
3.10 Terrestrial Species and Habitats

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3.10 TERRESTRIAL SPECIES AND HABITATS

TERRESTRIAL SPECIES AND HABITATS SYNOPSIS

The United States Department of the Navy considered all potential stressors, and the following were analyzed for terrestrial species and habitats:

- Acoustic (explosives noise, weapons firing noise, and aircraft noise)
- Physical (disturbance or strikes by aircraft and aerial targets, military expended materials including explosive munitions fragments, ground disturbance, and wildfires)
- Secondary (invasive species introductions)

Preferred Alternative (Alternative 1)

- Acoustic: Pursuant to the Endangered Species Act (ESA), acoustic stressors on Guam may affect, but are not likely to adversely affect, the Mariana fruit bat, Mariana common moorhen, and the Mariana swiftlet. Acoustic stressors on Guam would have no effect on the Guam rail, Mariana crow, Micronesian kingfisher, or *Serianthes nelsonii*. Acoustic stressors on Rota may affect, but are not likely to adversely affect, the Mariana fruit bat and Mariana crow. Acoustic stressors on Rota would have no effect on Rota bridled white-eye, *Serianthes nelsonii*, *Nesogenes rotensis*, or *Osmoxylon mariannense*. Acoustic stressors on Tinian may affect, but are not likely to adversely affect, the Mariana fruit bat, Micronesian megapode, or Mariana common moorhen. Acoustic stressors on Saipan may affect, but are not likely to adversely affect, the Mariana swiftlet, Micronesian megapode, and nightingale reed-warbler. Acoustic stressors on Farallon de Medinilla (FDM) may affect and are likely to adversely affect the Micronesian megapode and the Mariana fruit bat.
- Physical: Pursuant to the ESA, physical stressors on Guam may affect, but are not likely to adversely affect, the Mariana fruit bat, Mariana common moorhen, and the Mariana swiftlet. Physical stressors on Guam would have no effect on the Guam rail, Mariana crow, Micronesian kingfisher, or *Serianthes nelsonii*. Physical stressors on Rota may affect, but are not likely to adversely affect, the Mariana fruit bat and Mariana crow. Physical stressors on Rota would have no effect on Rota bridled white-eye, *Serianthes nelsonii*, *Nesogenes rotensis*, or *Osmoxylon mariannense*. Physical stressors on Tinian may affect, but are not likely to adversely affect, the Mariana fruit bat, Micronesian megapode, or Mariana common moorhen. Physical stressors on Saipan may affect, but are not likely to adversely affect, the Mariana swiftlet, Micronesian megapode, and nightingale reed-warbler. Physical stressors on FDM may affect and are likely to adversely affect the Micronesian megapode and the Mariana fruit bat on FDM.
- Secondary: Because of the Navy's biosecurity program, secondary stressors associated with the potential introduction of invasive species to terrestrial habitats resulting from training activities is not expected to affect the *Serianthes nelsonii*, *Osmoxylon mariannense*, *Nesogenes rotensis*, Rota bridled white-eye, Guam Micronesian kingfisher, Mariana crow, Mariana common moorhen, Mariana fruit bat, Mariana swiftlet, nightingale reed-warbler, or Micronesian megapode. Secondary stressors would not affect Critical Habitats on Guam or Rota.

TERRESTRIAL SPECIES AND HABITATS SYNOPSIS (continued)

- The U.S. Fish and Wildlife Service (USFWS) has designated Critical Habitats on Guam for the Mariana fruit bat, Mariana crow, and Guam Micronesian kingfisher. The USFWS has designated Critical Habitats on Rota for the Rota bridled white-eye, Mariana fruit bat, and Mariana crow. Proposed training and testing activities would not occur within these designated Critical Habitats; therefore, there would be no effect on critical habitat on Guam or Rota.
- Pursuant to the ESA, secondary stressors would have no effect on ESA-listed species. The Navy, in cooperation with the USFWS and other resource agencies, engages in policies and practices that reduce the potential for the transport of invasive species to the Mariana Islands and between military training areas.
- Acoustic and physical stressors have the potential to injure and kill terrestrial bird species that are not ESA listed, particularly those that roost and breed on FDM. Pursuant to the Migratory Bird Treaty Act (MBTA) and 50 Code of Federal Regulations Part 21.15, these impacts will not cause significant adverse effects to populations of bird species not ESA-listed and otherwise protected under the MBTA.

3.10.1 INTRODUCTION

This section addresses terrestrial species and habitats for military activities that occur on land training areas within the Mariana Islands Training and Testing (MITT) Study Area (Study Area). Specifically, this section addresses vegetation communities, wildlife communities, and Endangered Species Act (ESA) listed species (including species considered candidates for ESA listing) found on military owned and leased lands on Guam, Tinian, and Farallon de Medinilla (FDM). This section also addresses potential impacts on lands used by special agreement within the Study Area, such as lands on Rota and Saipan.

3.10.1.1 Endangered Species Act

The ESA of 1973 established protection over and conservation of threatened and endangered species and the ecosystems upon which they depend. An “endangered” species is a species in danger of extinction throughout all or a significant portion of its range, while a “threatened” species is one that is likely to become endangered within the near future throughout all or in a significant portion of its range. The United States (U.S.) Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service jointly administer the ESA and are also responsible for the listing of species (i.e., the labeling of a species as either threatened or endangered). The USFWS has primary management responsibility for terrestrial and freshwater species, while the National Marine Fisheries Service has primary management responsibility for marine species and anadromous fish species (species that migrate from saltwater to freshwater to spawn). The ESA allows the designation of geographic areas as Critical Habitat for threatened or endangered species.

The ESA requires federal agencies to conserve listed species and consult with the USFWS and/or National Marine Fisheries Service to ensure that proposed actions that may affect listed species or Critical Habitat are consistent with the requirements of the ESA. The ESA specifically requires agencies not to “take” or “jeopardize” the continued existence of any endangered or threatened species, nor to destroy or adversely modify designated critical habitat. Under Section 3 of the ESA, “take” means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect. “Jeopardize,” a term used in

Section 7 of the ESA, is defined in Title 50, Section 402.30 of the Code of Federal Regulations (50 C.F.R. 402.30) as engaging in any action that would be expected to appreciably reduce the likelihood of the survival and recovery of a listed species by reducing its reproduction, numbers, or distribution.

Section 7 formal consultation with the USFWS is necessary because some training activities proposed by the military may potentially affect federally protected species, habitats, and recovery efforts. The U.S. Department of the Navy (Navy) and the USFWS completed formal Section 7 in January 2015 with the completion of the USFWS Biological Opinion (U.S. Fish and Wildlife Service 2015).

3.10.1.1.1 Endangered Species Act Listed Species and Designated Critical Habitat

The ESA-listed terrestrial species known to occur within the Study Area include three plant species, six bird species, and one mammal. These species are listed in Table 3.10-1. Two ESA-listed sea turtle species that nest on Department of Defense (DoD)-owned and leased lands on Guam and Tinian are included in this Environmental Impact Statement (EIS)/Overseas EIS (OEIS) in Section 3.5 (Sea Turtles). Three species of ESA-listed seabirds are addressed in Section 3.6 (Marine Birds).

Critical habitat is a term defined and used in the ESA and includes specific geographic areas that are essential for the conservation of a threatened or endangered species and that may require special management and protection. Critical habitat may include an area that is not currently occupied by the species but that will be needed for its recovery. Critical habitat is designated on Guam and Rota for the Mariana fruit bat and Mariana crow (376 acres (ac.) [152 hectares {ha}]). The Micronesian kingfisher has critical habitat designated on Guam (376 ac. [152 ha]), and the Rota bridled white-eye has critical habitat designated on Rota (2,594 ac. [1,050 ha]). The Guam critical habitat designations are confined to the Guam National Wildlife Refuge Ritidian Unit and do not overlay or coincide with military training activities. Similarly, the military does not train within critical habitat designations on Rota. Figure 3.10-1 and Figure 3.10-2 show the critical habitat designations.

The Guam Micronesian kingfisher (*Todiramphus cinnamomina cinnamomina*) is extirpated from Guam habitats, and only exists in captive breeding programs. The Guam rail (*Rallus owstoni*) is also extirpated from Guam. A nonessential experimental population exists on Rota, and Guam rails have been introduced on Cocos Island (off the coast of Guam). The Mariana crow (*Corvus kubaryi*) is now considered extirpated from Guam, but still occurs on Rota. The Navy has determined that Alternative 1 and Alternative 2 will not affect these extirpated species. This conclusion was based on (1) the presence of the species relative to where military training activities occur, (2) the type of stressors introduced from the Proposed Action within these areas, (3) the status of recovery actions for extirpated species planned for portions of these areas, and (4) how stressors introduced from the Proposed Action may impact these future recovery efforts. In summary, no alternative proposed in this EIS/OEIS would require clearance of habitat that could be used in the future by a recovered species, and reintroduction of the species is not planned for the foreseeable future.

Table 3.10-1: Endangered Species Act-Listed Terrestrial Species in the Mariana Islands Training and Testing Study Area

Species Name and Regulatory Status			Presence in Study Area	
Local Name ¹	Scientific Name	Endangered Species Act Status	Preferred Habitat	DoD Training Area ²
Plants				
Hayun lagu/ Tronkon guafi (Fire tree) ^{4,5}	<i>Serianthes nelsonii</i>	Endangered	Limestone forests on Guam and Rota	Andersen AFB
-	<i>Osmoxylon mariannense</i>	Endangered	Limestone forests of Rota	-
-	<i>Nesogenes rotensis</i>	Endangered	Coastal strand habitats	-
Birds				
Yayaguak (Mariana swiftlet) ^{4,5}	<i>Aerodramus bartschi</i>	Endangered	Nests in caves; forages in savanna and ravine forest	NBG Munitions Site
Aga (Mariana crow) ^{4,5}	<i>Corvus kubaryi</i>	Endangered	Limestone forests of Guam and Rota	Rota, extirpated on Guam ³
Pulattat (Mariana common moorhen) ^{4,5}	<i>Gallinula chloropus guami</i>	Endangered	Freshwater aquatic habitat types (lake, pond, and springs)	NBG Apra Harbor, NBG Munitions Site, Tinian MLA
Sihek (Guam Micronesian kingfisher) ⁴	<i>Todiramphus cinnamomina</i>	Endangered	Limestone forests on Guam	Extirpated ³
Sasangat (Micronesian megapode) ⁵	<i>Megapodius laperouse</i>	Endangered	Limestone forests and coconut groves	Saipan Marpi Maneuver Area, Tinian MLA, FDM. Formerly occupied Andersen AFB, NBG Telecommunications Site, NBG Munitions Site, and NBG Apra Harbor.
Ko'ko' (Guam rail) ⁴	<i>Rallus owstoni</i>	Endangered	Secondary and open habitats in forests	Extirpated ³
Ga'ga' karisu (Nightingale reed-warbler) ⁵	<i>Acrocephalus luscini</i>	Endangered	Tangantangan thickets and wetlands	Saipan Marpi Maneuver Area
Nossa' Luta (Rota bridled white-eye) ⁵	<i>Zosterops rotensis</i>	Endangered	Limestone forests of Rota	-
Mammals				
Fanihi (Mariana fruit bat) ⁴	<i>Pteropus mariannus</i>	Threatened	Limestone and Ravine forests. Guam, Rota, Saipan, Tinian, FDM	Andersen AFB, NBG Telecommunications Site, NBG Munitions Site, Tinian MLA, FDM

¹ Scientific, Chamorro, and English names for plants and animals are provided in the table. Chamorro names will be used for plants, with first mention of scientific name (not all plants within the Study Area have commonly used English names). English names will be used for animals, with scientific and Chamorro names at first mention. Some species do not have an English name or a known Chamorro name. In these instances, only the scientific name is used. There are no English common names or known Chamorro names for *Osmoxylon mariannense* or *Nesogenes rotensis*.

