging shorebirds in the vicinity of the approaching amphibious vessel would likely be dispersed by the sound of the approaching vessel before it could come close enough to strike a shorebird/seabird (Section 3.6.3.1.3, Impacts from Aircraft and Vessel Noise).

3.6.3.3.2.1 No Action Alternative, Alternative 1, and Alternative 2

<u>Training Activities</u>

As indicated in Section 3.0.5.3.3 (Physical Disturbance and Strike Stressors), the majority of the training activities under all alternatives involve vessels. See Table 3.0-15 for a representative list of Navy vessel sizes and speeds. Vessel activities could be widely dispersed throughout the Study Area, but would be more concentrated near naval ports, piers and range areas. There would be a higher likelihood of seabird and vessel interactions over nearshore than in the open ocean portions of the Study Area because of the concentration of vessel movements in those areas. The number of Navy ships operating in the Study Area varies based on training schedules and can range up to 10 ships at any given time. The probability of vessel and seabird interactions occurring in the Study Area depends on several factors, including the presence and density of seabirds; numbers, types, and speeds of vessels; duration and spatial extent of activities; and protective measures implemented by the Navy.

Birds would not be exposed to unmanned underwater vehicles or remotely operated vehicles because they are typically used on the seafloor or in the water column deeper than the areas commonly used by birds during foraging. The other in-water devices used are typically towed by a helicopter. As discussed for electromagnetic devices (Section 3.6.3.2.1, Electromagnetic Devices), it is likely that any birds in the vicinity of the approaching helicopter would be dispersed by the sound of the helicopter (Section 3.6.3.1.3, Impacts from Aircraft and Vessel Noise) and move away from the in-water device before any exposure could occur.

Vessels and in-water devices under Alternative 2 may coincide with transiting short-tailed albatrosses through training areas; however, due to the rarity of this species in general and the lack of frequent sightings, chances for its potential interactions with training exercises would be extremely low. Birds of this family follow wakes of ships, slightly increasing the potential for interactions with vessels and in-water devices. The spatial and temporal variability of both the occurrence of a short-tailed albatross and the training activities conducted within offshore locations near foraging areas presents an improbable chance that a direct or indirect effect would occur to this species.

Amphibious landings under the No Action Alternative, Alternative 1, and Alternative 2 would occur within landing locations at Naval Base Guam Apra Harbor on Guam and Tinian landing beaches. None of the known breeding locations for seabirds within the Naval Base Guam Apra Harbor (rocky islets off of Orote Island and Orote Peninsula, Neye Island, and Apaoa Point) are used as amphibious landing areas. Unai Chulu and Unai Dankulo may be used for landing craft air cushion training. Historically, only Unai Chulu has been used for landing craft air cushion training; however, additional use of this beach would require beach repairs. Unai Babui is a rocky beach and may be used for amphibious assault vehicle training. Unai Dankulo is also a known breeding location for Pacific reef herons. The other known rookery locations on Tinian, Puntan Masalok (which supports breeding areas for the black noddy, brown noddy, and boobies) and Puntan Lamanibot (another location for Pacific reef herons) are not used for amphibious landings. As stated previously, vessel collision with a foraging seabird is unlikely because the noise generated by the amphibious assault vehicle would likely drive the seabird away from the area. Pacific reef herons nest in trees, so an amphibious assault vehicle maneuvering on the beach area would not likely physically disturb a nest. Amphibious landings do not occur on FDM.

As shown in Figure 3.6-9, the known ranges of Hawaiian petrels and Newell's shearwaters may overlap with the transit corridor and do not overlap with land training areas or surrounding coastal areas. They were observed in 2007 during cruise surveys in pelagic areas for marine mammals and sea turtles (U.S. Department of the Navy 2007). The potential for these two species to co-occur with vessel movements or in-water devices within the MITT Study Area is extremely low.

Pursuant to the ESA, the use of vessels and in-water devices during training activities under the No Action Alternative, Alternative 1, or Alternative 2 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the use of vessels and in-water devices during training activities under the No Action Alternative, Alternative 1, or Alternative 2 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

Testing Activities

As indicated in Section 3.0.5.3.3 (Physical Disturbance and Strike Stressors), the majority of the testing activities under all alternatives involve vessels. See Table 3.0-15 for a representative list of Navy vessel sizes and speeds. Under the No Action Alternative, there are no testing activities that specifically require vessel movements, whereas Alternative 1 would require 300 events and Alternative 2 would require 362 events. Vessel activities could be widely dispersed throughout the Study Area, but would be more concentrated near naval ports, piers, and range areas. There would be a higher likelihood of seabird and vessel interactions over nearshore than in the open ocean portions of the Study Area because of the concentration of vessel movements in those areas.

Birds would not be exposed to unmanned underwater vehicles or remotely operated vehicles because they are typically used on the seafloor or in the water column. The other in-water devices used are typically towed by a helicopter. As discussed for training activities using electromagnetic devices (Section 3.6.3.2.1, Electromagnetic Devices), it is likely that any birds in the vicinity of the approaching helicopter would be dispersed by the sound of the helicopter (Section 3.6.3.1.3, Impacts from Aircraft and Vessel Noise) and move away from the in-water device before any exposure could occur. Under the No Action Alternative, one annual event would require the use of towed in-water devices. Alternative 1 would require 300 events, and Alternative 2 would require 338 events.

Vessels and in-water devices under the No Action Alternative, Alternative 1, and Alternative 2 may coincide with transiting short-tailed albatrosses throughout the MITT Study Area; however, the rarity of this species in general and the lack of frequent sightings, chances for its potential interactions with testing exercises would be extremely low. Birds of this family follow wakes of ships, slightly increasing the potential for interactions with vessels and in-water devices. The spatial and temporal variability of both the occurrence of a short-tailed albatross and the testing activities conducted within offshore locations near foraging areas presents an improbable chance that a direct or indirect effect would occur to this species.

As shown in Figure 3.6-9, the known ranges of Hawaiian petrels and Newell's shearwaters may overlap with the transit corridor and do not overlap with land training areas or surrounding coastal areas. They were observed in 2007 during cruise surveys in pelagic areas for marine mammals and sea turtles(U.S. Department of the Navy 2007). The potential for these two species to co-occur with vessel movements or in-water devices within the MITT Study Area is extremely low.

Pursuant to the ESA, the use of vessels and in-water devices during testing activities under the No Action Alternative, Alternative 1, or Alternative 2 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the use of vessels and in-water devices during testing activities under the No Action Alternative, Alternative 1, or Alternative 2 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

3.6.3.3.3 Impacts from Military Expended Materials

This section analyzes the strike potential to birds of the following categories of military expended materials: (1) non-explosive practice munitions; (2) fragments from high-explosive munitions; and (3) expended materials other than ordnance, such as sonobuoys, vessel hulks, and expendable targets. For a discussion of the types of activities that use military expended materials, where they are used, and how many activities would occur under each Alternative, see Section 3.0.5.3.3.4 (Military Expended Materials).

Exposure of birds to military expended materials during Navy training and testing activities could result in physical injury or behavioral disturbances to birds in air, at the surface, or underwater during foraging dives. Although a quantitative analysis is not possible due to the absence of bird density information in the Study Area, an assessment of the likelihood of exposure to military expended materials was conducted based on general bird distributions in the Study Area.

The number of large-caliber projectiles and other large munitions (e.g., bombs, rockets, missiles) that would be expended in the Study Area annually at sea, coupled with the often patchy pelagic distribution of seabirds (Fauchald et al. 2002, Haney 1986), suggest that the likelihood of this type of strike for a seabird would be extremely low at sea. The number of small-caliber projectiles that would be expended annually during gunnery exercises is much higher than the number of large-caliber projectiles. However, the total number of rounds expended is not a good indicator of strike probability during gunnery exercises because multiple rounds are fired at individual targets.

Human activity such as vessel or boat movement, aircraft overflights, and target setting, could cause birds to flee a target area before the onset of firing, thus avoiding harm. If birds were in the target area, they would likely flee the area prior to the release of military expended materials or just after the initial rounds strike the target area. Additionally, the force of military expended material fragments dissipates quickly once the pieces hit the water, so direct strikes on birds foraging below the surface would not be likely. Also, munitions would not be used in shallow/nearshore areas. Individual birds may be impacted, but ordnance strikes would likely have no impact on bird populations.

At FDM, there is a higher probability for bird strike by military expended materials. FDM supports several rookeries, and therefore concentrations of birds at different times of year are likely to co-occur with training exercises. FDM is the only rookery location where military expended materials are deposited. On FDM, the range area where ordnance is restricted to inert munitions, vegetation is recovering in vertical structure and surface cover, relative to range areas on FDM where explosive ordnance is permitted (U.S. Department of the Navy 2008, 2013a).

3.6.3.3.3.1 No Action Alternative

Training Activities

Tables located in Section 3.0.4.5.3.4 (Military Expended Materials) list the activities that involve military expended materials, most of which are small- and medium-caliber projectiles.

Live fire events do occur within nearshore waters of Guam in defined surface danger zones, explosive ordnance disposal exclusion zones, and extended surface danger zones. Small- and medium-caliber projectiles would also be expended within the Small Arms Firing Area. These areas include a nearshore environment of Guam that is likely a primary foraging habitat for seabird species that roost and breed on the island and offshore islets. Figure 2.7-1 shows the location of these areas. The training activity areas do not include fish aggregating devices, artificial reefs, shipwrecks, abandoned vessels, and or buoys (e.g., navigational buoys, meteorological buoys) that attract seabird prey species and offer perch sites. Section 3.11 (Cultural Resources) discusses shipwrecks other submerged resources that may also serve to aggregate fish and therefore seabirds. The Navy routinely avoids locations of known obstructions which include submerged cultural resources such as historic shipwrecks. These avoidance measures prevent damage to sensitive Navy equipment and vessels, ensure the accuracy of training and testing exercises, and limit the possibility of large numbers of seabirds to be exposed to a training exercise. By avoiding areas where higher numbers of seabirds may congregate, risk of striking seabirds is minimized.

At FDM, there is an increased potential for bird strike by military expended materials. While increased ordnance use may increase exposure to direct strike, percussive force, and the direct and indirect effects of wild land fire, limiting increased ordnance use to existing impact areas will minimize effects on seabird nesting habitats on FDM. Impacts on the great frigatebird population and the masked booby population, may be avoided by not targeting known rookery locations and through the concentration of ordnance to designated range areas on the interior of the island. All these factors serve to minimize the risk of harming seabirds. FDM habitats and wildlife have been subject to perturbations associated with explosive ordnance training, yet utilization of FDM by seabirds has continued. The increase in the number of rounds deployed per year under the No Action Alternative is unlikely to endanger breeding activity of the seven seabird species known to breed at FDM (black noddies, brown noddies, brown boobies, masked boobies, red-footed boobies, white terns, and great frigatebirds) (Reichel 1991, Lusk et al. 2000, U.S. Department of the Navy 2013a). The Navy has reached this conclusion based on (1) population index surveys conducted since 1997 that show populations are relatively stable despite periodic oscillations, and (2) existing conservation measures and targeting restrictions that have minimized the potential impact associated with ordnance use. Further, the Navy will continue to conduct seabird surveys on FDM, as appropriate. FDM is the only land-based live fire range in the Mariana Islands, and live fire training does not occur near other important rookery locations within the archipelago.

Expending of military materials may coincide with transiting short-tailed albatrosses through training areas; however, the rarity of this species in general and the lack of frequent sightings, chances for its potential interactions with training exercises would be extremely low. The spatial and temporal variability of both the occurrence of a short-tailed albatross and the training activities conducted within offshore locations near foraging areas presents an improbable chance that a direct or indirect effect would occur to this species.