² Includes DoD-owned and leased lands.

³ Indicates that the species is extirpated. The Guam rail, Guam Micronesian kingfisher, and Mariana crow are extirpated from the wild on Guam. A nonessential experimental population was established for the Guam rail on Rota and Cocos Island (off of Guam).

⁴ Species considered by the Government of Guam as threatened or endangered under the local administrative code.

⁵ Species considered by the CNMI as threatened or endangered under the local administrative code.

Notes: DoD = Department of Defense, MLA = Military Lease Area, FDM = Farallon de Medinilla, NBG = Naval Base Guam, AFB = Air Force Base

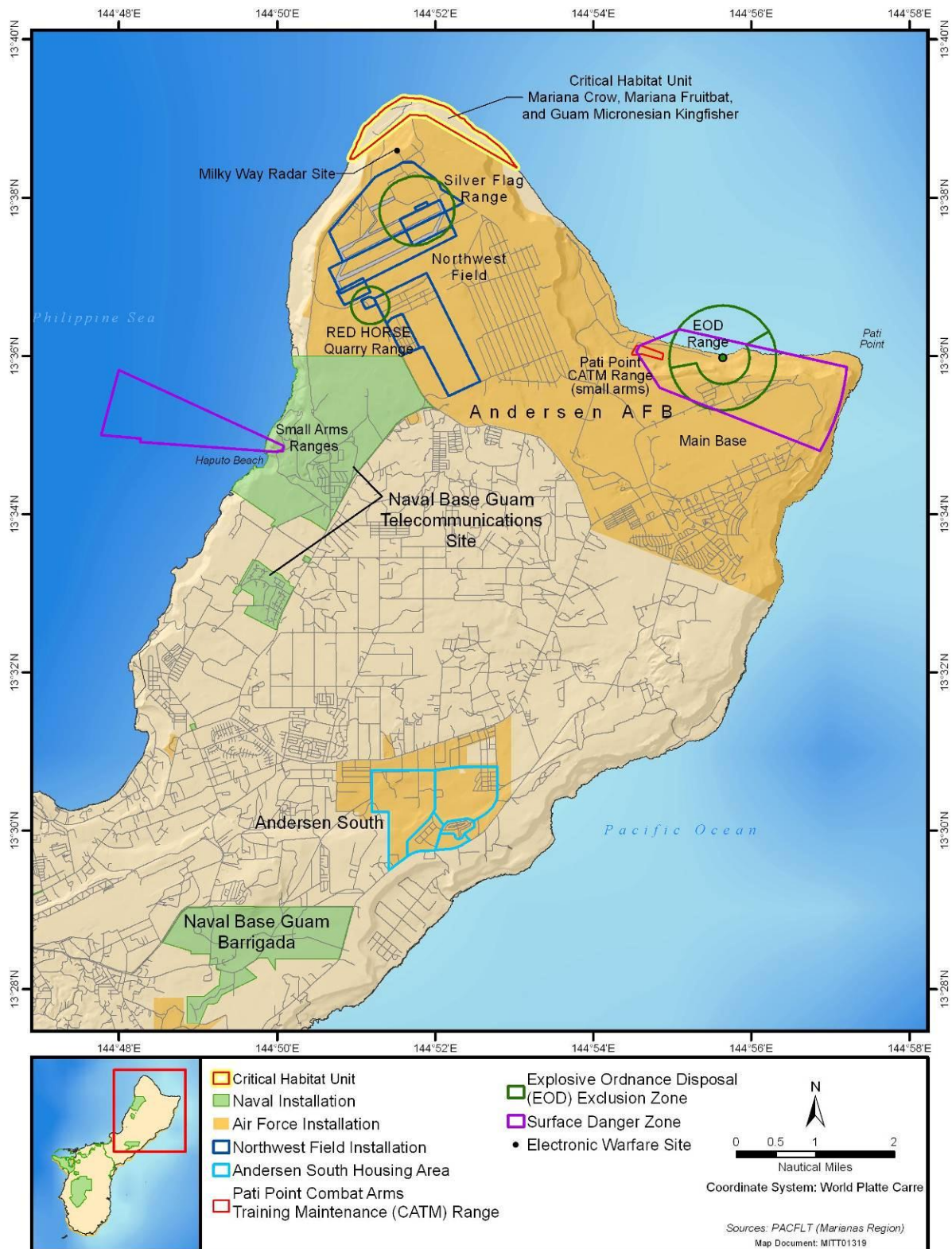
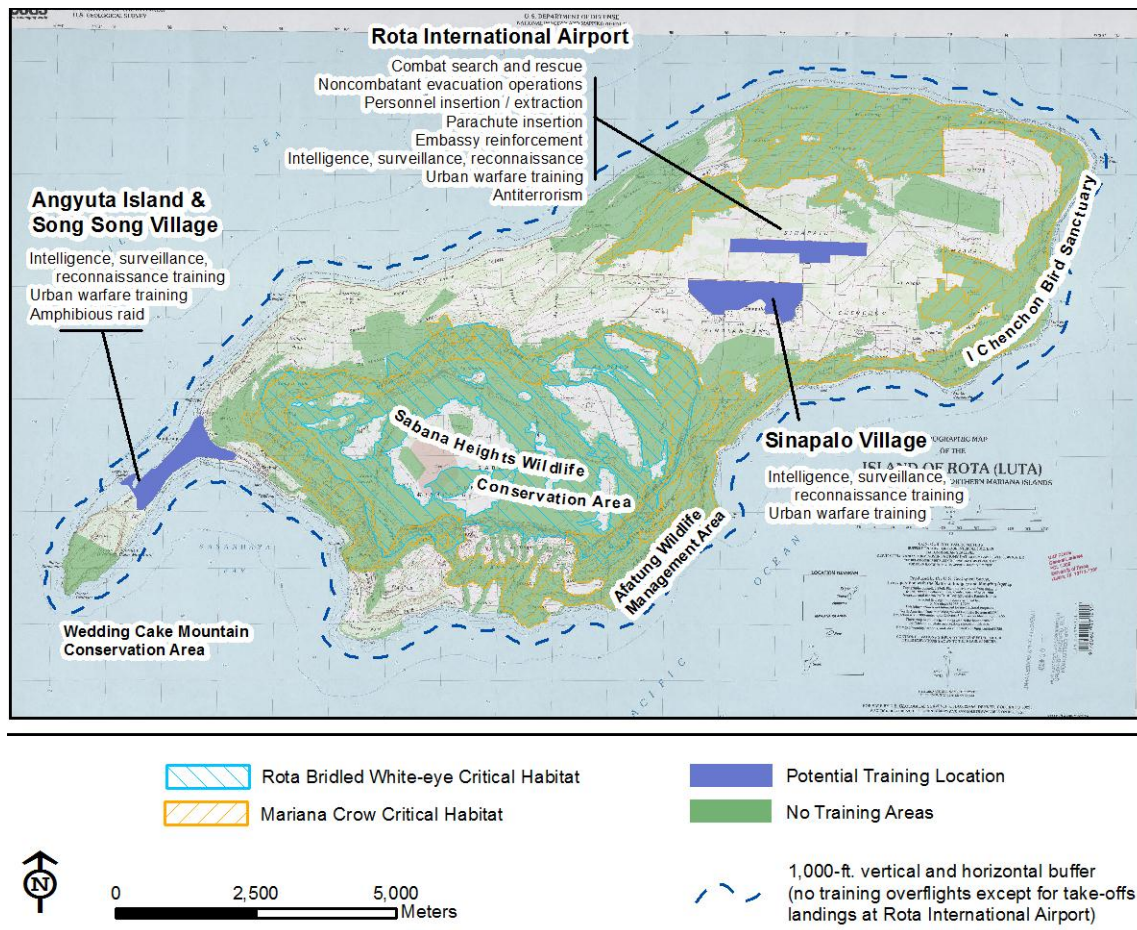


Figure 3.10-1: Critical Habitat Designations on Guam



Note: Potential training locations (shaded in blue) show where training activities may occur. Intelligence, surveillance, reconnaissance training and urban warfare training locations are not exact and are arranged in coordination with the Rota Mayor's office. These training activities occur in developed areas. No training activity would occur within designated critical habitat for the Mariana crow or Rota bridled white-eye, local conservation areas, or other any other area considered to be habitat for ESA-listed species. Green shaded areas represent all areas that could be occupied by ESA-listed species at any time throughout the year. These areas are not proposed for training. Mariana fruit bat colonies are not depicted in the map as they fall within designated critical habitat or conservation areas.

Figure 3.10-2: Training Locations, Critical Habitat, and Local Conservation Areas on Rota

3.10.1.1.2 Endangered Species Act Candidate Species

A candidate species is the subject of either a petition to list or status review, and for which the USFWS has determined that listing may be warranted (U.S. Fish and Wildlife Service and National Marine Fisheries Service 1998). Candidate species receive no statutory protection under the ESA; however, the USFWS encourages the formation of partnerships to conserve these species because they are, by definition, species that may warrant future protection under the ESA. In 2011, the USFWS completed a multi-year listing work plan that facilitates the systematic review of more than 250 species to determine if their listing is warranted under the ESA. The work plan and supplemental agreements were developed in coordination with two plaintiff groups (Wild Earth Guardians and the Center for Biological Diversity). These agreements were approved by the U.S. District Court for the District of Columbia in September 2011. In September 2014, the USFWS published in the Federal Register its intent to protect 23 species on Guam and on islands within the Commonwealth of the Northern Mariana Islands (CNMI). Public comments on the proposed rule were due on 1 December 2014; however, the USFWS extended the

public comment period and will be conducting further review of these species' ESA listing eligibility through early 2015. Of the 23 species proposed for listing, 22 are found on islands where the military trains. These species include:

- Five plants are endemic to the island of Guam (*Eugenia bryanii*, *Hedyotis megalantha*, *Phyllanthus saffordii*, *Psychotria malaspinae*, and *Tinospora homosepala*)
- Eight plants are known from Guam and the CNMI (*Bulbophyllum guamense*, *Dendrobium guamense*, *Heritiera longipetiolata*, *Maesa walkeri*, *Nervilia jacksoniae*, *Solanum guamense*, *Tabernaemontana rotensis*, and *Tuberolabium guamense*)
- One plant, *Cycas micronesica*, occurs in Guam, the CNMI, Palau, and Yap.
- The remaining species include four Partulid snail species (Guam tree snail [*Partula radiolata*], humped tree snail [*Partula gibba*], fragile tree snail [*Samoana fragilis*], and Langford tree snail [*Partula langfordi*]), two butterfly species (Mariana eight-spot butterfly [*Hypolimnas octocula mariannensis*] and Mariana wondering butterfly [*Vagrans egistina*]), and an insectivorous bat (Pacific sheath-tailed bat [*Emballonura semicaudata rotensis*]).

These species are listed in Table 3.10-2 and described in more detail below.

Table 3.10-2: Species Considered as Candidates for Endangered Species Act Listing

Species Name		Presence in Study Area	
Local Name ¹	Scientific Name	Habitat	Habitat within DoD Training Area ³
Plant Species			
-	<i>Eugenia bryanii</i>	Occurs within intact limestone forest, ravine forests on Guam	Andersen AFB, NBG Telecommunications Site, NBG Munitions Site
Fadang	<i>Cycas micronesica</i>	Tree fern of intact and secondary limestone forests	
Paudedo	<i>Hedyotis megalantha</i>	A perennial herb found in savanna habitat, southern Guam	NBG Munitions Site
-	<i>Phyllanthus saffordii</i>	A woody shrub found in savanna habitat, southern Guam	NBG Munitions Site
Aplokhatang-Palaoan	<i>Psychotria malaspinae</i>	Occurs within forests, possibly only at Ritidian National Wildlife Refuge	Andersen AFB, NBG Telecommunications Site
-	<i>Tinospora homosepala</i>	A vine found in intact limestone forest	
-	<i>Bulbophyllum guamense</i>	Epiphyte orchid found within intact limestone forests along cliff lines on Guam and Rota	
Cebello halumtano	<i>Dendrobium guamense</i>	Epiphyte orchid found within intact limestone forests on Guam and Rota	
Ufa-halomtano ⁵	<i>Heritiera longipetiolata</i>	Tree found within intact limestone forests on Guam, Rota, Tinian, and Saipan	
-	<i>Maesa walkeri</i>	A woody shrub found within intact limestone forests on Guam	
-	<i>Nervilia jacksoniae</i>	Epiphyte orchid found within intact limestone forests on Guam and Rota	
Bereng-henas halomtano	<i>Solanum guamense</i>	A woody shrub found within intact limestone forests on Guam, only one occurrence known on Guam	
-	<i>Tabernaemontana rotensis</i>	Small tree or shrub on Guam and Rota associated with limestone forests	
-	<i>Tuberolabium guamense</i>	Epiphyte orchid found within intact limestone forests on Guam and Rota, one occurrence known on Guam	

Table 3.10-2: Species Considered as Candidates for Endangered Species Act Listing (continued)

Species Name		Presence in Study Area	
Local Name ¹	Scientific Name	Habitat	Habitat within DoD Training Area ³
Invertebrate Species²			
Mariana eight-spot butterfly	<i>Hypolimnas octocula marianensis</i>	Limestone forests along cliffines, associated with two host plant species: <i>Procris pedunculata</i> and <i>Elatostema calcareum</i> . Occurs on Guam and Rota.	Andersen AFB, Tinian Military Lease Area
Mariana wandering butterfly	<i>Vagrans egistina</i>	Limestone forests along cliffines, associated with the host plant species <i>Maytenus thompsoni</i> . No longer occurs on Guam, but is known to occur on Rota.	Extirpated ⁴
Humped tree snail ⁵	<i>Partula gibba</i>	Sub-canopy vegetation in lower strata of intact limestone forests forested and river corridors. Humped tree snails occur on Guam, Rota, Aguiguan, Tinian, Saipan, Anatahan, Sarigan, Alamagan, and Pagan. Guam tree snails are restricted to Guam. Fragile tree snails are found on Guam and Rota. Langford tree snails are endemic to Aguiguan (they do not occur on other islands in the Mariana Archipelago).	Andersen AFB, NBG Telecommunications Site, NBG Munitions Site, Tinian MLA (potential)
Guam tree snail ⁵	<i>Partula radiolata</i>		Andersen AFB, NBG Telecommunications Site, NBG Munitions Site
Fragile tree snail ⁵	<i>Samoana fragilis</i>		-
Langford tree snail	<i>Partula langfordi</i>		-
Rota damselfly	<i>Ischnura luta</i>	Limestone forests of Rota	-
Mammalian Species			
Pacific sheath-tailed bat ^{5,6}	<i>Emballonura semicaudata</i>	Inhabits caves, prefers limestone forests as foraging habitat. Restricted to Aguiguan.	Extirpated ⁴

¹ Scientific, Chamorro, and English names for candidate species are provided in the table. Chamorro names will be used for plants, with first mention of scientific name (not all plants within the Study Area have commonly used English names). English names will be used for animals, with scientific and Chamorro names at first mention. Some species discussed in the text do not have an English name or a known Chamorro name. In these instances, only the scientific name is used.

² The Chamorro name, “ababang,” is used for both butterfly species listed in this table. The Chamorro name, “akaleha,” is used for all three tree snail species. Therefore, the English common name is used for the butterfly and snail species.

³ Includes DoD-owned and leased lands.

⁴ Indicates that the species is considered extirpated from the DoD training area. Mariana wandering butterfly is extirpated from Guam and is currently restricted to Rota. Pacific sheath-tailed bats are extirpated from Guam and other islands and are restricted to Aguiguan.

⁵ Species considered by the Government of Guam as threatened or endangered under the local administrative code.

⁶ Species considered by the CNMI as threatened or endangered under the local administrative code.

Notes: DoD = Department of Defense, NBG = Naval Base Guam, AFB = Air Force Base, ssp. = subspecies, MLA = Military Lease Area

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

Terrestrial birds in the Study Area include those listed under the Migratory Bird Treaty Act (MBTA) of 1918 (16 United States Code 703-712; Ch. 128; 13 July 1918; 40 Stat. 755 as amended) (U.S. Department of Defense and U.S. Fish and Wildlife Service 2006). The MBTA established federal responsibilities for the protection of nearly all species of birds, eggs, and nests. Further, the MBTA affords protections to terrestrial bird species within the Study Area that are not listed under the ESA.

Through the National Defense Authorization Act, Congress determined that allowing incidental take of migratory birds as a result of military readiness activities is consistent with the MBTA. The Final Rule was published in the Federal Register (FR) on 28 February 2007 (FR Volume 72, No. 29, 28 February 2007), and may be found at 50 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 National Environmental Policy Act (NEPA). It also requires the Armed Forces to develop and implement appropriate conservation measures if a proposed action may have a significant adverse effect on a migratory bird population. The Navy has determined that no activity described in this EIS/OEIS would represent a significant adverse effect on any terrestrial bird population.

3.10.1.2.1 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 for U.S. Pacific Islands (U.S. Fish and Wildlife Service 2008a).

Of the 21 terrestrial bird species considered as Birds of Conservation Concern for U.S. Pacific Islands, six species are known to breed on islands within the Study Area and are listed in Table 3.10-3: Micronesian Myzomela (*Myzomela rubrata*), rufous fantail (which includes two subspecies, the Aguiguan and Rota subspecies [*Rhipidura rufifrons mariae*] and Saipan and Tinian s`ubspecies [*Rhipidura rufifrons saipanensis*]), Tinian monarch (*Monarcha takatsukasae*), bridled white-eye (Saipan subspecies [*Zosterops conspicillatus saypani*]), golden white-eye (*Cleptornis marchei*), and Micronesian starling (*Aplonis opaca*).

Table 3.10-3: United States Fish and Wildlife Service Birds of Conservation Concern and Breeding Terrestrial Birds within the Study Area

Common Name	Scientific Name	Breeding location on DoD Owned or Leased Property	Other Islands within the Study Area ¹
Chichirika/Naabak (Rufous fantail)²	<i>Rhipidura rufifrons saipanensis</i>	Tinian MLA	Rota, Saipan, Aguiguan
	<i>Rhipidura rufifrons mariae</i>	-	Rota, Aguiguan
Sali (Micronesian starling)²	<i>Aplonis opaca</i>	Andersen AFB, Naval Base Guam Telecommunications Site, Tinian MLA	Rota, Saipan, Aguiguan, Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, Maug
Chichurikan Tinian (Tinian monarch)	<i>Monarcha takatsukasae</i>	Tinian MLA	-
Canario (Golden white-eye)	<i>Cleptornis marchei</i>	-	Saipan, Aguiguan
Nossa (Bridled White-eye)³	<i>Zosterops conspicillatus saypani</i>	Tinian MLA	Saipan
Egigi (Micronesian Myzomela)	<i>Myzomela rubrata</i>	Tinian MLA	Saipan, Aguiguan
Paluman apaka/Paluman kunao (White-throated ground dove) ²	<i>Gallicolumba xanthonura</i>	Tinian MLA	Rota, Aguiguan, Saipan, Anatahan
Totot (Mariana fruit dove) ²	<i>Ptilinopus roseicapilla</i>	Tinian MLA	Rota, Aguiguan, Saipan
Sihek Collared kingfisher	<i>Todiramphus chloris</i>	Tinian MLA	Rota, Aguiguan, Guguan, Sarigan, Alamagan, Pagan, Agrihan, Asuncion, Maug
Egigi (Micronesian honeyeater) ²	<i>Myzomela rubrata</i>	Tinian MLA	Rota, Aguiguan, Saipan, Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, Maug

¹ 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.

² Species considered by the Government of Guam as threatened or endangered under the local administrative code.

³ Species considered by the CNMI as threatened or endangered under the local administrative code.

Notes: Birds listed in the above table are native terrestrial birds not currently protected under the Endangered Species Act. The rufous fantail, Micronesian starling, Tinian monarch, bridled white-eye, and golden white-eye are considered by the USFWS as Birds of Conservation Concern, and highlighted in bold text. The island collared dove, black francolin, black drongo, and Eurasian tree sparrow also breeds within the Study Area; however, these species are not listed in the table because they are introduced species. ESA-listed terrestrial bird species are listed under Table 3.10-1.

DoD = Department of Defense, Tinian MLA = Tinian Military Lease Area, Andersen AFB = Andersen Air Force Base

3.10.1.3 General Taxonomic Groups

The ecological profile of the Mariana Islands is complex, with many factors interacting with each other, such as geology, human environmental history, climate and weather events, and invasive species. One way to provide a “snapshot” of the ecological profile of the Mariana Islands is to consider the faunal assemblage. Accordingly, Table 3.10-4 lists major vertebrate taxonomic groups (amphibians, reptiles, birds, and mammals) known to occur within the Mariana Islands. Some species represented in Table 3.10-4 have special regulatory status and are discussed in more detail in Section 3.10.1.1.1 (Endangered Species Act Listed Species and Designated Critical Habitat). Species that do not have special regulatory

status are discussed more generally in Section 3.10.2.1 (Vegetation Communities) and Section 3.10.2.2 (Wildlife Communities).