As shown in Figure 3.6-9, the known ranges of Hawaiian petrels and Newell's shearwaters may overlap with the transit corridor and do not overlap with land training areas or surrounding coastal areas. They were observed in 2007 during cruise surveys in pelagic areas for marine mammals and sea turtles (U.S. Department of the Navy 2007). The potential for these two species to co-occur with activities that use military expended materials within the MITT Study Area is extremely low.

Pursuant to the ESA, the use of military expended materials during training activities under the No Action Alternative would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the use of military expended materials during training activities under the No Action Alternative would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

Testing Activities

Under the No Action Alternative, there are no testing activities that involve the use of military expended materials.

3.6.3.3.3.2 Alternative 1 and Alternative 2

Training Activities

For training activities at sea, the majority of military expended materials (bombs, medium- and large-caliber projectiles, missiles and decelerators/parachutes) are all used in areas of the MITT Study Area greater than 3 nm from shorelines, and the larger of these (bombs, missiles, large-caliber projectiles) are restricted to use in areas greater than 12 nm from shore. Small caliber projectiles would be used throughout the MITT Study Area. As indicated in Section 3.0.5.3.3.4 (Military Expended Materials), under Alternative 1 and Alternative 2, the total amount of military expended materials is more than twice the amount expended in the No Action Alternative. The activities and type of military expended materials under Alternative 1 and Alternative 2 would be expended in the same geographic locations as the No Action Alternative.

As with the No Action Alternative, live fire training events would continue under Alternative 1 and Alternative 2 within nearshore waters of Guam in defined surface danger zones, explosive ordnance disposal exclusion zones, and extended surface danger zones. Small- and medium-caliber projectiles would also be expended within the Small Arms Firing Area. The training activity areas do not include fish aggregating devices, artificial reefs, known shipwrecks and abandoned vessels, and or buoys (e.g., navigational buoys, meteorological buoys) that attract seabird prey species and offer perch sites. Section 3.11 (Cultural Resources) discusses shipwrecks and other submerged resources that may also serve to aggregate fish and therefore seabirds. The Navy routinely avoids locations of known obstructions which include submerged cultural resources such as historic shipwrecks. These avoidance measures prevent damage to sensitive Navy equipment and vessels, ensure the accuracy of training and testing exercises, and limit the possibility of large numbers of seabirds to be exposed to a training exercise. By avoiding areas where higher numbers of seabirds may congregate, risk of striking seabirds is minimized for training activities under Alternative 1 and Alternative 2.

Specifically at FDM, the number of bombs, projectiles, missiles, and rockets targeting range portions of the island would increase by a factor of three. Although increases in ordnance use are proposed, only existing impact areas (totaling 34 acres [ac.] [13.8 hectares {ha}]) would be used. While increased ordnance use may increase exposure to direct strike, percussive force, and the direct and indirect effects of wild land fire, limiting increased ordnance use to existing impact areas will minimize effects on seabird nesting habitats on FDM. Impacts on any nesting great frigatebirds (believed to nest on the island periodically) and the masked booby population (a species that uses FDM as a large colonial rookery) may be avoided by not targeting known rookery locations and through the concentration of ordnance to designated range areas on the interior of the island. All these factors serve to minimize the risk of harming seabirds, even with the projected increase in training activities utilizing explosive ordnance, relative to the No Action Alternative.

Direct strike from inert munitions and other military expended materials is far less likely to impact seabirds than the potential for blast effects associated with explosive munitions, especially heavy weight munitions. By way of example, a single MK 84 (2,000 lb. explosive bomb) has a hazardous fragment distance of over 300 yards (yd.) (274 m) (U.S. Department of Defense 2004a). For a single MK 48 (25 lb. non-explosive practice bomb), seabird would need to be directly struck by, or in very close proximity to the area of impact. If the injury zone is conservatively estimated to be a 1 yd. radius, the resultant area would be just over 3 square yards ($yd.^2$) (2.5 square meters [m^2]. For a 20 mm (3.5-ounce [oz.]) projectile, the zone would be smaller still, likely less than 0.5 $yd.^2$ (0.42 m^2). Hundreds of thousands of 20 mm projectiles would need to be expended at a single time, and evenly distributed over a given area to equal the impact footprint of a single MK 84 heavyweight bomb.

FDM has been subject to perturbations associated with live-fire weapons training, yet utilization of FDM by seabirds has continued. As discussed previously, the best available data for measuring the impacts of military activities on seabird populations on FDM comes from the helicopter-based surveys for masked booby, red-footed booby, and brown booby. The population trends (shown in

Figure 3.6-6, Figure 3.6-7, and Figure 3.6-8) show annual and seasonal fluctuations, but relatively stable populations and breeding success for the three booby species over the long-term (since 1997 when surveys began). Despite the likely injury and mortality to individual seabirds and eggs, and habitat degradation within the impact areas caused by the continued military use of FDM, the island continues to be a valuable, important, and productive rookery location in the Mariana archipelago (U.S. Fish and Wildlife Service 2005, Lusk et al. 2000, Reichel 1991).

Other factors associated with the military use of the island may benefit seabirds, such as restricting access to the island and nearshore areas surrounding FDM. Excluding access to land prevents poaching of eggs, a major threat to seabirds identified in the USFWS Pacific Islands Seabird Conservation Plan (U.S. Fish and Wildlife Service 2005). Further, restricting availability of waters from the nearshore of FDM through the issuance of NTMs may decrease fishing pressure and provide refugia for seabird prey species, thereby increasing the availability and ease for seabirds to capture prey near FDM.

The increase in the number of rounds deployed per year under Alternative 1 and Alternative 2 is unlikely to endanger breeding activity at FDM for the seven species of seabirds known to nest on the island (black noddies, brown noddies, brown boobies, masked boobies, red-footed boobies, white terns, and great frigatebirds). The Navy has reached this conclusion based on (1) population index surveys conducted since 1997 that show populations are relatively stable despite periodic oscillations, (2) existing conservation measures and targeting restrictions that have minimized the potential impact associated with ordnance use, and (3) the fact that no new areas of FDM will be targeted; therefore, the increases in munitions use at FDM would occur in areas already impacted by existing munitions use. Further, the Navy will conduct periodic seabird surveys on FDM to track population trends. The increases in munitions as proposed under Alternative 1 or Alternative 2 may increase potential for disturbance, injury, and mortality events; however, after analyzing the effects of such activities within the Study Area and population data on FDM, the likelihood of Alternative 1 or Alternative 2 diminishing the ability of a species to maintain genetic diversity, to reproduce, and function effectively in its native ecosystem is remote.

Expending of military materials may coincide with transiting short-tailed albatrosses through training areas; however, due to the rarity of this species in general and the lack of frequent sightings, chances for its potential interactions with training exercises would be extremely low. The spatial and temporal variability of both the occurrence of a short-tailed albatross and the training activities conducted within offshore locations near foraging areas presents an improbable chance that a direct or indirect effect would occur to this species.

As shown in Figure 3.6-9, the known ranges of Hawaiian petrels and Newell's shearwaters may overlap with the transit corridor and do not overlap with land training areas or surrounding coastal areas. They were observed in 2007 during cruise surveys in pelagic areas for marine mammals and sea turtles (U.S. Department of the Navy 2007). The potential for these two species to co-occur with activities that use military expended materials within the MITT Study Area is extremely low.

Pursuant to the ESA, the use of military expended materials during training activities under Alternative 1 or Alternative 2 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the use of military expended materials during training activities under Alternative 1 or Alternative 2 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

Testing Activities

Tables in Section 3.0.5.3.3.4 (Military Expended Materials) list the activities that involve military expended materials (e.g., medium-caliber projectiles, missiles, and rockets), most of which are large-caliber projectiles associated with kinetic energy weapon testing. As indicated in Section 3.0.5.3.3.4 (Military Expended Materials), under Alternative 2, the total amount of military expended materials is slightly higher than the amount expended under Alternative 1. The activities and type of military expended materials under Alternative 1 and Alternative 2 would be expended in the same geographic locations.

Testing activities under Alternative 1 and Alternative 2 would occur within nearshore waters of Guam in defined surface danger zones, explosive ordnance disposal exclusion zones, and extended surface danger zones. Small- and medium-caliber projectiles would also be expended within the Small Arms Firing Area. These activity areas do not include fish aggregating devices, artificial reefs, known shipwrecks and abandoned vessels, and or buoys (e.g., navigational buoys, meteorological buoys) that attract seabird prey species and offer perch sites. Section 3.11 (Cultural Resources) discusses shipwrecks and other submerged resources that may also serve to aggregate fish and therefore seabirds. The Navy routinely avoids locations of known obstructions which include submerged cultural resources such as historic shipwrecks. These avoidance measures prevent damage to sensitive Navy equipment and vessels, ensure the accuracy of training and testing exercises, and limit the possibility of exposing large numbers of seabirds to military expended materials. By avoiding areas where higher numbers of seabirds may congregate, risk of striking seabirds is minimized for testing activities under Alternative 1 and Alternative 2.

Alternative 1 and Alternative 2 do not contain any testing activities that target FDM; therefore, Alternative 1 and Alternative 2 would not impact nesting and breeding activities on the island.

Pursuant to the ESA, the use of military expended materials during testing activities under Alternative 1 or Alternative 2 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the use of military expended materials during testing activities under Alternative 1 or Alternative 2 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

3.6.3.3.4 Impacts from Ground Disturbance

Amphibious landings are conducted to transport troops and equipment from ship to shore for subsequent inland maneuvers. Subsequently, these activities may disturb seabird nesting areas and foraging grounds for shorebirds. Concerns associated with amphibious landing activities in the Mariana Islands include potential impacts on coral reefs and impacts on natural and cultural resources in nearby inland areas since disembarked personnel and equipment must often traverse such areas in order to exit and enter a landing beach.

In a previous study of the impact of amphibious landings on corals at Unai Chulu in Tinian during Tandem Thrust 1999, it was observed that sediment plumes were generated in the track of the amphibious vehicles. The plumes remained localized in the track area, dissipated within minutes, and were not qualitatively different from episodes of sediment resuspension during periods of storm-generated waves that occur routinely on Tinian (Marine Research Consultants 1999). Because of the rapid dissipation and temporary nature of turbidity due to amphibious vehicles, it is unlikely that these activities would impact seabird or shorebird foraging grounds.

As described in Section 3.6.3.1.3 (Impacts from Aircraft and Vessel Noise), birds are likely to move away from an area in response to visual or sound stimuli. Therefore, it is highly unlikely that shorebirds would be directly impacted by ground disturbing activities associated with amphibious training.

Military use of FDM may contribute to ongoing soil disturbance and erosion from natural causes. FDM is comprised of highly weathered limestone overlain by a thin layer of clay soil (U.S. Department of the Navy 2013a). Ordnance use, particularly within Impact Areas 2 and 3 (where explosive ordnance use is permitted), would dislodge sediments that may potentially wash into nearshore waters of FDM. In addition to natural wind and water erosion (including high-energy typhoon events), erosion caused by ordnance use would contribute to increased turbidity and siltation of habitats used by marine bird prey species.

3.6.3.3.4.1 No Action Alternative, Alternative 1, and Alternative 2

Training Activities

Table 2.8-1 lists amphibious training activities that may disturb foraging grounds for shorebirds for the No Action Alternative, Alternative 1, and Alternative 2. As stated previously, amphibious landings under the No Action Alternative, Alternative 1, and Alternative 2 would occur within landing locations at Naval Base Guam Apra Harbor on Guam and Tinian landing beaches. None of the known breeding locations for seabirds within the Naval Base Guam Apra Harbor (rocky islets off of Orote Island and Orote Peninsula, Neye Island, And Apaoa Point) are used as amphibious landing areas. On Tinian, the only potential landing beach known to support a breeding colony is located at Unai Dankulo, a known breeding location for Pacific reef herons. Pacific reef herons nest in trees, so an amphibious assault vehicle maneuvering on the beach area would not likely physically disturb a nest. The other known rookery locations on Tinian, Puntan Masalok (which supports breeding areas for the black noddy, brown noddy, and boobies) and Puntan Lamanibot (another location for Pacific reef herons) are not used for amphibious landings. Amphibious landings do not occur on FDM, and are not proposed under the No Action Alternative, Alternative 1, or Alternative 2 (access to FDM is by helicopter only).

Shorebirds, however, likely forage in the intertidal zone where amphibious vehicles and personnel maneuver. Under the No Action Alternative, Alternative 1, and Alternative 2, foraging would be temporarily hindered by turbidity and sediment plumes created by amphibious vehicle contact with the beach along with the overall presence of vehicles and human activity. This impact is expected to be temporary, and coincide with the actual presence of the activity. The duration of these activities may range for a few minutes to 3 or 4 hours of time on the beach.

On FDM, the Navy restricts the target area extents and types of ordnance used by establishing impact areas, which minimizes mass wasting, sediment plumes, and siltation of nearshore foraging habitats. Because of the rapid dissipation and temporary nature of turbidity, it is unlikely that these activities would impact seabird or shorebird foraging grounds above effects associated with natural weathering processes on FDM.

The short-tailed albatross, Newell's shearwater, and Hawaiian petrel do not occur on lands within the Mariana Islands. These species would not be affected by ground disturbing training activities under the No Action Alternative, Alternative 1, or Alternative 2. Nesting locations for the great frigatebird, masked booby, and other species of birds that are known to roost or breed within the Study Area would not be disturbed by amphibious warfare training activities.

Pursuant to the ESA, ground disturbing activities resulting from amphibious training activities and military use of FDM under the No Action Alternative, Alternative 1 or Alternative 2 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), ground disturbing activities resulting from amphibious training activities and military use of FDM under the No Action Alternative, Alternative 1, or Alternative 2 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

Testing Activities

There are no testing activities under the No Action Alternative, Alternative 1, or Alternative 2 that require ground disturbance in seabird or shorebird terrestrial habitats.

3.6.3.3.5 Impacts from Wildfires

This section assesses impacts from wildfires on seabirds and shorebirds that visit or breed on FDM. As the only land-based training area within the MITT Study Area subject to ordnance drops and live fire, FDM is the only site within the Study Area where training could cause uncontrolled wildland fires. See Section 3.10 (Terrestrial Species and Habitats) for a more detailed analysis of habitat degradation at FDM associated with ordnance use. Fires do occur on other DoD-owned and leased lands within the MIRC; however, these fires are sourced from properties offsite outside the DoD use boundary. Live fire on small arms ranges that include simulated training devices (including pyrotechnics) have been actively used on Guam for over 10 years, along with explosive ordnance demolition training. Range controls and fire response protocols have limited brush fires to very small areas (limited to a few square meters), which are immediately controlled and extinguished. Because range controls, fire response protocols, and long-term fire management plans have resulted in no uncontrolled wildfires, only wildfire potential on FDM is included for analysis.

Fires could occur on FDM in any month of the year; however, fuel loading (the amount of flammable vegetation) and ignition potential would increase during the dry season. Fire danger increases during the dry season (February through April) and decreases in the wet season (July through October). Wildland fires can set back succession within vegetation communities and facilitate establishment of fire-tolerant species, which may alter the composition and structure of vegetation communities. Fires may cause direct mortality of birds and nests in vegetated areas with fuel loadings sufficient to carry fire, and indirect mortality through exposure to smoke or displacement of nest predators into nesting habitats.

Fire can indirectly affect seabirds and shorebirds at FDM by changing the physical and biological characteristics of the area, which can subsequently degrade nesting habitat. Seabirds forage at sea, so wildfires would not affect the forage base; however, shorebirds that visit the island may forage on invertebrates in the impacted vegetation communities. Light levels, temperatures, and wind speeds will increase with destruction of canopy plants, and relative humidity will decrease (Hoffmann et al. 2003). Because vegetation cover affects erosion rate, soil erosion may occur after fire except where rapid establishment of non-native invasive grasses are prevalent. Grass, vine, or other herbaceous vegetation may invade following removal of shrub and tree canopy (D'Antonio and Vitousek 1992; Tunison et al. 2001).

Fire history on FDM is not well documented, but the replacement of at least patchy forest communities and with lower stature vegetation is evidenced in historical aerial imagery (see Figure 3.10-2). The potential for military bombardment of FDM to alter vegetation composition and structure was noted during post-bombardment surveys conducted in August 1997. These surveys revealed 25–50 fresh bomb craters and a large section of the island burned to bare earth (Lusk et al. 2000).

Based on surveys conducted in 1974 (as discussed in Section 3.10.2.1.5, Farallon de Medinilla), recent assessments in 2000 (Lusk et al. 2000), and current surveys of FDM's avifauna and knowledge of FDM's vegetation community status (U.S. Department of the Navy 2013a), the vegetation and avian communities have changed significantly since 1974. Prior to intensive military use of the island, the presence of more trees with a higher canopy resulted in a higher number of tree nesting seabirds (Lusk et al. 2000).

3.6.3.3.5.1 No Action Alternative, Alternative 1, and Alternative 2

Training Activities

Training activities that involve explosive detonations on FDM introduce the potential for wildfires on the island. The number of training activities using explosives at FDM is presented in Table 2.8-1 of Chapter 2 (Description of the Proposed Action and Alternatives). Although the numbers of ordnance with explosives increases from the No Action Alternative to Alternative 1, and from the No Action Alternative to Alternative 2, the potential for wildfire does not vary among alternatives.

On FDM, the impact areas total approximately 34 ac. (13.8 ha), which accounts for 20 percent of the island's area. FDM use restrictions were designed to minimize wildland fire danger to FDM's avifauna and to limit the indirect impacts associated with fire tolerant invasive species encroachment into non-impact areas. Live-fire weapons are restricted in that cluster bombs, live cluster weapons, live scatterable munitions, fuel-air explosives, incendiary devices, and bombs greater than 2,000 lb. (907.2 kg) are prohibited. The live-fire weapons allowed are used only in two specific areas and targets are placed to reduce the potential for wildfire. The areas for target placement support only low-growing vegetation due to long-term training with explosives. Due to the lack of fuels in the area, explosions are unlikely to result in wildfires. Dense vegetation grows on the northern portion of the island within the "No Drop Zone" which could create a wildfire if weapons are misfired.

The short-tailed albatross, Newell's shearwater, and Hawaiian petrel do not occur on lands within the Mariana Islands. These species would not be affected by wildfires on FDM under the No Action Alternative, Alternative 1, or Alternative 2.

The great frigatebird utilizes shrubs and trees for nesting, and the loss of higher stature forests in the interior portion of the FDM may represent a loss of nesting habitat for this species and other tree nesting seabird species. The great frigatebird, however, likely never occurred in the Mariana Islands in great numbers (Reichel 1991), and the colony on Maug (the only other known location of great frigatebird nesting in the archipelago), which is not subject to stressors of military training activities, has remained small (Reichel 1991, Lusk et al. 2000, U.S. Fish and Wildlife Service 2005, 2011b). Although wildfires may destroy nests, reduce nesting habitat, and directly and indirectly impact individual birds, these effects do not adversely affect the population of great frigatebirds.

Masked boobies may also experience direct effects of fire, but likely limited to smoke exposure because of nesting habitat and rookery locations. These birds prefer to nest on bare or rocky ground without fuel loading to carry a fire through the rookery locations, and Lusk et al. (2000) speculated that the military use of FDM in the interior portions of the island has created additional suitable nesting habitat for this species. Despite the risks associated with wildfires at FDM, the masked booby numbers at FDM have remained relatively stable since 1997 when systematic monitoring began.

Pursuant to the ESA, potential wildfires at FDM due to training activities under the No Action Alternative, Alternative 1 or Alternative 2 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), potential wildfires at FDM during training activities under the No Action Alternative, Alternative 1, or Alternative 2 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

Testing Activities

There are no testing activities that involve expending ordnance on FDM that would potentially ignite a wildfire.

3.6.3.4 Ingestion Stressors

This section analyzes the potential impacts of the various types of expended materials used by the Navy during training and testing activities within the Study Area. The activities that expend these items and their general distribution are detailed in Section 3.0.5.3.5 (Ingestion Stressors), and aspects of ingestion stressors that are applicable to marine organisms in general are presented in Appendix H.6 (Conceptual Framework for Assessing Effects from Ingestion).

Birds could potentially ingest expended materials used by the Navy during training and testing activities within the Study Area. The Navy expends the following types of materials that could become ingestion stressors for birds during training and testing in the Study Area: chaff and flare endcaps/pistons. Ingestion of expended materials by birds could occur in all large marine ecosystems and open ocean areas and would occur either at the surface or just below the surface portion of the water column, depending on the size and buoyancy of the expended object and the feeding behavior of the birds. Floating material of ingestible size could be eaten by birds that feed at or near the water surface, while materials that sink pose a potential risk to diving birds that feed just below the water's surface.

Foraging depths of most diving birds are generally restricted to shallow depths, so it is highly unlikely that benthic, nearshore, or intertidal foraging would occur in areas of munitions use, and these birds would not encounter any type of munitions or fragments from munitions in nearshore or intertidal areas. Ingestion of military expended material from munitions is not expected to occur because the solid metal and heavy plastic objects from these ordnances sink rapidly to the seafloor, beyond the foraging depth range of most birds. Therefore, no impact of ingestion of military expended material from munitions would result for birds. As a result, the analysis in this section includes the potential ingestion of military expended materials other than munitions, all of which are expended away from nearshore habitats and close to the water surface.

A variety of ingestible materials may be released into the marine environment by Navy training and testing activities. Birds of all sizes and species are known to ingest a wide variety of items, which they might mistake for prey. For example, 21 of 38 seabird species (55 percent) collected off the coast of North Carolina from 1975 to 1989 contained plastic particles (Moser and Lee 1992). The mean particle sizes of ingested plastic were positively correlated with the birds' size though the mean mass of plastic found in the stomachs and gizzards of 21 species was below 3 grams (g) (0.11 oz.).

Plastic is often mistaken for prey, and the incidence of plastic ingestion appears to be related to a bird's feeding mode and diet. Seabirds that feed by pursuit-diving, surface-seizing, and dipping tend to ingest plastic, while those that feed by plunging or piracy typically do not ingest plastic (Azzarello and Van Vleet 1987). Birds of the order Procellariiformes, which include petrels and shearwaters, tend to accumulate more plastic than other species (Azzarello and Van Vleet 1987, Moser et al. 2000). Some birds, including gulls and terns, commonly regurgitate indigestible parts of their food items such as shell and fish bones. However, the structure of the digestive systems of most Procellariiformes makes it difficult to regurgitate solid material such as plastic (Azzarello and Van Vleet 1987, Moser et al. 2000).