Table 3.10-4: Major Vertebrate Taxonomic Groups

Major Taxonomic Group		Presence in Study Area
Common Name (Species Grouping) ¹	Description	DoD Training Area
Amphibians		
Frogs and Toads (Family Ranidae, Family Microhylidae, Family Leptodactylidae, Family Eleutherodactylidae, Family Hylidae, and Family Bufonidae)	The marine toad, an introduced species established on Guam and the CNMI, inhabits upland and wetland sites. Ten species of frogs are known to occur on Guam and the CNMI, all introduced.	Marine toads occur on Guam, Tinian, and Saipan MMA. Other amphibians occur on Guam.
Reptiles		
Freshwater turtles (Family Emydidae)	Uncommon introduced turtles living in freshwater streams and wetlands, such as the red-eared slider. Likely introduced through the commercial pet trade and Asian food markets.	Occurring at Naval Base Guam, Naval Base Guam Munitions Site
Geckos, Anoles, Skinks (Family Gekkonidae, Polychridae, Scincidae)	On Guam, declining native populations with increasing introduced species serving as an additional food source for brown treesnakes. Introduced species in the Marianas are documented to displace native species. Endemic species in the CNMI include the slender-toed gecko, Micronesian gecko, tide pool skink, and Slevin's skink.	Occurring on all DoD owned and leased lands
Monitor lizards (Family Varanidae)	A native species considered to be an early introduction (approximately 1,600 years ago), this large lizard species inhabits upland and wetland sites.	Occurring on all DoD owned and leased lands, except for FDM
Blind snakes (Family Typhlopidae)	Recent introduction to Mariana Islands, ground burrowing snakes with vestigial (remnant) eyes.	Occurring on all DoD owned and leased lands, except for FDM
Colubrid snakes (Family Colubridae)	Represented by the invasive brown treesnake.	Established population on Guam
Birds²		
Megapodes (Family Megapodiidae)	Represented by the Micronesian megapode within the Mariana Islands. Extirpated from Guam.	Tinian MLA, Saipan MMA, FDM
Moorhens and Rails (Family Rallidae)	Represented by the Mariana common moorhen in the Marianas and Guam rails (Guam rails persist in captivity; a nonessential experimental population was established on Rota, and a Safe Harbor Agreement is in effect on Cocos Island).	Mariana common moorhens are found on all DoD-owned and leased lands, except for FDM.
Quails and Pheasants (Family Phasianidae)	Introduced species represented by the black francolin and the uncommon blue-breasted quail.	Occurring on all DoD-owned lands on Guam. Blue-breasted quail only found on the southern savannas of Guam, possibly including Naval Base Guam Munitions Site.
Pigeons and doves (Family Columbidae)	Represented by four species: the endemic Mariana fruit dove and white-throated ground dove, and the introduced island collared-dove and rock dove.	Native species extirpated on Guam, but native fruit doves and ground doves found on Tinian MLA, Saipan MMA, and Rota.

Table 3.10-4: Major Vertebrate Taxonomic Groups (continued)

Major Taxonomic Group		Presence in Study Area
Common Name (Species Grouping) ¹	Description	DoD Training Area
Swifts (Family Apodidae)	Represented by one cave-dwelling species (Mariana swiftlet). Extirpated from Tinian and Rota.	Occurs on Naval Base Guam Munitions Site, possible foraging in the Saipan MMA.
Kingfishers (Family Alcedinidae)	Species group extirpated from Guam. Guam Micronesian kingfisher persists in captivity; Collared Kingfisher present on Rota, Tinian, and Saipan.	Collared kingfisher present on Tinian MLA and Saipan MMA.
Drongos (Family Dicruridae)	Represented by the introduced black drongo.	Occurring on all DoD lands on Guam, potential training locations on Rota (e.g., Rota International Airport, Song Song Village, and Sinapalo Village).
Crows and jays (Family Corvidae)	Represented by the Mariana crow, declining numbers on Rota.	The last known crow on Guam was detected on Andersen Air Force Base in August 2011 and is considered extirpated from Guam. Crows occur in areas with suitable habitat that surround potential training locations on Rota.
Old World flycatchers and warblers (Family Muscicapidae)	On Guam, represented by four native species, all extirpated from Guam. The Guam flycatcher is extinct. This species group is found on Tinian and Saipan.	Tinian monarchs are found within Tinian MLA, nightingale reed-warblers are found on Saipan MMA.
Starlings (Family Sturnidae)	Represented by the native Micronesian starling.	Andersen Air Force Base, potential training locations on Rota (e.g., Rota International Airport, Song Song Village, and Sinapalo Village), Tinian MLA, Saipan MMA, and FDM,
Honeyeaters (Family Meliphagidae)	Represented by the Micronesian honeyeater; extirpated from Guam	Present on Tinian MLA and Saipan MMA.
White-eyes (Family Zosteropidae)	Represented by the bridled white-eye, golden white-eye; extirpated from Guam, but occurs within the CNMI. Golden white-eyes only occur on Aguiguan and Saipan. Rota bridled white-eye occurs on Rota, and bridled white-eye occurs on Saipan and Tinian.	Rota, Tinian MLA, and Saipan MMA.
Weavers (Family Passeridae)	Represented by the Eurasian tree sparrow.	All DoD-owned and leased lands
Mammals		
Rats, mice, shrews (Family Muridae and Soricidae)	Introduced species of musk shrews, Polynesian rats, roof rats, Norway rats, and house mice.	Occurring on all DoD-owned and leased lands. No shrews/house mice on FDM.
Bats (Family Pteropodidae and Emballonuridae)	The Mariana fruit bat and Pacific sheath-tailed bat. Sheath-tailed bats are restricted to Aguiguan Island in the CNMI and have been extirpated from Guam.	Mariana fruit bats on Andersen Air Force Base, Navy Communications Site, Naval Base Guam Munitions Site, potential training locations on Rota (e.g., Rota International Airport, Song Song Village, and Sinapalo Village), Tinian MLA, FDM

Table 3.10-4: Major Vertebrate Taxonomic Groups (continued)

Major Taxonomic Group		Presence in Study Area
Common Name (Species Grouping) ¹	Description	DoD Training Area
Dogs and cats (Family Canidae and Felidae)	Introduced feral, semi-feral, and domesticated dogs and cats.	Occurring on all DoD-owned and leased lands, except for FDM
Ungulates (Families Suidae, Cervidae, Bovidae)	Feral pigs, Philippine deer, Asiatic water buffalo	Water buffalo only occur on Naval Base Guam Munitions Site. Deer and pig potentially occur on all DoD-owned and leased lands, except for FDM.

¹ Various seabird and shorebird bird groups associated with marine and coastal environments are discussed in Section 3.6 (Marine Birds).

² Sources: Wiles (1998), U.S. Department of the Navy (2012); Pregill and Steadman (2009).

Notes: DoD = Department of Defense, FDM = Farallon de Medinilla, MLA = Military Lease Area, CNMI = Commonwealth of the Northern Mariana Islands, Saipan MMA = Saipan Marpi Maneuver Area.

3.10.1.4 General Threats to Terrestrial Species and Habitats within the Mariana Islands

There are numerous threats to native species and habitats in the Mariana Islands. Major threats to native species include (but are not limited to): (1) introduced and invasive plants and animals, and (2) loss and/or degradation of key habitat types. These threats are summarized below.

3.10.1.4.1 Introduced and Invasive Species

Terrestrial species may be classified as either native or introduced depending on their origin and the chronology of their introduction to Guam and other islands within the Study Area. A native species may be further considered as endemic to a particular island or the Mariana archipelago if the species is not found outside the area. An introduced species will demonstrate some degree of invasiveness, which is a measure of severity on native ecosystems (Davis 2009; Thompson and Davis 2011). Increasing populations, economic cycles of growth and retraction, and strategic location contributed to the escalating rate of intentional and accidental introductions of alien species in the Mariana Islands (Commonwealth of the Northern Mariana Islands Division of Fish and Wildlife 2005; Guam Division of Aquatic and Wildlife Resources 2006).

Although there are many introduced plant and animal species important to the degradation of habitats and modification of ecological processes, the most notorious species introduced to Guam is the brown treesnake (*Boiga irregularis*), discussed in more detail in Section 3.10.2.2 (Wildlife Communities). The brown treesnake was accidentally introduced to Guam from the Admiralty Islands (a group of islands of northern Papua New Guinea) following World War II (Rodda et al. 1997). Snakes that survived the transport escaped into terrestrial habitats of Guam, expanding outward from Apra Harbor. The snakes established on Guam and, by 2011, only 2 of 12 native forest bird species remain (the Micronesian starling and the Mariana swiftlet) (Fritts and Leasman-Tanner 2001). Further, the snake population on Guam appears to be sustained by introduced skinks and geckos, which was a food source for the brown treesnake within its native range (Christy et al. 2007a). Introduction, establishment, and subsequent removal of ecological prey species could occur on other Mariana Islands or other suitable areas in the Pacific if brown treesnakes survive transport to new locations.

The potential for training activities to degrade island habitats through the accidental introduction of potentially invasive species is addressed in Section 3.10.3.3.1 (Impacts from Invasive Species

Introductions). This section identifies the potential introduction pathways associated with training activities described in this EIS/OEIS.

3.10.1.4.2 Loss and/or Degradation of Key Habitat Types

Loss of key habitats is a problem that will have long-term effects on terrestrial habitats and species. Major factors exacerbating habitat loss are ungulates (hoofed animals), development, introduction of invasive plant and animal species, natural events (such as typhoons), and the ecological modification of factors that affect recovery from natural events (Commonwealth of the Northern Mariana Islands Division of Fish and Wildlife 2005; Guam Division of Aquatic and Wildlife Resources 2006).

Probably the most difficult and labor-intensive factor to control is damage by invasive species, such as brown treesnakes and ungulates. One of the potential cascading effects of the introduced brown treesnake is the loss and/or reduction of seed-dispersing birds and bats, which in turn may contribute to the loss of native forest. Feral pigs, deer, and water buffalo alter the forest composition by browsing on or disturbing vegetation. Many native flora are preferred by ungulates because native flora do not possess the chemical and physical defenses found in many introduced plants. This form of artificial selection allows invasive plant species to dominate natural habitats, which further modifies native habitats (Davis 2009; Guam Division of Aquatic and Wildlife Resources 2006; Thompson and Davis 2011).

3.10.2 AFFECTED ENVIRONMENT

3.10.2.1 Vegetation Communities

This section describes vegetation communities found on DoD owned or leased lands on Guam and the CNMI. The composition and structure of these plant communities are influenced by a variety of factors, such as current and past disturbances, substrates, and precipitation. Many native plants discussed in this section are culturally important as medicinal plants, spiritual significance, or traditional food sources.¹

3.10.2.1.1 Department of Defense Lands on Guam

The floristic complexity of Guam's plant communities and the absence of distinct associations of species have led ecologists to emphasize the underlying soil and the relative degree of disturbance when classifying plant communities, rather than solely their floristic composition. Navy natural resource specialists grouped vegetation types based on works by Fosberg (1960) and Stone (1970).

These vegetation types are grouped into the following five general plant communities: (1) limestone, (2) ravine, (3) wetland, (4) strand, and (5) savanna (U.S. Department of the Navy 2013a). The five general plant communities occurring on Guam are discussed in greater detail in the following paragraphs. Distinct communities within the general plant communities are identified where possible based on data from previous field surveys. Photos of representative community types are shown in Figure 3.10-3.

Limestone Communities. Limestone communities are situated on elevated limestone terraces, plateaus, and slopes. Forest community structure and composition are primarily influenced by the high winds of typhoons. Depending on the relative age of the vegetation within the community, limestone forest can be further divided into primary and secondary forests, with primary forests being the historic limestone

¹ Species of flora and fauna continue to have integral roles in contemporary Chamorro culture. In acknowledgement, this EIS/OEIS will use Chamorro names for plants, with first mention of scientific name (not all plants within the Study Area have commonly used English names). English names will be used for animals, with scientific and Chamorro names at first mention. Some species discussed in the text do not have an English name or a known Chamorro name. In these instances, only the scientific name is used.

forest and the secondary being a successional form after primary forests were impacted by catastrophic forces such as typhoons and intensive military actions (e.g., bombing). Limestone plant communities are diverse and highly variable, containing both native and nonnative woody plants, ferns, and herbaceous plants adapted to excessively drained, shallow limestone soil. The endangered *Serianthes* tree occurs in limestone forests and is restricted to the forested portion of Northwest Field above Ritidian Point (see Table 3.10-1). In their least disturbed state, these plant communities have a stratified canopy consisting of scattered, large, emergent trees, such as dukduk (*Artocarpus mariannensis*) and nunu (*Ficus prolixa*), with a maximum height of 60 to 70 feet (ft.) (18 to 21 meters [m]). Other dominant species composing both the upper canopy and mid-canopy layers include mapunao (*Aglaia mariannensis*), langiti (*Ochrosia mariannensis*), ahgao (*Premna obtusifolia*), yoga (*Elaeocarpus joga*), ifit (*Intsia bijuga*), umumu (*Pisonia grandis*), pahong (*Pandanus dubius*), and kafo (*Pandanus tectorius*) (U.S. Department of the Navy 2013a). Mid-canopy layers can be 30 to 45 ft. (9 to 14 m) tall. Smaller individuals of the above species and species such as paipai (*Guamia mariannae*), fadang (*Cycas micronesica*), and lada (*Morinda citrifolia*) are often present as an understory layer. The floristic composition of a limestone forest can be variable depending on location and the history of disturbance (U.S. Department of the Navy 2013a).



Notes: 1. Upper left panel: large dukduk (*Artocarpus mariannensis*) in mature limestone forest, Naval Base Guam Telecommunications Site (March 2011). 2. Upper right panel: coastal strand community located at Mergagan Point, near Andersen AFB (April 2010). 3. Lower left panel: karisu (*Phragmites karka*) and open water near Laguas River bridge (April 2011). 4. Lower right panel: savanna communities and erosion scars west of the Naval Base Guam Munitions Site, along with ravine forests along drainages.

Figure 3.10-3: Representative Vegetation Community Types on Guam

Two subtypes of the limestone community type are recognized: disturbed limestone forest and halophytic-xerophytic scrub (salt tolerant vegetation on exposed and thin-soiled slopes and rock flats). Disturbed limestone plant communities are usually dominated by nonnative woody species of relatively short heights. The floristic composition represents subclimax seral stages following human-induced disturbances such as land clearing. The canopy of disturbed limestone forest is fairly open, which allows abundant sunlight to reach the forest floor. The majority of the woody biomass in the disturbed areas is derived from nonnative species, including tangantangan (*Leucaena leucocephala*), lemondichina (*Triphasia trifolia*), and papaya (*Carica papaya*). Some areas of disturbed limestone forest are dominated by larger, nonnative trees such as African tulip (*Spathodea campanulata*) and ahgao manila (*Vitex parviflora*). Scattered niyok or coconuts (*Cocos nucifera*) are common overstory components of disturbed limestone forests. Inland groves of coconuts are the remnants of copra plantations. Native species can be present in the understory, including kafo, nanaso (*Scaevola sericea*), panao (*Guettarda speciosa*), and nunu. The open understory, the result of ungulate browsing, rooting, and trampling, is occupied by various nonnative grasses, vines, and weeds. Chromolaena (*Chromolaena odorata*), known as masiksik in the Chamorro language, is a common nonnative shrub in recently disturbed areas (U.S. Department of the Navy 2013a).

The halophytic-xerophytic scrub subtype of the limestone community is a unique plant community that exists on limestone terraces and cliff edges. The presence of drying winds, exposure to salt spray, and excessively drained limestone soil result in a microclimate that supports a stunted, wind-pruned plant community. The floristic diversity in these communities varies from low to high. Common species in halophytic-xerophytic scrub communities include nigas (*Pemphis acidula*), nanaso, panao, chopak (*Mammea odorata*), hunik (*Tournefortia argentea*), lodugao (*Clerodendrum inerme*), kafo, pago (*Hibiscus tiliaceus*), langiti, nunu, gasoso (*Colubrina asiatica*), lalahag (*Jasminum marianum*), and gulos (*Cynometra ramiflora*) (U.S. Department of the Navy 2013a).

Ravine Communities. Fosberg (1960) classified the forest vegetation in valleys and ravines in southern Guam as ravine forests. Although the floristic composition of the ravine communities is similar to the limestone communities, these forests generally occur on volcanic soil or on argillaceous or clayey limestone soil, and are quite variable in floristic composition. Plant communities are often defined by the variability in soil moisture. Valley bottoms and ravines often have higher soil moisture than on the upper slopes. Canopies of ravine forest are structurally complex with multiple layers. Species present often include dukduk, pago, kafo, nunu, chosga (*Glochidion mariannensis*), ahgao, nunu, fagot, langiti, and da'ok (*Calophyllum inophyllum*). Because of their proximity to freshwater streams in southern Guam, these plant communities contain many species of cultivated plants such as coconut, betelnut palm or pugua (*Areca catechu*), alangilang (*Cananga odorata*), and banana or chotda (*Musa* spp.). Epiphytes and common woody climbers (i.e., lianas) are also present (U.S. Department of the Navy 2013a).

A disturbed ravine forest subtype is also recognized. Disturbed ravine plant communities are usually dominated by nonnative woody species with a more open canopy. The floristic composition represents subclimax seral stages following human-induced disturbances, such as agriculture. The majority of the woody biomass in the disturbed ravine forest is usually derived from nonnative species. Ahgao manila and alangilang are common components of disturbed ravine forests on Guam. The open understory is occupied by various nonnative grasses, vines, and weeds (U.S. Department of the Navy 2013a). Ravine forests and disturbed ravine forests are limited to the Naval Base Guam Apra Harbor and Naval Base Guam Munitions Site.

Wetland Communities. Wetlands are areas subject to permanent or periodic inundation by surface or groundwater with a frequency sufficient to support a prevalence of vegetative or aquatic life that require saturated or seasonally saturated soil conditions for growth and reproduction. The surface or subsurface water must be sufficient for the establishment of hydrophytes or development of hydric soil or substrates. Wetlands generally include swamps, marshes, bogs, and similar areas, such as sloughs, depressions, wet meadows, river overflows, mud flats, and natural ponds (U.S. Department of the Navy 2013a). The northern limestone plateau of Guam is generally lacking in substantial wetlands, but marshes are found in the southern portion of the island (U.S. Department of the Navy 2013a).

Fosberg (1960) described seven subtypes of wetland plant communities based on their dominant floristic composition. Fosberg defined swamps as supporting plant communities with a predominance of woody species, and marshes as supporting herbaceous plant communities (Fosberg 1960). Marshes are generally situated in low places along the coast, along streams, in depressions and sinkholes with argillaceous limestone, or in poorly drained areas with volcanic soil. Marshes can be inundated with freshwater or brackish water if near the ocean. Swamps are generally situated along rivers, especially near the coast or along river valleys if inland, and are usually designated as ravine communities rather than as wetland communities (U.S. Department of the Navy 2013a).

Most marshes on Guam are floristically simple with few dominant plant species. Karisu (*Phragmites karka*), a tall, reedy perennial grass, is the most common marsh species, often forming a dense monocultural plant community. *Scirpus littoralis*, a perennial sedge with rhizomes, is also found in dense pure stands along stream banks and in estuaries. Langayao (*Acrostichum aureum*), a large fern, can dominate some marshes. Other floristic components of wetland plant communities on Guam can include introduced invasive grasses and sedges (U.S. Department of the Navy 2013a).

Mangroves, freshwater and brackish swamps of woody vegetation, on Guam are the largest category of wetlands and can be found on the edges of marshes, along river courses, and in wet depressions in forests. Pago is usually the dominant species, although the largest tract of swamp forest on the island, the Talofofo River Valley to the east of Naval Base Guam Munitions Site, is dominated by langasat (*Barringtonia racemosa*). Other trees that might be present are kafo, gulos, and the betelnut palm (Guam Division of Aquatic and Wildlife Resources 2006). Natural freshwater marshes are also common on Guam. Most are dominated by dense, nearly pure stands of karisu that are 6 to 16 ft. (2 to 5 m) tall. Other grasses (e.g., *Panicum muticum*), sedges (e.g., *Eleocharis ochrostachys* and *Cyperus* spp.), and langayao are often present but are usually less prevalent (Guam Division of Aquatic and Wildlife Resources 2006). Vegetation in man-made freshwater habitats is variable, but karisu and pago are usually present (Guam Division of Aquatic and Wildlife Resources 2006).

Coastal Strand Communities. Strand vegetation is adapted to excessively drained soil and salt spray from adjacent coastal waters. Many beach areas on Guam are occasionally inundated with salt water during storms, which imposes a controlling influence on all biota. Strand communities vary floristically and in diversity. Backstrand communities usually are inundated at high tide and dry out at low tide. Some common overstory species found in strand plant communities include coconut, gagu (*Casuarina equisetifolia*), nonak (*Hernandia* spp.), and da'ok. Where an overstory is lacking or the canopy is open and a shrub layer is common, the shrub species often include nanaso, hunik, and pago. Vines, including morning glory or halaihai (*Ipomoea* spp.), are often present. Grass species on these coastal strands can include bunchgrass (*Lepturus repens*) and *Paspalum distichum* (U.S. Department of the Navy 2013a). Strand plant communities are limited to narrow strips in coastal areas within Naval Base Guam, Main Cantonment Area, and Andersen Air Force Base (AFB).

Savanna Communities. Savannas, defined as grasslands with scattered individual or clumps of trees, cover extensive areas in southern Guam. Savannas are predominately found on volcanic soil and are maintained by periodic burning initiated by humans (U.S. Department of the Navy 2013a). If left undisturbed, savanna communities would gradually be colonized by an increasing number of woody trees and shrubs, and convert to a ravine or limestone forest depending on the soil type (U.S. Department of the Navy 2013a). These five savanna plant communities were recognized by (Fosberg 1960): (1) *Miscanthus*, (2) *Dimeria*, (3) erosion scar, (4) karisu, and (5) weed communities.

3.10.2.1.1.1 Andersen Air Force Base

Basewide vegetation surveying and mapping were conducted on Andersen AFB in 2007 and 2008, and included quantitative characterization of 3,211 randomly located plots on 15,371 ac. (6,220.4 ha) on Andersen AFB proper and the adjacent Guam National Wildlife Refuge on Ritidian Point (U.S. Department of the Navy 2013a). Twenty-two distinct communities (21 vegetative communities and disturbed land) were observed on Andersen AFB within the survey area (U.S. Air Force 2008). Vegetation community types were named in accordance with the Fosberg (1960) classification, with secondary forest subdivisions based on descriptions of Donnegan et al. (2004). Community types were typically named by the dominant or keystone plant species therein. No wetlands are identified on Andersen AFB (U.S. Air Force 2008).