Moser and Lee (1992) found no evidence that seabird health was impacted by the presence of plastic, but other studies have documented negative consequences of plastic ingestion. As summarized by Pierce et al. (2004), Auman et al. (1997), and Azzarello and Van Vleet (1987), the consequences of plastic ingestion by seabirds that have been documented include blockage of the intestines and ulceration of the stomach, reduction in the functional volume of the gizzard leading to a reduction of digestive capability, and distention of the gizzard leading to a reduction in hunger. Dehydration has also been documented in seabirds that have ingested plastic (Sievert and Sileo 1993). Studies have also found negative correlations between body weight and plastic load, as well as between body fat (a measure of energy reserves), and the number of pieces of plastic in a seabird's stomach. Pierce et al. (2004) described two cases where plastic ingestion caused seabird mortality from starvation. The examination of a deceased adult northern gannet revealed that a 1.5 in. (3.8-centimeter [cm]) diameter plastic bottle cap lodged in its gizzard blocked the passage of food into the small intestine, which resulted in its death from starvation. Northern gannets are larger, and dive deeper than the ESA-listed birds in the Study

Area. Also, since gannets typically utilize flotsam in nest-building, they may be more susceptible to ingesting marine debris than other species as it gathers that material. Dissection of an adult greater shearwater's gizzard revealed that a 1.5 in. by 0.5 in. (3.8 cm by 1.3 cm) fragment of plastic blocked the passage of food in the digestive system, which also resulted in death from starvation.

Species such as storm-petrels, albatrosses, shearwaters, fulmars, and noddies that forage by picking prey from the surface may have a greater potential to ingest any floating plastic debris. Ingestion of plastic military expended material by any species from the taxonomic groups found within the Study Area (Table 3.6-3) has the potential to impact individual birds.

Items of concern are those of ingestible size that remain floating at the surface, including lighter items such as plastic end caps from chaff and flares, pistons, and chaff, that may be caught in currents and gyres or snared in floating algal mats before sinking.

3.6.3.4.1 Impacts from Military Expended Materials other than Munitions

3.6.3.4.1.1 Chaff

A general discussion of chaff and chaff end caps as an ingestion stressor is presented in Section 3.0.5.3.5.3 (Military Expended Materials Other than Munitions). It is unlikely that chaff would be selectively ingested (U.S. Department of the Air Force 1997). Ingestion of chaff fibers is not expected to cause substantial damage to a bird's digestive tract based on the fibers' small size (ranging in lengths of 0.25 to 3 in. [0.63 to 7.6 cm] with a diameter of about 0.0015 in.) and flexible nature, as well as the small quantity that could reasonably be ingested. In addition, concentrations of chaff fibers that could reasonably be ingested are not expected to be toxic to birds. Scheuhammer (1987) reviewed the metabolism and toxicology of aluminum in birds and mammals. Intestinal adsorption of orally ingested aluminum salts was very poor, and the small amount adsorbed was almost completely removed from the body by excretion. Dietary aluminum normally has small effects on healthy birds and mammals and often high concentrations (> 1,000 milligrams [mg] per kg) are needed to induce effects such as impaired bone development, reduced growth, and anemia (Arfsten et al. 2002, Spargo 1999). A bird weighing 2.2 lb. (1 kg) would need to ingest more than 83,000 chaff fibers per day to receive a daily aluminum dose equal to 1,000 mg per kg; this analysis was based on chaff consisting of 40 percent aluminum by weight and a 5 oz. (141.7 g) chaff canister containing 5 million fibers. As an example, a masked booby weighs about 2.6 to 5.2 lb. (1.2 to 2.4 kg). It is highly unlikely that a bird would ingest a toxic dose of chaff based on the anticipated environmental concentration of chaff (i.e., 1.8 fibers per square foot for an unrealistic, worst-case scenario of 360 chaff cartridges simultaneously released at a single drop point).

3.6.3.4.1.2 Flares

A general discussion of flares as an ingestion stressor is presented in Section 3.0.5.3.5.3 (Military Expended Materials Other than Munitions). Ingestion of flare end caps 1.3 in. (3.3 cm) in diameter and 0.13 in. (0.33 cm) thick (U.S. Air Force 1994, 1997) by birds may result in gastrointestinal obstruction or reproductive complications. Based on the information presented above, if a seabird were to ingest a plastic end-cap or piston, the response would vary based on the species and individual bird. The responses could range from none, to sublethal (reduced energy reserves), to lethal (digestive tract blockage leading to starvation). Ingestion of end caps and pistons by species that regularly regurgitate indigestible items would likely have no adverse effects. However, end caps and pistons are similar in size to those plastic pieces described above that caused digestive tract blockages and eventual starvation. Therefore, ingestion of plastic end caps and pistons could be lethal to some individuals of some species of seabirds. Species with small gizzards and anatomical constrictions that make it difficult to regurgitate solid material would likely be most susceptible to blockage (such as Procellariiformes). Based on available information, it is not possible to accurately estimate actual ingestion rates or responses of individual birds.

3.6.3.4.1.3 No Action Alternative

Training Activities

Although chaff fibers are too small for birds to confuse with prey, there is some potential for chaff to be incidentally ingested along with other prey items. If ingested, chaff is not expected to impact birds, due to the low concentration that would be ingested and the small size of the fibers.

The plastic materials associated with flare end caps and pistons sink in saltwater (Spargo 1999), which reduces the likelihood of ingestion by seabirds. However, some of the material could remain at or near the surface if it were to fall directly on a dense algal mat or flotsam. Actual environmental concentrations would vary based on actual release points and dispersion by wind and water currents. The number of end caps and pistons that would remain at the surface and would potentially be available to seabirds is unknown but is expected to be an extremely small percentage of the total.

Birds would have the potential to ingest military expended material. However, the concentration of military expended material in the Study Area is low, and seabirds are patchily distributed (Haney 1986). The overall likelihood that birds would be impacted by ingestion of military expended material in the Study Area under the No Action Alternative is very low.

If foraging in an area where military expended materials are present on the sea surface, the short-tailed albatross, Hawaiian petrel, and Newell's shearwater could be impacted by ingestion of military expended material. Expended materials may be deposited in areas transited by short-tailed albatrosses; however, due to the rarity of this species in general and the lack of frequent sightings, chances for its potential interactions with military expended materials would be extremely low. As shown in Figure 3.6-9, the known ranges of Hawaiian petrels and Newell's shearwaters may overlap with the transit corridor and do not overlap with land training areas or surrounding coastal areas. They were observed in 2007 during cruise surveys in pelagic areas for marine mammals and sea turtles (U.S. Department of the Navy 2007). The potential for these two species to co-occur with activities that expend ingestible materials before sinking within the MITT Study Area is extremely low.

Pursuant to the ESA, potentially ingestible materials used during training activities under the No Action Alternative would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), potentially ingestible materials used during training activities under the No Action Alternative would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

Testing Activities

Under the No Action Alternative, there are no testing activities that involve the use of ingestible materials.

3.6.3.4.1.4 Alternative 1

Training Activities

As indicated in Section 3.0.5.3.5.3 (Military Expended Materials Other than Munitions), under Alternative 1 the number of expended decelerators/parachutes is approximately 35 percent higher than that of the No Action Alternative (from approximately 8,000 parachutes under the No Action Alternative to less than 11,000 decelerators/parachutes under Alternative 1). In addition to the geographic locations identified in the No Action Alternative, decelerators/parachutes would also be expended anywhere in the Study Area, outside the Study Area while vessels are in transit. As indicated in Sections 3.0.5.3.5.3 (Military Expended Materials Other than Munitions), under Alternative 1, the numbers of chaff canisters and flares increase by approximately 300 percent, relative to the No Action Alternative. The activities using chaff under Alternative 1 would occur in the same geographic locations as the No Action Alternative.

If foraging in an area where military expended materials are present on the sea surface, the short-tailed albatross, Hawaiian petrel, and Newell's shearwater could be impacted by ingestion of military expended material. Expended materials may be deposited in areas transited by short-tailed albatrosses; however, the rarity of this species in general and the lack of frequent sightings, chances for its potential interactions with military expended materials would be extremely low. As shown in Figure 3.6-9, the known ranges of Hawaiian petrels and Newell's shearwaters may overlap with the transit corridor and do not overlap with land training areas or surrounding coastal areas. They were observed in 2007 during cruise surveys in pelagic areas for marine mammals and sea turtles (U.S. Department of the Navy 2007). The potential for these two species to co-occur activities that expend ingestible materials before sinking within the MITT Study Area is extremely low.

Pursuant to the ESA, potentially ingestible materials used during training activities under Alternative 1 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), potentially ingestible materials used during training activities under Alternative 1 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

Testing Activities

Alternative 1 testing activities would introduce 1,727 decelerators/parachutes within the Study Area. The decelerators or parachutes would be expended widely across the Study Area and would not be expended over land. Decelerators/parachutes would not be expended over important rookeries or the nearshore foraging areas adjacent to these rookery areas. The likelihood of foraging seabirds encountering and ingesting decelerators or parachutes is extremely low.

Pursuant to the ESA, potentially ingestible materials used during testing activities under Alternative 1 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), potentially ingestible materials used during testing activities under Alternative 1 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

3.6.3.4.1.5 Alternative 2

Training Activities

The number and type of materials that seabirds may ingest are the same under Alternative 2 as they are for Alternative 1. Therefore, the conclusions for Alternative 2 are the same as Alternative 1.

Pursuant to the ESA, potentially ingestible materials used during training activities under Alternative 2 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), potentially ingestible materials used during training activities under Alternative 2 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

Testing Activities

Under Alternative 2, testing activities would introduce 1,912 decelerators/parachutes within the Study Area, which is an 11 percent increase over Alternative 1. The decelerators/parachutes would be expended widely across the Study Area, and would not be expended over land. Decelerators/parachutes would not be expended over important rookeries or the nearshore foraging areas adjacent to these rookery areas. The likelihood of foraging seabirds encountering and ingesting flares or decelerators/parachutes is extremely low.

Pursuant to the ESA, potentially ingestible materials used during testing activities under Alternative 2 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), potentially ingestible materials used during testing activities under Alternative 2 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

3.6.3.5 Secondary Stressors

The potential of sediments, water quality, and air quality stressors associated with training and testing activities to indirectly affect birds, as a secondary stressor, was analyzed. The assessment of potential water, sediment, and air quality stressors refers to Section 3.1 (Sediments and Water Quality) and Section 3.2 (Air Quality); the assessment addresses specific activities in local environments that may affect seabird habitats. At-sea activities that may impact water and air include general emissions.

Amphibious warfare training on Guam and Tinian, as well as military use of FDM, may affect water quality in nearshore foraging environments for seabirds and migrating shorebirds. Amphibious training activities on landing beaches on Guam and Tinian would likely disturb unconsolidated sediments in the intertidal and subtidal zones; however, these effects (such as changes in turbidity in nearshore waters) would be similar to changes caused by normal wave action during stormy conditions. Similarly, sediments dislodged from ordnance strikes on FDM that wash into FDM's nearshore environments would cause temporary water quality impacts in seabird and shorebird foraging areas. FDM is highly susceptible to natural causes of erosion because it is comprised of highly weathered limestone overlain by a thin layer of clay soil. The Navy minimizes the potential for military use of FDM to contribute to naturally induced water quality impacts by limiting the location and extent of target areas, along with the types of ordnance allowed within specific impact areas.

In accordance with DoD Directive 4715.11, *Environmental and Explosives Safety Management on Operational Ranges within the United States* (U.S. Department of Defense 2004b), the Navy has in place an Operational Range Clearance Plan for FDM (U.S. Department of the Navy 2013c). The Operational Range Clearance Program on FDM includes range clearance, inspection, certification, demilitarization, and recycling or disposal procedures. The plan requires range surfaces at FDM to be cleared of all ordnance, inert ordnance debris, inert munitions, and other material that may potentially present an explosive hazard. Materials greater than 2 ft. (0.6 m) in size are removed from impact areas on FDM. Range clearance on FDM occurs every 2 to 4 years, which reduces the potential for soil contamination and contamination of nearshore habitats receiving surface runoff.