The predominant vegetation type in undeveloped areas on Andersen AFB is limestone forest. This vegetative community occurs along portions of the western boundary and the northern and eastern boundaries of the installation, atop the plateau, on the fore slope (cliff face), and at the toe of the cliff slope.

Excellent examples of native strand vegetation are found on coastal areas of Andersen AFB. Strand plants are characteristically salt tolerant, thrive in sandy soil or on rocky coasts, and tolerate direct sunlight and hot, dry conditions. Major components of the coastal strand flora include trees and shrubs such as nanaso, hunik (*Tournefortia argentea*), masiksik hembra (*Triumfetta procumbens*), panao, nonak, binalo (*Thespesia populnea*), gagu, puting (*Barringtonia asiatica*), and coconut trees. Rocky coasts typically support stunted, wind-sheared shrubs.

3.10.2.1.1.2 Naval Base Guam Telecommunications Site

Three plant communities were described on Naval Base Guam Telecommunications Site (the northern portion previously called Finegayan North) in 2008: limestone forest, coconut forest (remnants of copra plantations), and disturbed/weed community (successional vegetation between vegetation types) (U.S. Department of the Navy 2013a). The disturbed/weed plant community occurs at forest edges and in patches within the forest (U.S. Department of the Navy 2013a). The predominant vegetation community in the southern portion of the area (Andersen South, previously called South Finegayan) is disturbed limestone forest (U.S. Department of the Navy 2013a).

Limestone forests on Naval Base Guam Telecommunications Site occur on the upper plateau and below the cliffline (U.S. Department of the Navy 2013a). The majority of the plateau area supports disturbed limestone communities composed of nonnative species (U.S. Department of the Navy 2013a). In the forests of the southern section of Naval Base Guam Telecommunications Site, the three species with the highest relative densities were paipai, kafo, and fagot, which are all native species and collectively account for 62 percent of the overall density. All native tree species within the southern section of Naval Base Guam Telecommunications Site had a combined density of 87 percent. Two native tree species,

paipai and mapunao, are endemic to the Mariana Islands and have a combined density of 27 percent (U.S. Department of the Navy 2013a).

The limestone forested area in the southern portion of Naval Base Guam Telecommunications Site is dominated by nonnative ahgao manila, tangantangan, and papaya, which comprise 67 percent of the number of trees. The remaining 33 percent of tree cover is by five native species. The low native tree component might be the result of past clearing activities at the annex (U.S. Department of the Navy 2013a).

3.10.2.1.1.3 Andersen South

The most common native tree species within the disturbed limestone forest on Andersen South include the following: pogo, paipai, lada (*Morinda citrifolia*), fagot, and ahgao (*Premna obtusifolia*). The most common introduced tree species on Andersen South include the following: ahgao manila, tangantangan and pickle tree (*Averrhoa bilimbi*). Aside from pickle tree, other nonnative species in the survey, such as papaya and custard apple (*Annona reticulata*), produce edible fruits that are likely dispersed by ungulate activity (U.S. Department of the Navy 2013a).

3.10.2.1.1.4 Naval Base Guam Barrigada

Activities carried out at Naval Base Guam Barrigada require large amounts of cleared, maintained land for operation. Vegetation communities include tangantangan scrub, limestone forest, disturbed limestone forest, shrub/grassland, and wetlands. The disturbance of land has led to an increase of nonnative and invasive species. The degree of disturbance within the annex results in portions of the remaining forested plant communities being highly modified and dominated by tangantangan and African tulip (U.S. Department of the Navy 2013a).

Twenty tree species were documented on transects quantified during the 2008 vegetation surveys performed on Naval Base Guam Barrigada (U.S. Department of the Navy 2013a). The most commonly observed trees included nunu, pogo, and fagot. All three species are native to Guam. Paipai, which is also native, is a dominant understory species within the forests on Naval Base Guam Barrigada. Common introduced species on Naval Base Guam Barrigada include custard apple, limeberry, and tangantangan. Native species have a combined relative density of approximately 77 percent, far exceeding the relative density of introduced species for the survey transects at Naval Base Guam Barrigada (U.S. Department of the Navy 2013a).

3.10.2.1.1.5 Naval Base Guam Main Base

Naval Base Guam Main Base includes Naval Base Guam Polaris Point, Naval Base Guam Apra Harbor, Sasa Valley Tank Farm, and Tenjo Vista Tank Farm. Vegetation communities on Naval Base Guam Main Base include limestone, ravine, and wetland communities. Limestone communities are situated on slopes found within Naval Base Guam Main Base. Relatively large disturbed limestone communities are present on the lower slopes of Orote Peninsula and a narrow band of halophytic-xerophytic scrub communities exists on the cliff faces (U.S. Department of the Navy 2013a).

Vegetation surveys were performed along a transect in the upper plateau to the west of the old runway in the southern sector of Orote in 2008. The area has rugged limestone karst topography. The limestone forest is characterized by native fagot, which comprises 28 percent of the relative density. Collectively, approximately one-third of the relative tree density within this transect is composed of introduced understory tree species (i.e., tangantangan, limeberry, and papaya). The remaining two-thirds of the relative density are composed of native species, including the Mariana Islands endemic species

mapunao. Absolute cover was highest for native upper canopy tree species, including nunu, umumu, and fai'a (*Tristiropsis acutangula*) (U.S. Department of the Navy 2013a). Based on the 2008 vegetation survey on Naval Base Guam Polaris Point, tangantangan comprises 88 percent of the tree layer within the transect (U.S. Department of the Navy 2013a).

Within the Naval Base Guam Main Base, ravine forests are restricted to narrow strips along the few freshwater drainages near the coast (U.S. Department of the Navy 2013a). Manmade wetlands are found at Sasa Valley Tank Farm and Tenjo Valley Tank Farm.

3.10.2.1.1.6 Naval Base Guam Munitions Site

Vegetation communities on the Naval Base Guam Munitions Site include limestone, ravine, wetland, and savanna communities. Limestone communities are situated on elevated limestone terraces, plateaus, and slopes found within the Naval Base Guam Munitions Site. The Naval Base Guam Munitions Site has the largest extent of interior limestone communities on Joint Region Marianas lands on Guam. These limestone communities persist on the ridge tops and upper slopes from Mount Lamlam northward to Mount Alifan. A narrow band of a halophytic-xerophytic scrub plant community is delineated near Mount Almagosa on the Naval Base Guam Munitions Site (U.S. Department of the Navy 2013a).

The ravine forest plant communities are abundant in the Naval Base Guam Munitions Site, occupying much of the south-central portion of the installation. Swamps, delineated as ravine communities, are often present on argillaceous limestone soil, bottomlands, and in depressional areas. Pago and kafo are the most common woody plants associated with these communities, often forming dense thickets. Langasat, a tall forest tree, dominates bottomland forest in areas along the Talofofo River. Extensive areas of disturbed ravine forest are also present in the Naval Base Guam Munitions Site, especially in areas subjected to low-intensity ground fires and past human disturbance. Several acres of coconut plantations still exist within the Naval Base Guam Munitions Site (U.S. Department of the Navy 2013a).

Twelve native species were documented along transects during the 2008 vegetation surveys within the ravine forests in the northern sector of the Naval Base Guam Munitions Site: akgak, pago, da'ok, chosgo (*Glochidion marianum*), *Melastoma malabathricum*, fadang, lada, gulos, chi'ute, pahong, *Discocalyx megacarpum*, and a'abang (*Eugenia reinwardtiana*) (U.S. Department of the Navy 2013a). Native tree species dominate the relative density of trees in all transects in the northern sector. Akgak and pago are the most dominant native species in the northern sector (U.S. Department of the Navy 2013a). Common introduced tree and shrub species within the northern sector include the betelnut palm, ahgao manila, the invasive bay rum tree (*Pimenta racemosa*), and limeberry (U.S. Department of the Navy 2013a).

A 2009 vegetation survey in the ravine forest in the valley slopes surrounding Mount Almagosa in the southern sector of the Naval Base Guam Munitions Site characterized the native fai'a (*Merrilliodendron megacarpum*) as the native species comprising more than 63 percent of the relative density. The ravine forest along the Sadog Gagu River in the southern sector of the Naval Base Guam Munitions Site is dominated by coconut and two introduced species, ahgao manila and betelnut palm. The overall relative density of native species along the Sadog Gagu River is approximately 33 percent, which is lower than the densities observed in ravine forest transects in the northern sectors of the Naval Base Guam Munitions Site. In the ravine forest in the southwestern sector of the installation, south and west of the explosive ordnance disposal range, the introduced species coconut and betelnut palms and native kafo trees are dominant (U.S. Department of the Navy 2013a).

Fena Dam, built in 1951, contains Fena Reservoir, the largest freshwater body of water on Guam. Fena Reservoir is approximately 200 ac. (81 ha), the shallow water fringes of the lake are dominated by karisu. The Naval Base Guam Munitions Site contains the greatest area of wetlands on DoD-owned or leased lands in Mariana Islands (U.S. Department of the Navy 2013a). Most of these freshwater wetlands are adjacent to the rivers or their tributaries. Wetlands on the Naval Base Guam Munitions Site occur in limestone forest, ravine forest, and savanna communities. Common forested wetland species include pago, coconut, kafo, and the betelnut palm (U.S. Department of the Navy 2013a).

Erosion in savanna communities is particularly evident within the Naval Base Guam Munitions Site. Large areas of bare ground are present primarily due to degraded soil and destruction of vegetation by feral ungulates. Without vegetation, slope failures expose bare ground.

3.10.2.1.2 Rota

Training activities on Rota described in this EIS/OEIS are limited to Rota International Airport and other areas in conjunction with local law enforcement. Potential training locations on Rota are shown on Figure 3.10-2. The infrequent use of locations on Rota occurs in developed areas, not in Rota's natural areas that support special status species. An overview of Rota's natural vegetation communities and locations of special ecological interest is included below.

No major military battles occurred on Rota during World War II. Therefore, the island of Rota was spared much of the ecological destruction that occurred on Guam, Saipan, and Tinian. With a small human population and limited agriculture, Rota has also been less developed than the other islands in the southern portion of the archipelago. The vegetation communities on Rota includes primary and secondary limestone forest, atoll forest, agricultural forest, coconut plantations, Formosan koa forest, secondary vegetation, open fields, grassland, and urban vegetation (Fosberg 1960, Mueller-Dombois and Fosberg 1998).

Rota also has a substantial portion of land in designated conservation areas, and other lands also remain relatively undisturbed. Consequently, intact limestone forest covers a majority of the island. Rota also hosts several rare plants, including *Tabernaemontana rotensis*, and nearly all *Serianthes* trees in existence (both of these species also occur on Andersen AFB on Guam). Two other ESA-listed plant species occur exclusively on Rota—*Osmoxylon mariannense*, and *Nesogenes rotensis* (U.S. Fish and Wildlife Service 2006c).

The Sabana region is an uplifted plateau 1,476 ft. (450 m) in elevation covering approximately 5 square miles (mi.) (13 square kilometers) on the western half of the island. This area supports dense limestone forests and also includes the known locations of the ESA-listed *Osmoxylon mariannense*. Cliffs border the Sabana on all sides except to the northeast, where the Sabana slopes down to the eastern part of the island, which has been covered since the 1930s in secondary growth forest intermingled with residential and agricultural lands. The cliff lines surrounding the plateau remain primary forest due to their steepness, a hindrance to past agricultural development. The plateau's western cliffs support the Rota population of the ESA-listed *Serianthes* tree. The I'Chinchon Bird Sanctuary is located on the southeastern and eastern coastlines of Rota and is now part of the Mariana Crow Conservation Area. The sanctuary is an important seabird and shorebird location and contains intact limestone forest and exposed limestone outcrops suitable for nesting habitat. This area is also the location of one of two populations of the ESA-listed *Nesogenes rotensis*.

Most of the ecological services provided by the native vertebrates, such as insectivory, pollination, and seed dispersal, still appear to function on Rota (Hess and Pratt 2006). However, introduced deer are responsible for unnatural native plant herbivory, and rats (*Rattus* spp.) are likely seed predators, as well as nest predators of native birds. The abundant Black Drongo (*Dicrurus macrocercus*) may also be responsible for nest predation of native forest birds. Despite these depredations and frequent typhoons, limestone forest regeneration processes appear to be unimpeded in comparison to Guam. Abundant birds that disperse large seeds include the Mariana fruit dove and the white-throated ground dove, whereas the Micronesian honeyeater may serve as an important pollinator bird species (Hess and Pratt 2006).

3.10.2.1.3 Tinian Military Lease Area

Tinian consists of a series of five limestone plateaus at various elevations, separated by escarpments and steeply sloping areas (U.S. Department of the Navy 2013a). These areas are described in more detail below.

3.10.2.1.3.1 Limestone Forests

Limestone forests fall into three types: mixed forest, coastal forest, and halophytic-xerophytic shrub. Mixed forest is classified as a cliff-line ecosystem. These forests occur on the peak of Mt. Lasso and areas surrounding the north escarpment of Maga. The coastal and halophytic-xerophytic forests occur in near-shore ecosystems. Limestone forests occurring in cliff-line ecosystems are referred to as “typhoon forests” due to adaptations in the vegetation promoting forest regeneration in the presence of typhoon damage. Some plant species will reproduce by generating new shoots from fallen branches and by flowering in exposed areas cleared by wind damage. Vegetation that occurs in typhoon forests includes umumu, gulos, nunu, and paipai.

Coastal limestone forest occurs on slopes above the ocean. Plants found in this vegetative community include chi’ute (*Cerbera dilatata*), langiti, paipai, and kafo. Coastal limestone forests can be found at Unai Masalok.

Halophytic-xerophytic scrub vegetation occurs in near ocean habitat on limestone rocks. The dominant plant species in a halophytic-xerophytic scrub habitat is *Pemphis acidula* (U.S. Department of the Navy 2013a).

3.10.2.1.3.2 Secondary Growth Forests

Secondary growth forests contain a mixture of native and introduced trees, shrubs, and dense understory plants. These forests comprise parts of the lowland ecosystem. Dominant trees include tangantangan, kamachili (*Pithecellobium dulce*), and gago (*Casuarina equisetifolia*), with rare occurrences of *Acacia confusa*. Dense stands of piao (*Bambusa vulgaris*) can also be found in secondary forests.

Tangantangan forest dominates mainly the level to moderately sloping areas at the north end of the island. Tangantangan is also included in secondary growth forest and is a part of the lowland ecosystem. However, on Tinian there are extensive homogeneous stands of this species. Often the stands are interspersed with *Panicum maximum*, which grows to 6 ft. (1.8 m) tall (U.S. Department of the Navy 2013a).

3.10.2.1.3.3 Open Fields and Grasslands

Open field habitat is characterized by grass and other ground-covering vegetation with small thickets of native and introduced vegetation. Open field habitat is also included as a component of the lowland ecosystem. Generally, these fields occur in areas of historical cattle grazing. Introduced species such as lantana (*Lantana camara*), morning glory, climbing hempvine (*Mikania scandens*), and giant false sensitive plant (*Mimosa invisa*) are present in open fields as well as small groves of trees, including African tulip tree (*Spathodea campanulata*).

Vegetation present near open water area is typically dominated by *Schoenoplectus litoralis* var. *capensis*, with patches of langayao and *Paspalum orbiculare*. This band of mixed vegetation is surrounded by a band of karisu, an obligate wetland species (U.S. Department of the Navy 2013a). Crop plants have been planted in areas, and these disturbed areas contain gago, vines, and weedy herbs.

3.10.2.1.3.4 Wetlands (Freshwater)

Although surface water is rare, some areas of limestone on Tinian have developed conditions that allow wetlands or seasonal wetlands to form. Three of these areas occur within the Tinian Military Lease Area (MLA). Each of these areas consists of discrete sites that impound rainwater and are entirely dependent upon rainfall as a source of water. Hagoi is the largest of the wetlands, with a capacity to hold approximately 39 ac. (15.5 ha) of surface water, with surrounding areas of karisu. The wetland submergent plant-like algae, *Chara* spp., is abundant in some of the open water areas within sedge vegetation. Green algae (Chlorophyta) are also present and increase during the dry season. During the dry season, more than 50 percent of the open water areas was found to be covered with algae (U.S. Department of the Navy 2013c). Mahalang (1.3 ac. [0.5 ha]) and Bateha (1.5 ac. [0.6 ha]) are both composed of depressions and crater features (possibly World War II bomb craters), some of which retain water after heavy rains or typhoons. Each of these sites, however, is dry for most of the year, and in dry years may not pond water even during the wet season (U.S. Department of the Navy 2013c).

3.10.2.1.3.5 Strand Vegetation

Strand vegetation occurs on sandy beaches, and is often mixed with halophytic-xerophytic species. This vegetation type is a component of the coastal ecosystem. Tinian beaches consisting of strand vegetation are Unai Chulu, Unai Babui, Unai Chiget, and Unai Dangkulo (U.S. Department of the Navy 2013a). Vegetation in strand habitat includes hunik, beggar's tick (*Bidens alba*), blue porterweed (*Stachytarpheta jamaicensis*), lantana, binalo, and morning glory. *Euphorbia sparrmannii* var. *tinianensis*, is a semi-succulent herb endemic to Tinian and occurs only at Unai Masalok. Lamanibot Bay and other headland communities are valued as healthy xerophytic-halophytic scrub and can contain ufa halom-tano (*Heritiera longipetiolata*) (U.S. Department of the Navy 2013a). *Heliotropium anomalum* can be found near the cliff slope rim terrace pools created by the Unai Chiget blow hole and is not reported elsewhere on Tinian. The Unai Chiget region also includes a forest of nonak trees. Dense areas of this tree are not common in its range and this particular stand is unique on Tinian.

3.10.2.1.4 Saipan Marpi Maneuver Area

As described in Chapter 2 (Description of Proposed Action and Alternatives), Marpi Maneuver Area is authorized for training; however, the area is seldom used. Portions of the Marpi Maneuver Area are owned by CNMI, and other portions are privately owned. The Marpi Maneuver Area is 374.5 ac. (151.5 ha) and is characterized by tangantangan thickets and elephant grass meadows with some limestone forest areas in the southwestern portion of the facility. The area includes some old building pads on the eastern side of the area, adjacent to an old motocross track. With the coordination of the Army Reserve Unit Saipan and the approval of CNMI government, land navigation training is conducted

on non-DoD lands within the Marpi Maneuver Area (shown in Figure 2.1-11, east side of northern Saipan). Land navigation training does not include vehicular training, and no fires are allowed for associated bivouac activities. Generally, maneuver training on Saipan is infrequent and rare, and most training activities are expected to use only the areas surrounding the buildings on the western edge of the old motocross track.

3.10.2.1.5 Farallon de Medinilla

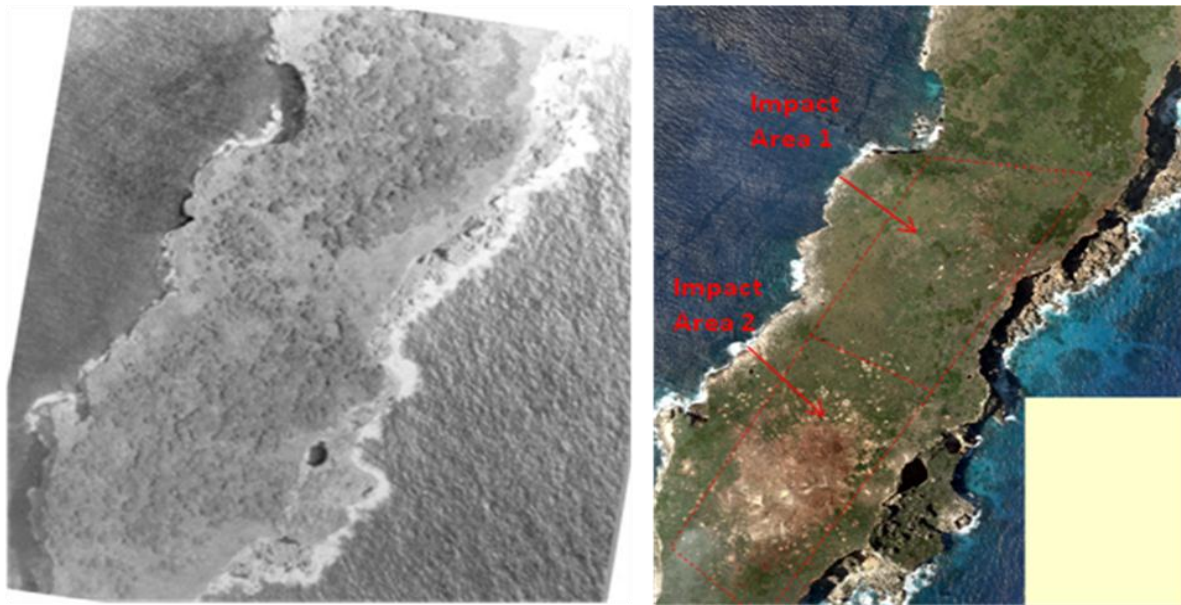
The U.S. military has used the island of FDM as a bombing range since at least 1971, and the agreement between the U.S. Government and the CNMI was formalized in a 50-year lease agreement (United States of America and Commonwealth of the Northern Mariana Islands 1983). Few vegetation surveys have been conducted on FDM. The first published flora record by Fritz in 1902 described the island as a plateau covered by brush approximately 13 ft. (4.0 m) high (Mueller-Dombois and Fosberg 1998); however, aerial photographs from 1944 show large canopy trees on FDM (Figure 3.10-4). FDM's vegetation appears to have undergone significant changes since the island was leased by the DoD and the subsequent bombardment for military training. The most intensive bombardment to date of FDM occurred during the Vietnam era, when as much as 22 tons of ordnance per month was dropped on the island (Lusk et al. 2000). Based on early 20th century descriptions of FDM vegetation and aerial photographs of the island prior to military bombardment activities, island tree height and canopy cover have been greatly reduced (Lusk et al. 2000; Mueller-Dombois and Fosberg 1998). A brief botanical survey of the northern portion of the island carried out in 1996 identified 43 plant species, 32 of which were native (Mueller-Dombois and Fosberg 1998). Vegetation on FDM may be grouped into coastal vegetation, cliff-line vegetation, and vegetation on the upper plateau known as the mesic terrace system. These vegetation types are described below.