As noted in Section 3.1 (Sediments and Water Quality) and Section 3.2 (Air Quality), implementation of the No Action Alternative, Alternative 1, or Alternative 2 would not adversely affect sediments, water, or air quality and therefore would not indirectly impact seabirds as secondary stressors. Any physical impacts on seabird habitats would be temporary and local because training activities would occur infrequently. Impacts from activities would not be expected to adversely impact seabirds or seabird habitats.

There is no overlap of activities that could potentially impact sediments, water, or air quality with nesting or breeding locations of short-tailed albatross, Hawaiian petrel, and Newell's shearwater. These locations are found outside of the MITT Study Area. Further, these species would be expected to forage in pelagic areas of the study area, far from shore; therefore, only water quality and air quality impacts would potentially impact ESA-listed seabird species. Short-tailed albatrosses may transit through training and testing areas; however, the rarity of this species in general and the lack of frequent sightings, chances for its potential interactions with training and testing exercises would be extremely low. As shown in Figure 3.6-9, the known ranges of Hawaiian petrels and Newell's shearwaters may overlap with the transit corridor and do not overlap with land training areas or surrounding coastal areas. They were observed in 2007 during cruise surveys in pelagic areas for marine mammals and sea turtles (U.S. Department of the Navy 2007).

Indirect impacts on water or air quality under the No Action Alternative, Alternative 1, or Alternative 2 would have no effect on ESA-listed bird species due to (1) the temporary nature of impacts on water or air quality, (2) the distribution of temporary water or air quality impacts, (3) the wide distribution of birds in the Study Area, and (4) the dispersed spatial and temporal nature of the training and testing activities that may have temporary water, or air quality impacts. No long-term or population-level impacts are expected.

Pursuant to the ESA, secondary stressors associated with training or testing activities under the No Action Alternative, Alternative 1, or Alternative 2 would have no effect on the Hawaiian petrel, Newell's shearwater, or short-tailed albatross.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), secondary stressors associated with training or testing activities under the No Action Alternative, Alternative 1, or Alternative 2 would not result in a significant adverse effect on populations of the great frigatebird, masked booby, or other marine bird populations.

3.6.4 SUMMARY OF POTENTIAL IMPACTS ON MARINE BIRDS

3.6.4.1 Combined Impacts of All Stressors

As described in Section 3.0.5 (Overall Approach to Analysis), this section evaluates the potential for combined impacts of all the stressors from the Proposed Action. The analysis and conclusions for the potential impacts from each of the individual stressors are discussed in the analyses of each stressor in the sections above and summarized in Section 3.6.4.2 (Endangered Species Act Determinations).

There are generally two ways that a bird could be exposed to multiple stressors. The first would be if a bird were exposed to multiple sources of stress from a single activity or activities (e.g., an amphibious landing activity may include an amphibious vessel that would introduce potential acoustic and physical strike stressors). The potential for a combination of these impacts from a single activity would depend on the range of effects for each of the stressors and the response or lack of response to that stressor. Most of the activities as described in the Proposed Action involve multiple stressors; therefore, it is likely that if a bird were within the potential impact range of those activities, they may be impacted by multiple stressors simultaneously. This would be more likely to occur during large-scale exercises or activities that span a period of days or weeks (such as a sinking exercise or composite training unit exercise).

Secondly, an individual bird could be exposed to a combination of stressors from multiple activities over the course of its life. This is most likely to occur in areas where training and testing activities are more concentrated (e.g., near ports, training ranges, and routine activity locations) and in areas that individual birds frequent because it is within the animal's home range, migratory route, breeding area, or foraging area. Except for in the few concentrated areas mentioned above, combinations are unlikely to occur because training and testing activities are generally separated in space and time in such a way that it would be very unlikely that any individual birds would be exposed to stressors from multiple activities. However, animals with a small home range intersecting an area of concentrated Navy activity have elevated exposure risks relative to animals that simply transit the area through a migratory route. The majority of the proposed training and testing activities occur over a small spatial scale relative to the entire Study Area, have few participants, and are of a short duration (the order of a few hours or less).

Multiple stressors may also have synergistic effects. For example, birds that experience temporary hearing loss or injury from acoustic stressors could be more susceptible to physical strike and disturbance stressors via a decreased ability to detect and avoid threats. Birds that experience behavioral and physiological consequences of ingestion stressors could be more susceptible to physical strike stressors via malnourishment and disorientation. These interactions are speculative, and without data on the combination of multiple Navy stressors, the synergistic impacts from the combination of Navy stressors on birds are difficult to predict.

Although potential impacts on certain bird species from the Proposed Action could include injury or mortality, impacts are not expected to decrease the overall fitness or result in long-term population-level impacts of any given population. In cases where potential impacts rise to the level that warrants mitigation, mitigation measures designed to reduce the potential impacts are discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring). The potential impacts anticipated from the Proposed Action are summarized in Sections 3.6.4.2 (Endangered Species Act Determinations) and 3.6.4.3 (Migratory Bird Act Determinations) with respect to each regulation applicable to birds.

3.6.4.2 Endangered Species Act Determinations

Table 3.6-7 summarizes the ESA determinations for each substressor analyzed. There are no critical habitat designations for ESA-listed marine bird species within the MITT Study Area. In 2010, the USFWS Pacific Islands Fish and Wildlife Office issued a Biological Opinion, pursuant with Section 7 of the ESA, on proposed training activities within the MIRC. In early 2015, the Navy completed Section 7 ESA consultation for activities proposed in this EIS/OEIS with the issuance of a new Biological Opinion. The

Biological Opinion concurred with the Navy's determination that training activities within the MITT Study Area would have no effect on the short-tailed albatross, Hawaiian petrel, or Newell's shearwater. These no effect determinations were primarily based on the rare occurrence of these species within the MITT Study Area, and absence from breeding grounds and rookery sites located within the Study Area, particularly at FDM. Because training and testing activities described in this EIS/OEIS do not introduce additional stressors to ESA-listed seabird species, the Navy concludes that implementation of the No Action Alternative, Alternative 1 or Alternative 2 would have no effect on the short-tailed albatross, Hawaiian petrel, or Newell's shearwater.

Table 3.6-7: Summary of Endangered Species Act Effects Determinations for Seabirds for the Preferred Alternative

Navy Activities and Stressors		Short-Tailed Albatross	Hawaiian Petrel	Newell's Shearwater
Acoustic Stressors				
Sonar and other Active Acoustic Sources	Training Activities	No effect	No effect	No effect
	Testing Activities	No effect	No effect	No effect
Explosives[1]	Training Activities	No effect	No effect	No effect
	Testing Activities	No effect	No effect	No effect
Aircraft Noise and Vessel Noise	Training Activities	No effect	No effect	No effect
	Testing Activities	No effect	No effect	No effect
Energy Stressors				
Electromagnetic devices	Training Activities	No effect	No effect	No effect
	Testing Activities	No effect	No effect	No effect
Physical Disturbance and Strike Stressors				
Aircraft strike	Training Activities	No effect	No effect	No effect
	Testing Activities	No effect	No effect	No effect
Vessels and in-water devices	Training Activities	No effect	No effect	No effect
	Testing Activities	No effect	No effect	No effect

Table 3.6-7: Summary of Endangered Species Act Effects Determinations for Seabirds and Shorebirds for the Preferred Alternative (continued)

Navy Activities and Stressors		Short-Tailed Albatross	Hawaiian Petrel	Newell's Shearwater
Physical Disturbance and Strike Stressors (continued)				
Military expended materials	Training Activities	No effect	No effect	No effect
	Testing Activities	No effect	No effect	No effect
Ground Disturbance	Training Activities	No effect	No effect	No effect
	Testing Activities	Not applicable	Not applicable	Not applicable
Wildfires	Training Activities	No effect	No effect	No effect
	Testing Activities	Not applicable	Not applicable	Not applicable
Ingestion Stressors				
Military expended materials other than munitions	Training Activities	No effect	No effect	No effect
	Testing Activities	No effect	No effect	No effect
Secondary Stressors				
Secondary Stressors	Training Activities	No effect	No effect	No effect
	Testing Activities	No effect	No effect	No effect

[1] The explosives substressor includes other impulsive sound sources, such as swimmer defense airguns, weapons firing, launch, and impact noise.

Notes: The scientific names of the listed species are as follows: Short-tailed albatross (*Phoebastria albatrus*), Hawaiian petrel (*Pterodroma sandwichensis*), and Newell's shearwater (*Puffinus newelli*).

3.6.4.3 Migratory Bird Treaty Act Determinations

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), the stressors introduced during training and testing activities would not result in a significant adverse effect on migratory bird populations. While this determination is applicable to all seabirds and shorebirds that occur in the Study Area, the Navy carried out a focused analysis for seabirds known to breed within the Study Area, particularly for breeding seabirds on FDM. The Navy identified two birds in particular that have a heightened concern with regards to 50 C.F.R. Part 21—the great frigatebird and the masked booby. FDM is an important breeding ground for these two species.

The Navy assessed the significance of injury and mortality of individual masked boobies and great frigatebirds relative to the viability of these species' populations. The populations of the masked booby and great frigatebird were defined based on (1) the distribution of subspecies *S. d. personata* and *F. m. palmerstoni*, (2) the colony locations within these distributions, and (3) the number of individual birds associated with these colonies. The Navy then compared the number of masked boobies and great frigatebirds that are found within the colonies within the Marianas (particularly FDM) to that of the regional population within the western and central Pacific.

The great frigatebird may occasionally nest on FDM, which is one of only two small breeding colonies known to exist within the Mariana Islands (the other is located on Maug in the northern portion of the archipelago). FDM does not appear to be a temporally or spatially stable rookery location. Compared to the numbers of great frigatebirds estimated throughout central and western Pacific (10,000 pairs in the Hawaiian Islands, with other colonies on Howland, Baker, Jarvis, Johnston Atoll, and Christmas Island [U.S. Fish and Wildlife Service 2005, Reichel 1991, Schreiber and Schreiber 1988]), and the apparent low numbers of great frigatebirds from historic times through the present within the Mariana archipelago, the direct and indirect effects on effects of military activities on FDM would not represent a significant adverse impact on the population of the great frigatebird.

For the masked booby, FDM is the largest breeding colony in Mariana Islands. The colony numbers recorded by the Navy appear to be stable, and the data do not suggest any significant changes of masked booby numbers. Although the masked booby may be subject to short- and long-term impacts of military use of FDM and individuals likely suffer injury and mortality from some activities (e.g., explosives), FDM continues to support a relatively stable rookery. In the central and western Pacific, 2,500 pairs are estimated within the Northwestern Hawaiian Islands, Jarvis (up to 1,200 pairs), Barker Island (over 1,500 pairs), and smaller colonies in American Samoa, Palmyra, Johnson Atoll, and northern islands in the Mariana archipelago (Maug, Uracas, Guguan, and FDM). Based on the long-term use and stability of the masked booby breeding population on FDM and the wide geographic range and abundance of the masked booby throughout the Pacific, the effects of military use of FDM would not represent a significant adverse impact on the population of the masked booby.

Pursuant with the DoD's obligations under 50 C.F.R. Part 21, the DoD will continue to implement training restrictions on FDM (see Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring), monitoring of bird populations on FDM, and other natural resource projects described in the Joint Region Marianas Integrated Natural Resources Management Plan (U.S. Department of the Navy 2013a).

REFERENCES

Aebischer, N. J., Coulson, J. C. & Colebrook, J. M. (1990). Parallel long-term trends across four marine trophic levels and weather. *Nature, 347*(6295), 753-755.

Agreement on the Conservation of Albatrosses and Petrels. (2012). Midway Atoll's Short-tailed Albatross pair has an egg for the second year (Vol. 2012).

Aguon, C. F., Lujan, D., Dicke, L. & Henderson, L. (2000). Survey and Inventory of Non-Game Birds in the Mariana Islands *Job Progress Report Research Project Segment*. (pp. 7) Government of Guam Division of Aquatic and Wildlife Resources.

Ainley, D. G., Thomas, C. T. & Reynolds, M. H. (1997). Townsend's and Newell's Shearwater (*Puffinus auricularis*). [Electronic Article]. *The Birds of North America Online* (297).

Air Force Safety Center. (2007). Bird/Wildlife Aircraft Strike Hazard (BASH). Retrieved from http://www.afsc.af.mil/organizations/bash/, 29 February 2012.

Akesson, S. & Hedenstrom, A. (2007). How Migrants Get There: Migratory Performance and Orientation. [electronic version]. *BioScience, 57*(2), 123-133.

Alderfer, J. (2003). Auks, murres, puffins. M. Baughman (Ed.), *National geographic reference atlas to the birds of North America.* (pp. 176-185). Washington DC: National Geographic Society.

Andersen, D.E., O. J. Rongstad, & W.R. Mytton. (1990). Home-range changes in raptor exposed to increased human activity levels in southeastern Colorado. *Wildlife Society Bulletin 18*:134-142

Arfsten, D. P., Wilson, C. L. & Spargo, B. J. (2002). Radio frequency chaff: The effects of its use in training on the environment. *Ecotoxicology and Environmental Safety, 53*, 1–11.

Auman, H., Ludwig, J., Giesy, J. & Colborn, T. (1997). Plastic ingestion by Laysan Albatross chicks on Sand Island, Midway Atoll, in 1994 and 1995 *Chapter Twenty Albatross Biology and Conservation*.

Austin, J. O. L., Robertson, J. W. B. & Woolfenden, G. E. (1970). Mass Hatching Failure in Dry Tortugas Sooty Terns. Presented at the XVth International Ornithological Congress, The Hague, The Netherlands.

Azzarello, M. & Van Vleet, E. (1987). Marine birds and plastic pollution. *Marine Ecology - Progress Series, 37*, 295-303.

Barron, D.G., J.D. Brawn, L.E. Butler, L.M. Romero and P.J. Weatherhead. (2012). Effects of military activity on breeding birds. *Journal of Wildlife Management 76:* 911-918.

Beason, R. (2004). What Can Birds Hear? *Wildlife Damage Management, Internet Center for USDA National Wildlife Research Center - Staff Publications* (pp. 6). University of Nebraska - Lincoln.

Beuter, K. J., Weiss, R. & Frankfurt, B. (1986). Properties of the auditory system in birds and the effectiveness of acoustic scaring signals. Presented at the Bird Strike Committee Europe (BSCE), 18th Meeting Part I, Copenhagen, Denmark.

Bies, L., T. B. Balzer, & W. Blystone. (2006). Pocosin Lakes National Wildlife Refuge: Can the Military and Migratory Birds Mix? *Wildlife Society Bulletin, 34*, 502-503.

BirdLife International. (2010a). *Pterodroma sandwichensis*. In *IUCN 2011. IUCN Red List of Threatened Species*. Version 2011.2 ed. Retrieved from www.iucnredlist.org, 2 March 2012.

BirdLife International. (2010b). *Puffinus newelli*. In *IUCN 2011. IUCN Red List of Threatened Species*. Version 2011.2 ed. Retrieved from www.iucnredlist.org, 2 March 2012.

BirdLife International. (2010c). Species factsheet: *Pterodroma sandwichensis* (Vol. 2010).

BirdLife International. (2012). *Phoebastria albatrus*. In *IUCN 2011. IUCN Red List of Threatened Species*. Version 2012.2 ed. Retrieved from www.iucnredlist.org, 9 September 2012.

Black, B. B., Collopy, M. W., Percival, H. F., Tiller, A. A. & Bohall, P. G. (1984). Effects of low level military training flights on wading bird colonies in Florida, Society of Florida Restoration and Conservation and University of Florida (Eds.). Gainesville, FL.

Bowles, A. E., Awbrey, F. T. & Jehl, J. R. (1991). The effect of high-amplitude impulsive noise on hatching success. (HSD-TP-91-0006). Wright Patterson Air Force Base, Ohio.

Bowles, A. E., Knobler, M., Sneddon, M. D. & Kugler, B. A. (1994). Effects of simulated sonic booms on the hatchability of white leghorn chicken eggs T. Prepared for Systems Research Laboratories under Contract to United States Air Force Brooks Air Force Base (Ed.). (BBN Report No. 7990).

Brooke, A. (2012). Joint Region Marianas. Status of the wedge-tailed breeding colony on Managahan Island (off Saipan), CNMI. Comments provided in document review T. Houston, SRS-Parsons Joint Venture, 16 January 2012.

Brown, A. L. (1990). Measuring the effect of aircraft noise on sea birds. *Environmental International, 16*, 587-592.

Burger, J. (1981). Behavioural responses of herring gulls *Larus argentatus* to aircraft noise. *Environmental Pollution Series A, Ecological and Biological, 24*(3), 177-184.

Camp, R.J., Leopold, C., Brinck, K.W., & Joula, F. (2014). Farallon de Medinilla Seabird and Tinian Moorhen Analysis. Hawaii Cooperative Studies Unit, University of Hawaii at Hilo. Technical Report HCSU-060. December 2014.

Chesser, R. T., Banks, R. C., Barker, F. K., Cicero, C., Dunn, J. L., Kratter, A. W., Winker, K. (2009). Fiftieth Supplement to the American Ornithologists' Union Check-List of North American Birds. *The Auk, 126*(3), 705-714.

Clavero, M., Brotons, L., Pons, P. & Sol, D. (2009). Prominent role of invasive species in avian biodiversity loss. *Biological Conservation, 142*(10), 2043-2049.

Clements, J. F. (2000). Birds of the world: a checklist. 5th edition. Ibis publishing company, Vista, CA. 867 pp.

Commonwealth of the Northern Mariana Islands Division of Fish and Wildlife. (2005). Comprehensive Wildlife Conservation Strategy For the Commonwealth of the Northern Mariana Islands. Saipan, CNMI. Prepared by J. G. G. G. M. Berger, G. Schroer.

Congdon, B. C., Erwin, C. A., Peck, D. R., Baker, G. B., Double, M. C. & O'Neill, P. (2007). Vulnerability of seabirds on the Great Barrier Reef to climate change. In J. E. Johnson and P. A. Marshall (Eds.), *Climate Change and the Great Barrier Reef: A Vulnerability Assessment* (pp. 427-463). Townsville, Australia: Great Barrier Reef Marine Park Authority and Australian Greenhouse Office.

Conomy, J. T., Dubovsky, J. A., Collazo, J. A. & Fleming, W. J. (1998). Do black ducks and wood ducks habituate to aircraft disturbance? *Journal of Wildlife Management, 62*(3), 1135-1142.

Cooper, J. (1982). Methods of reducing mortality of seabirds caused by underwater blasting. *The Cormorant: bulletin of the Southern African Seabird Group, 10*, 109-113.

Damon, E. G., Richmond, D. R., Fletcher, E. R. & Jones, R. K. (1974). The tolerance of birds to airblast *Defense Nuclear Agency Technical Report*. (DNA 3314F).

Danil, K. & St. Ledger, J. A. (2011). Seabird and dolphin mortality associated with underwater detonation exercises. *Marine Technology Society Journal, 45*(6), 89-95.

D'Antonio, C. M. & Vitousek, P. M. (1992). Biological invasions by exotic grasses, the grass fire cycle, and global change. *Annual Review of Ecology and Systematics 23*, 63-87.

Davis, R. W., Evans, W. E., Wursig, B. & eds. (2000). Cetaceans, Sea Turtles and Seabirds in the Northern Gulf of Mexico: Distribution, Abundance and Habitat Associations. Volume I: Executive Summary. New Orleans, Louisiana.

Dolbeer, R. A. (2006). Height Distribution of Birds Recorded by Collisions with Civil Aircraft University of Nebraska - Lincoln, *Wildlife Damage Management Internet Center for Publications*. (pp. 7). Lincoln, Nebraska: U.S. Department of Agriculture Wildlife Services.

Dooling, R. J., Lohr, B., & Dent, M. L. (2000). Hearing in birds and reptiles. In R. J. Dooling, R. R. Fay, & A. N. Popper (Eds.), Comparative hearing in birds and reptiles (Vol. 13, pp. 308–359). New York: Springer-Verlag.

Dooling, R. J., & Therrien, S. C. (2012). Hearing in birds: what changes from air to water. *Journal of Advanced Experimental Medical Biology 730*:77-82.

Dove, C. T. & Goodroe, C. (2008). Marbled Godwit Collides with Aircraft at 3,700 M. *The Wilson Journal of Ornithology, 120*(4), 914-915.

Duffy, D. C. (2011). No Room in the Ark? Climate Change and Biodiversity in the Pacific Islands of Oceania. *Pacific Conservation Biology 17:*192-200.

Durant, J. M., Anker-Nilssen, T. & Stenseth, N. C. (2003). Trophic interaction under climate fluctuations: The Atlantic Puffin as an example. *Proceedings of the Royal Society of London 270(B)*(1), 461-1466.

Ellis, D. H. (1981). Responses of Raptorial Birds to Low Level Military Jets and Sonic Booms *Results of the 1980-1981 joint U.S. Air Force - U.S. Fish and Wildlife Service Study*. (pp. 59) Institute for Raptor Studies.

Engilis, A., Jr. & M. Naughton. (2004). *U.S. Pacific Islands Regional Shorebird Conservation Plan: U.S. Shorebird Conservation Plan*.

Fauchald, P., Erikstad, K. E. & Systad, G. H. (2002). Seabirds and marine oil incidents: is it possible to predict the spatial distribution of pelagic seabirds? *Journal of Applied Ecology, 39*(2), 349-360.

Federal Aviation Administration. (2003). Memorandum of Agreement Between the FAA, the USAF, the U.S. Army, the USEPA, the U.S. Fish and Wildlife Service, and the U.S. Department of Agriculture (USDA) to Address Aircraft-Wildlife Strikes. Retrieved from http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/birdstrikes.pdf, 16 January 2012.

Fisher, H. I. (1971). Experiments on Homing in Laysan Albatrosses, *Diomedea immutabilis*. *The Condor, 73*(4), 389-400.

Fletcher, C. H. (2009). Sea level by the end of the 21st century: a review. S*hore and Beach 77*: 4–12.

Gehring, J., P. Kerlinger, & A. M. Manville. (2009). Communication towers, lights, and birds: successful methods of reducing the frequency of avian collisions. *Ecological Applications, 19*(2), 505-514.

GovGuam Department of Aquatic and Wildlife Resources. (2006). Guam Comprehensive Wildlife Conservation Strategy. Mangalao, Guam. Prepared by D. L. C. F. Aguon, L. Dicke, L. Henderson.

Greene, G. D., Engelhardt, F. R. & Paterson, R. J. (1985). Proceedings of the Workshop on Effects of Explosives Use in the Marine Environment (pp. 1-383). Canada: Canada Oil and Gas Lands Administration, Environmental Protection Branch.

Haftorn, S., Mehlum, F. & Bech, C. (1988). Navigation to Nest Site in the Snow Petrel (*Pagodroma nivea*). *The Condor, 90*(2), 484-486.

Hamby, W. (2004). Ultimate Sound Pressure Level Table. Available online: http://www.makeitlouder.comlDecibel %2 OLevel %2 OChart.txt. Accessed 1 September 2011.

Hamilton III, W. J. (1958). Pelagic birds observed on a north Pacific crossing. *The Condor, 60*(3), 159-164.

Haney, J. C. (1986). Seabird Patchiness in Tropical Oceanic Waters: The Influence of Sargassum "Reefs." *The Auk, 103*, 141-151.

Hanowski, J. M., Blake, J. G., Niemi, G. J. & Collins, P. T. (1993). Effects of Extremely Low Frequency Electromagnetic Field on Breeding and Migrating Birds. *American midland Naturalist, 129*(1), 96-115.

Harrison, C. S. (1990). *Seabirds of Hawaii: Natural History and Conservation* (pp. 249). Ithaca, NY: Cornell University Press.

Harrison, P. (1983). *Seabirds, an Identification Guide* (pp. 445). Boston, MA: Houghton Mifflin Company.

Hashino, E., Sokabe, M. & Miyamoto, K. (1988). Frequency specific susceptibility to acoustic trauma in the budgerigar (*Melopsittacus undulatus*). *Journal of the Acoustical Society of America, 83*(6), 2450-2453.

Hoffmann, W. A., B. Orthen, & P. V. Nascimento. (2003). Comparative fire ecology of tropical savanna and forest trees. *Functional Ecology, 17*, 720–726.

Hunter, W. C., Golder, W., Melvin, S. & Wheeler, J. (2006). Southeast United States Regional Waterbird Conservation Plan North American Bird Conservation Initiative (Ed.).

Hyrenbach, K. D. (2001). Albatross response to survey vessels: implications for studies of the distribution, abundance, and prey consumption of seabird populations. *Marine Ecology Progress Series, 212*, 283-295.

Hyrenbach, K. D. (2006). Training and Problem-Solving to Address Population Information Needs for Priority Species, Pelagic Species and Other Birds at Sea. Presented at the Waterbird Monitoring Techniques Workshop, IV North American Ornithological Conference, Veracruz, Mexico.

International Union for Conservation of Nature and Natural Resources. (2010). *The IUCN Red List of Threatened Species Version 2010.1* (Vol. 2010): International Union for Conservation of Nature and Natural Resources.

Jessup, D. A., Miller, M. A., Ryan, J. P., Nevins, H. M., Kerkering, H. A., Mekebri, A., Kudela, R. M. (2009). Mass stranding of marine birds caused by a surfactant-producing red tide. [Electronic version]. *PLoS ONE, 4*(2), e4550. doi: 10.1371/journal.pone.0004550

Jones, I. L. (2001). Auks C. Elphick, J. Dunning, J.B. and D. A. Sibley (Eds.), *The Sibley Guide to Bird Life and Behavior* (pp. 309-318). New York: Alfred A. Knopf, Inc.

Kessler, C. C. (2009). Seabird Surveys U.S. Fish and Wildlife Service Pacific Islands Fish and Wildlife Office (Ed.), *In: Terrestrial Surveys of Tinian and Aguiguan, Mariana Islands, 2008 (Working Draft)*. (pp. 150 - 168). Honolulu, Hawaii. Prepared for Naval Facilities Command Pacific.

Knight, R. L. & Temple, S. A. (1986). Why does intensity of avian nest defense increase during the nesting cycle? *The Auk, 103*(2), 318-327.

Kushlan, J. A. (1978). Non-rigorous foraging by robbing egrets. *Ecology. 59:* 649-653.

Larkin, R. P., Pater, L. L. & Tazik, D. J. (1996). Effects of military noise on wildlife: A literature review (pp. 1-107).

Larkin, R. P. & Sutherland, P. J. (1977). Migrating Birds Respond to Project Seafarer's Electromagnetic Field. *Science, New Series, 195*(4280), 777-770.

Lin, J. (2002). Alca torda: *Animal diversity web. http://animaldiversity.ummz.umich.edu/site/accounts/information/Alca_torda.html*.

Lincoln, F. C., Peterson, S. R. & Zimmerman, J. L. (1998). Migration of birds. U.S. Department of Transportation & U.S. Fish and Wildlife Service. (Vol. Circular 16). Washington, D.C.

Lusk, M. R., Bruner, P. & Kessler, C. (2000). The Avifauna of Farallon De Medinilla, Mariana Islands. *Journal of Field Ornithology, 71*(1), 22-33.

Manci, K.M., Gladwin, D.N., Villella, R. & M.G. Cavendish. (1988). Effects of aircraft noise and sonic booms on domestic animals and wildlife: A literature synthesis. U.S. Fish and Wildlife Service. National Ecology Research Center, Ft. Collins, CO NERC-88/29. 88 pp.

Mann, K. H. & Lazier, J. R. N. (1996). Dynamics of Marine Ecosystems: Biological-Physical Interactions in the Oceans (2nd ed.). Boston, Massachusetts: Blackwell Scientific Publications.

Marine Research Consultants. (1999). Marianas training effects of LCAC landing on coral reefs. Contract report. Honolulu, Hawaii: Belt Collins.

McGowan, J. A., Bograd, S. J., Lynn, R. J. & Miller, A. J. (2003). The biological response to the 1977 regime shift in the California Current. *Deep-Sea Research II, 50*, 2567-2582.

Melvin, E. & Parrish, J. (1999). Seabird Bycatch: Trends, Roadblocks, and Solutions, February 26–27. Presented at the Annual Meeting of the Pacific Seabird Group, Blaine, Washington.

Melvin, E. F., Parrish, J. K., Dietrich, K. S. & Hamel, O. S. (2001). Solutions to seabird bycatch in Alaska's demersal longline fisheries. Washington Sea Grant Program.

Merkel, F. R. & Johansen, K. L. (2011). Light-induced bird strikes on vessels in Southwest Greenland. *Marine Pollution Bulletin, 62*(11), 2330-2336.

Moser, M. & Lee, D. (1992). A Fourteen-Year Survey of Plastic Ingestion by Western North Atlantic Seabirds. *Colonial Waterbirds, 15*(1), 83-94.

Moser, H. G., Charter, R. L., Watson, W., Ambrose, D. A., Butler, J. L., Charter, S. R. & Sandknop, E. M. (2000). Abundance and distribution of rockfish (*Sebastes*) larvae in the Southern California Bight in relation to environmental conditions and fishery exploitation. *California Cooperative Oceanic Fisheries Investigations Reports, 41*, 132-147.

Mosher, S. (2013). Personal communication between Mr. Stephen Mosher (Joint Region Marianas Natural Resources Specialist) and Mr. Taylor Houston (SRS-Parsons Joint Venture) regarding breeding activities of white terns and noddies on NBG Guam. 27 June 2013. *Via comments on draft documents.*

National Oceanic and Atmospheric Administration. (2005a). Environmental Sensitivity Index Map. *Tinian: ESI 23*. (Area covered: Guam). 1:32000. Seattle, Washington.

National Oceanic and Atmospheric Administration. (2005b). Environmental Sensitivity Index Map. *Guam and the Northern Mariana Islands: ESIMAP 1*. (Area covered: Guam). 1:32000. Seattle, Washington.

National Oceanic and Atmospheric Administration. (2005c). Environmental Sensitivity Index Map. *Guam and the Northern Mariana Islands: ESIMAP 9*. (Area covered: Guam). 1:32000. Seattle, Washington.

National Oceanic and Atmospheric Administration. (2005d). Environmental Sensitivity Index Map. *Tinian: ESI 21*. (Area covered: Guam). 1:32000. Seattle, Washington.

National Oceanic and Atmospheric Administration. (2005e). Environmental Sensitivity Index Map. *Tinian: ESI 22*. (Area covered: Guam). 1:32000. Seattle, Washington.

National Parks Service. (1994). Report on Effects of Aircraft Overflights on the National Park System (Vol. 2011, pp. Report to Congress prepared pursuant to Public Law 100-191, the national parks Overflights Act of 1987).

Navy Safety Center. (2009). BASH Hazard Data Summaries. Retrieved from http://www.safetycenter.navy.mil, 29 February 2012.

North American Bird Conservation Initiative, U.S. Committee. (2010). *The State of the Birds 2010 Report on Climate Change, United States of America* [Electronic Version]. (pp. 32). Washington, DC: U.S. Department of the Interior. Available from http://www.stateofthebirds.org/

O'Brien, R.M., & Davies, J. (1990). New Subspecies of Masked Booby *Sula Dactylatra* from Lord Howe, Norfolk and Kermadec Islands. *Marine Ornithology, 18*: 1-7.

Oedekoven, C. S., Ainley, D. G. & Spear, L. B. (2001). Variable responses of seabirds to change in marine climate: California Current, 1985-1994. *Marine Ecology Progress Series, 212*, 265-281.

Parish, D., B. Lane, P. Sagar, & P. Tomkovitch. (1987). Wader Migration Systems in East Asia and Austral Asia. Wader Study Group Bull. 49 Suppl., I*WRB Special Publ. 7*:4-14.

Partecke J., Schwabl I., Gwinner E. (2006). Stress and the city: urbanization and its effects on the stress physiology in European blackbirds. *Ecology, 87*:1945–1952.

Pennycuick, C. J. (1982). The Flight of Petrels and Albatrosses (Procellariiformes), Observed in South Georgia and its Vicinity. *Philosophical Transactions of the Royal Society, Biological Series, 300*(1098) 75-106.

Pierce, K., Harris, R., Larned, L. & Pokras, M. (2004). Obstruction and Starvation Associated with Plastic Ingestion in a Northern Gannet *Morus Bassanus* and a Greater Shearwater *Puffinus Gravis*. [electronic version]. *Marine Ornithology, 32*, 187-189.

Plumpton, D., Sheaffer, S., Hunsaker, D. & Petrie, S. (2006). Review of Studies Related to Aircraft Noise Disturbance of Waterfowl, a Technical Report in Support of the Supplemental Environmental Impact Statement (SEIS) for Introduction of F/A-18 (Super Hornet) Aircraft to the East Coast of the United States Ecology and Environment, Inc. (Ed.). San Francisco, CA: Prepared for Naval Facilities Engineering Command, Norfolk, VA.

Poot, H., Ens, B. J., de Vries, H., Donners, M. A. H., Wernand, M. R. & Marquenie, J. M. (2008). Green Light for Nocturnally Migrating Birds. *Ecology and Society, 13*(2), 47.

Pratt, H. D., Bruner, P. L. & Berrett, D. G. (1987). A Field Guide to The birds of Hawaii and the Tropical Pacific. Princeton, New Jersey: Princeton University Press.

Rauzon, M. J. Forsell, D. J., & Flint, E. N. (2002). Seabird re-colonization after cat eradication on equatorial Jarvis, Howland, and Baker Islands. Pp. 41, Abstracts *In* Turning the tide: the eradication of invasive species. IUCN, Gland, Switzerland.

Reed, J., Sincock, J. & Hailman, J. (1985). Light Attraction in Endangered Procellariiform Birds: Reduction by Shielding Upward Radiation. *The Auk 102*, 377-383.

Reichel, J.D. (1991). Status and conservation of seabirds in the Mariana Islands. Pp. 248-262, *In* Seabird Status and Conservation, a Supplement. (J.P. Croxall, ed.). International Council for Bird Preservation Technical Publication Number 11, Cambridge, United Kingdom.

Rodda, G. H., Fritts, T. H. & Chiszar, D. (1997). The Disappearance of Guam's Wildlife. *BioScience, 47*(9), 565-574.

Ronconi, R. (2001). *Cepphus grylle*. Animal Diversity Web. *http://animaldiversity.ummz.umich.edu/site/accounts/information/Cepphus_grylle.html*.

Russel Jr., W. A., Lewis, N. D. & Brown, B. T. (1996). The impact of impulsive noise on bald eagles at Aberdeen Proving Ground, Maryland. [Abstract Only]. Presented at the 131st Meeting: Acoustical Society of America.

Ryals, B. M., Dooling, R. J., Westbrook, E., Dent, M. L., MacKenzie, A. & Larsen, O. N. (1999). Avian species differences in susceptibility to noise exposure. *Hearing Research, 131*, 71-88.

Ryals, B. M., Stalford, M. D., Lambert, P. R. & Westbrook, E. W. (1995). Recovery of noise-induced changes in the dark cells of the quail tegmentum vasculosum. *Hearing Research, 83*, 51-61.

Saunders, J. & Dooling, R. (1974). Noise-Induced Threshold Shift in the Parakeet (*Melopsittacus undulatus*). *Proc Natl Acad Sci U S A, 71*(5), 1962-1965.

Savidge, J. A. (1987). Extinction of an Island Forest Avifauna by an Introduced Snake. *Ecology, 68*(3), 660-668.

Scheuhammer, A. (1987). The chronic toxicity of aluminium, cadmium, mercury, and lead in birds: A review. *Environmental Pollution, 46*, 263-295.

Schreiber, E. A. & Burger, J. (2002). *Biology of Marine Birds* (pp. 744). New York: CRC Press.

Schreiber, E.A. & Schreiber, R.W. (1988). Great Frigatebird size dimorphism on two central Pacific atolls. *Condor, 90:* 90-99.

Sibley, D. A. (2000). *National Audubon Society: The Sibley Guide to Birds* (9th ed., pp. 544). New York, NY: Chanticleer Press.

Sievert, P. & Sileo, L. (1993). The effects of ingested plastic on growth and survival of albatross chicks. *National Wildlife Health Research Center*.

Spargo, B. J. (1999). *Environmental Effects of RF Chaff: A Select Panel Report to the Undersecretary of Defense for Environmental Security* [Final Report]. (NRL/PU/6110-99-389, pp. 85). Washington, DC: U.S. Department of the Navy, Naval Research Laboratory.

Spear, L. B., Ainley, D. G., Nur, N. & Howell, S. N. G. (1995). Population size and factors affecting at-sea distributions of four endangered procellariids in the tropical Pacific. *The Condor, 97*(3), 613-638.

Spennemann, D. R. (1999). Exploitation of bird plumages in the German Mariana Islands. Micronesica 31: 309-318.

Stinson, D. W., G. J. Wiles, & J. D. Reichel. (1997). Migrant land birds and water birds in the Mariana Islands. *Pacific Science 51:* 314 – 327.

Teer, J. G. & Truett, J. C. (1973). Studies of the effects of sonic boom on birds.

Temple, S. A. (2001). Individuals, Populations, and Communities: The Ecology of Birds. In *Handbook of Bird Biology*. Ithaca, New York: Cornell Lab of Ornithology and Princeton University Press.

Thiessen, G. J. (1958). Threshold of hearing of a ring-billed gull. Journal of the Acoustical Society of America, 30(11).

Ting, C., Garrelick, J. & Bowles, A. E. (2002). An analysis of the response of Sooty Tern eggs to sonic boom overpressures. *Journal of the Acoustical Society of America, 111*(1).

Tremblay, Y., Cherel, Y., Tveraa, T. & Chastel, O. (2003). Unconventional ventral attachment of time-depth recorders as a new method for investigating time budget and diving behaviour of seabirds. *The Journal of Experimental Biology, 206*, 1929-1940.

Tunison, T., D'Antonio, C. M. & Loh, R. K. (2001). Fire and invasive plants in Hawaii Volcanoes National Park. T. P. Wilson (Ed.), *Proceedings of the Invasive Species Workshop: The role of fire in the control and spread of invasive species*. Presented at the Fire Conference 2000, The First National Congress on Fire Ecology, Prevention, and Management, Tall Timbers Research Station; Tallahassee, TN.

United States of America & Commonwealth of the Northern Mariana Islands. (1983). Lease agreement made pursuant to the covenant to establish a commonwealth of the Northern Mariana Islands in a political union with the United States of America.

U.S. Air Force. (1994). *Technical reports on chaff and flares. Technical report No. 5: Laboratory analysis of chaff and flare materials*. Prepared for U.S. Air Force Headquarters Air Combat Command, Langley Air Force Base, VA.

U.S. Air Force. (1997). Environmental Effects of Self-Protection Chaff and Flares - Final Report. (p. 241). Prepared for U.S. Air Force, Headquarters Air Combat Command.

U.S. Department of Defense. (2004a). Department of Defense Ammunition and Explosives Safety Standards. DoD Directive 6055.9-STD. Prepared by the Under Secretary of Defense for Acquisition, Technology, and Logistics. Washington, D.C.

U.S. Department of Defense. (2004b). Environmental and Explosives Safety Management on Department of Defense Active and Inactive Ranges within the United States. DoD Directive 4715.11. 10 May 2004.

U.S. Department of Defense. (2012). Bird/Animal Aircraft Strike Hazard. Department of Defense – Partners in Flight. Retrieved from http://dodpif.org/groups/bash.php, 18 January 2012.

U.S. Department of Defense and U.S. Fish and Wildlife Service. (2006). Memorandum of Understanding Between the U.S. Department of Defense and the U.S. Fish and Wildlife Service To Promote the Conservation of Migratory Birds. (pp. 14).

U.S. Department of the Navy. (2007). *Marine mammal and sea turtle survey and density estimates for Guam and the Commonwealth of the Northern Mariana Islands: 2007* [Unpublished contract report (DRAFT)]. (p. 64). Prepared by Geo-Marine Inc. Prepared for Naval Facilities Engineering Command Pacific.

U.S. Department of the Navy. (2008). Micronesian Megapode (*Megapodius laperouse laperouse*) Surveys on Farallon de Medinilla, Commonwealth of the Northern Marianas Islands. (pp. 9).

U.S. Department of the Navy. (2013a). 2013 Joint Region Marianas Integrated Natural Resources Management Plan. (pp. 121). Prepared by HDR Contract # SF1449-N40192-10-R-9915. Prepared for Joint Region Marianas.

U.S. Department of the Navy. (2013b). Annual Report of Wildlife Surveys on FDM and Tinian. Joint Region Marianas (Draft).

U.S. Department of the Navy. (2013c). Operational Range Clearance Plan for the Mariana Islands Range Complex/Farallon de Medinilla. June 2013.

U.S. Fish and Wildlife Service. (1983). *Hawaiian Dark-rumped Petrel and Newell's Manx Shearwater Recovery Plan*. (pp. 57). Portland, OR: U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service. (2001). Short-tailed albatross (*Phoebastria albatrus*). Factsheet, U.S. Fish and Wildlife Service. Alaska Region. Available from: http://alaska.fws.gov/fisheries/endangered/pdf/STALfactsheet.pdf

U.S. Fish and Wildlife Service. (2005). *Regional Seabird Conservation Plan, Pacific Region*. (pp. 264). Portland, OR: U.S. Fish and Wildlife Service, Migratory Birds and Habitat Programs, Pacific Region.

U.S. Fish and Wildlife Service. (2008a). *Birds of Conservation Concern 2008*. (pp. 85). Arlington, VA: U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management. Available from http://www.fws.gov/migratorybirds/

U.S. Fish and Wildlife Service. (2008b). Short-Tailed Albatross Draft Recovery Plan. (pp. 62). Anchorage, Alaska. Available from http://endangered.fws.gov/recovery/Index.html#plans

U.S. Fish and Wildlife Service. (2010). Biological Opinion for the Mariana Islands Range Complex, Guam and the Commonwealth of the Northern Mariana Islands 2010-2015. Consultation Number 2009-F-0345. Honolulu, Hawaii: U.S. Fish and Wildlife Service Pacific Islands Fish and Wildlife Office.

U.S. Fish and Wildlife Service. (2011a). Newell's Shearwater (*Puffinus auricularis newelli*) 5-Year Review Summary and Evaluation. (p. 17). Honolulu, Hawaii: U.S. Fish and Wildlife Service Pacific Islands Fish and Wildlife Office.

U.S. Fish and Wildlife Service. (2011b). Incidental Observations, Marianas Expedition Wildlife Survey 2010. Prepared by: C.C. Kessler. August 2011.

U.S. Fish and Wildlife Service. (2015). Biological Opinion for the Mariana Islands Training and Testing Program. Consultation Number 01EPIF00-2014-F-0262. Honolulu, Hawaii: U.S. Fish and Wildlife Service Pacific Islands Fish and Wildlife Office.

U.S. Geological Survey. (2008). Pomarine jaeger *Stercorarius pomarinus* Identification Tips (Vol. 2010).

Van Tuinen, M., Waterhouse, D. & Dyke, G. J. (2004). Avian molecular systematics on the rebound: a fresh look at modern shorebird phylogenetic relationships. *Journal of Avian Biology, 35*(3), 191-194.

Vandenbosch, R. (2000). Effects of ENSO and PDO events on seabird populations as revealed by Christmas bird count data. *Waterbirds, 23*(3), 416-422.

VanderWerf, E. Y. (2000). Final Report. A Study to Determine the Effects of Noise from Military Training on the Endangered O'ahu 'Elepaio. Honolulu, Hawaii. Prepared by a. W. C.-P. Ebisu and Associates, Inc.

Vice, D. S. & D. L. Vice. (2004). Prey items of migratory peregrine falcon *(Falco peregrinus*) and Eurasian kestrel (*Falco tinnunculus*) on Guam. *Micronesica 37*: 33-36.

Wever, E. G., Herman, P. N., Simmons, J. A. & Hertzler, D. R. (1969). Hearing in the blackfooted penguin (*Spheniscus demersus*), as represented by the cochlear potentials. *Proceedings of the National Academy of Sciences USA, 63*, 676-680.

Wiles, G. J., D. J. Worthington, R. E. Beck, Jr., H. D. Pratt, C. F. Aguon, & R. L. Pyle. (2000). Noteworthy bird records for Micronesica, with a summary of raptor sightings in the Mariana Islands. Micronesica 32:257-284.

Wiles, G.J. (2005). A checklist of the birds and mammals of Micronesia. Micronesica 38(1): 141-189.

Wiltschko, R. & Wiltschko, W. (2003). Orientation Behavior of Homing Pigeons at the Gernsheim Anomaly. *Behavioral Ecology and Sociobiology, 54*(6), 562-572.

Wiltschko, R., Denzau, S., Gehring, D., Thalau, P. & Wiltschko, W. (2011). Magnetic orientation of migratory robins, Erithacus rubecula, under long-wavelength light. Journal of Experimental Biology, 214(18), 3096-3101. 10.1242/jeb.059212

Yelverton, J. T., Richmond, D. R., Fletcher, E. R. & Jones, R. K. (1973). Safe distances from underwater explosions for mammals and birds [Defense Nuclear Agency Report]. (DNA 3114T, p. 66). Albuquerque, New Mexico: Lovelace Foundation for Medical Education and Research.