3.10.2.1.5.1 Coastal Vegetation

Along the windward shoreline of FDM are large boulders interspersed with cobbles. The boulders are covered with microalgae of the genera *Padina*, *Liagora*, and *Asparagopsis*. The emergent portion of the beach is composed of rubble/cobbles with little sand and no vegetation (U.S. Department of the Navy 2013a). In the region of the isthmus is a reef terrace in the form of a ridge and spur system with sand channels. Algae of the genera *Padina*, *Dictyota*, *Hamimeda*, *Lyngbya*, *Liagora*, *Neomeris*, and *Calupera* cover the upper surface of the ridges (U.S. Department of the Navy 2013a). Along the leeward coastline is a structurally unique submerged shoreline forming a vertical wall to a depth of 49 to 66 ft. (15.0 to 20.1 m), undercut by ledges and caves. The exposed wall supports the green calcareous algae *Halimeda* and calcareous red algae (U.S. Department of the Navy 2013a).

3.10.2.1.5.2 Cliff-Line Vegetation

The dominant plant species in the cliff-line communities are *Exocoecaria aqallocha*, with less coverage by *Digitaria gaudichaudii*, *Bikkia tetandra*, *Hedyotis stringulosa*, and *Portulaca oleracea* (Lusk et al. 2000).



Notes: 1. Left panel photograph (circa 1944) shows apparent taller stature vegetation within the mesic terrace vegetation type in the central portion of the island (Source: U.S. Department of the Navy 2013a). 2. Right panel photograph (2012) shows recently cleared targets within range areas. Mesic terrace lacks forests evident from the 1944 photograph.

Figure 3.10-4: Reduction of Forest Communities on Farallon de Medinilla by Military Bombardment and Typhoons

3.10.2.1.5.3 Mesic Terrace System

Most of the mesic terrace ecosystem is dominated by dense herbaceous plant communities. Soil on the terrace is more developed and has higher moisture content than the cliff-line ecosystem soil. As a result, the once forested mesotrophic environment supports greater diversity of plant species than observed in the cliff-line ecosystem. This area receives most of the ordnance at FDM, and subsequently has been altered the most in terms of structure and composition (from closed canopy forested areas to dense herbaceous and shrub cover (Lusk et al. 2000).

3.10.2.2 Wildlife Communities

3.10.2.2.1 Department of Defense Lands on Guam

3.10.2.2.1.1 Birds

Three endemic bird species from the Mariana Islands occur in small populations on Guam. The Mariana common moorhen persists in low numbers throughout Guam and on military-owned lands. The Mariana swiftlet was once common throughout the island but is now restricted to three caves on the Naval Munitions Site in southern Guam. The Micronesian starling, listed as endangered by Guam but not by the Federal government, was nearly extirpated in the early 1990s; however, it currently appears to be making a modest recovery and occurs in small numbers on Andersen AFB, Cocos Island, parts of Hagatna, Apra Harbor, and some coastal areas in southern Guam (U.S. Department of the Navy 2013a). Two other native terrestrial avian species are still found on military lands, neither of which is listed as threatened or endangered, but both are protected by the MBTA. These are the yellow bittern (*Ixobrychus sinensis*) and Pacific reef heron (*Egretta sacra*). The yellow bittern is the only native land bird that is still considered to be common on Guam (U.S. Department of the Navy 2013a). The Mariana crow has not survived in the wild on Guam and is believed to be extirpated from the island.

ESA-listed bird species are addressed in more detail in Section 3.10.2.3 (Endangered Species Act Listed Species). Seabirds and shorebirds protected under the MBTA are addressed separately in Section 3.6 (Marine Birds).

Several nonnative bird species are also present on Guam, which were either unintentionally introduced or intentionally introduced to provide hunting resources. Commonly observed introduced avian species include the island collared dove (*Streptopelia bitorquata bitorquata*), Eurasian tree sparrow (*Passer montanus*), black francolin (*Francolinus francolinus*), and the black drongo (*Dicrurus macrocercus harterti*). Guam Division of Aquatic and Wildlife Resources officially closed the dove hunting season in 1987; however, feral pigeons may be legally shot when it is legal to discharge a firearm (U.S. Department of the Navy 2013a). The island collared dove is present on all Joint Region Marianas lands on Guam (U.S. Department of the Navy 2013a). The Eurasian tree sparrow is commonly observed in small flocks, usually close by manmade structures. Black francolins were introduced to southern Guam as a game bird by the USFWS in 1961 and currently inhabit a variety of habitat types throughout the island, including Andersen AFB. The black drongo was introduced to Rota by the Japanese in the 1930s. The black drongo eventually spread to Guam and is considered a nuisance species that can be hunted at any time of the year. The black drongo occurs mostly in developed areas (U.S. Department of the Navy 2013a).

3.10.2.2.1.2 Mammals

Three species of bats, the Mariana fruit bat (*Pteropus mariannus mariannus*), the little Mariana fruit bat (*P. tokudae*), and the Pacific sheath-tailed bat (*Emballonura semicaudata rotensis*) were historically the only native mammals on Guam. The Pacific sheath-tailed bat has been extirpated from the island, while the little Mariana fruit bat is thought to be extinct. The Mariana fruit bat is federally listed as threatened; therefore, this is the only bat species addressed under Section 3.10.2.3 (Endangered Species Act Listed Species).

Spanish introductions included Asiatic water buffalo (known as carabao in Chamorro) (*Bubalus bubalis*), Philippine deer (*Cervus mariannus*), dogs (*Canis familiaris*), cats (*Felis catus*), feral pigs (*Sus scrofa*), goats (*Capra hircus*), and cattle (*Bos taurus*). Three of these introduced species, the Asiatic water buffalo, Philippine deer, and pigs, have feral populations that are damaging natural resources on Guam (U.S. Department of the Navy 2013a). Other introduced species include the Indian musk shrew (*Suncus murinus*) and several rodent species such as the common house mouse (*Mus musculus*), Malayan black rat (*Rattus diardii*), roof rat (*Rattus rattus*), Polynesian rat (*Rattus exulans*), and the Norwegian rat (*Rattus norvegicus*) (Wiewel et al. 2009).

3.10.2.2.1.3 Reptiles and Amphibians

Native reptile species known to still exist on Guam include stump-toed (mutilating) gecko (*Gehyra mutilata*), blue-tailed skink (*Emoia caeruleocauda*), Slevin's skink (*Emoia slevini*), moth skink (*Lipinia noctua*), snake-eyed skink (*Cryptoblepharus poecilopleurus*), Pacific slender-toed gecko (*Nactus pelagicus*), mourning gecko (*Lepidodactylus lugubris*), oceanic gecko (*Gehyra oceanica*), Micronesian gecko (*Perochirus ateles*), green sea turtle (*Chelonia mydas*), and hawksbill sea turtle (*Eretmochelys imbricata*) (Christy et al. 2007a, 2007b). Red-eared sliders (*Trachemys scripta elegans*) and snapping turtles (*Chelydra serpentina*) were recently introduced to some freshwater and brackish aquatic sites on Guam (Vogt and Williams 2004, U.S. Department of the Navy 2013a). The monitor lizard (*Varanus indicus*), which is common in some areas on Guam, is considered an early introduction to the Mariana Islands, approximately 1,600 years ago (Pregill and Steadman 2009). Sea turtles are discussed separately in Section 3.5 (Sea Turtles).

There are no native amphibian species on Guam; however, several nonnative amphibians have been introduced, including the marine toad (*Rhinella marina*), greenhouse frog (*Eleutherodactylus planirostris*), eastern dwarf tree frog (*Litoria fallax*), Guenther's Amoy frog (*Rana guntheri*), Hong Kong whipping frog (*Polypedates megacephalus*), Pacific chorus frog (*Pseudacris regilla*), slender-digit chorus frog (*Kaloula picta*), white-lipped tree frog (*Polypedates leucomystax*), grass frog (*Fejervarya limnocharis*), crab-eating frog (*Fejervarya cancrivora*), and marbled pygmy frog (*Microhyla pluchra*) (Vogt and Williams 2004, Christy et al. 2007a, 2007b). Incidental occurrences of the Malaysian narrowmouth toad (*Kaloula pulchra*) and coqui (*Eleutherodactylus coqui*) have been recorded but neither species has become established on Guam (Christy et al. 2007a, 2007b).

The primary cause of the decline in native reptile populations on Guam is probably predation by introduced animals, including brown treesnakes, cats, and rats (*Rattus* spp.). The population of the blue-tailed skink has declined in response to predation or competition from the curious skink (*Carlia fusca*); however, it is relatively common in appropriate habitat (Fritts and Leasman-Tanner 2001, Vogt and Williams 2004). The stump-toed gecko has also declined, apparently in response to predation by introduced vertebrate predators, including rats, cats, shrews, and the brown treesnake. The mourning gecko is relatively common (Fritts and Leasman-Tanner 2001).

3.10.2.2.1.4 Invertebrates

Guam is home to dozens of endemic invertebrate species, many of which are rare or have extremely limited ranges. Endemic invertebrate species include the Mariana eight-spot butterfly (*Hypolimnas octocula marianensis*) and an undescribed *Catacanthus* species, known as the bronze boonie bug. Guam also supports three native tree snail species (humped tree snail [*Partula gibba*], fragile tree snail [*Samoana fragilis*], and Guam tree snail [*Partula radiolata*]). Additionally, Guam has a number of endemic invertebrate cave species that are likely extremely limited in their distribution. Among these are the Almagosa Cave amphipod (*Melita* spp.), at least three Almagosa isopods (*Isabelloscia* spp.), and the Guam karst katydid (*Salomona guamensis*).

The three native tree snails, Mariana eight-spot butterfly, and Mariana wondering butterfly are considered candidates for listing under the ESA. Population declines of native tree snails are likely due to overgrazing of vegetation by ungulates resulting in a loss of forest habitats, and the predation by introduced species, namely the terrestrial flatworm (*Platydemus manokwari*) and rosy wolfsnail (*Euglandina rosea*) (U.S. Department of the Navy 2013a). Overbrowse of nurse plants for the Mariana eight-spot butterfly and Mariana wandering butterfly is a major threat to the recovery of this species (U.S. Department of the Navy 2013a).

The native terrestrial crab or panglao (*Cardisoma carnifex*), land hermit crab or umang (*Coenobita brevimanus*) and coconut crab (*Birgus latro*) (known as ayuyu in Chamorro) begin life in the sea. After a planktonic larval stage, small crabs emerge from the ocean to live on land. Mangrove crabs or atmangao live in burrows among the roots of riverbank trees. Land hermit crabs rely on borrowed shells for protection throughout their lives, often using the shell of the introduced giant African land snail (*Achatina fulica*). Coconut crabs are the largest terrestrial land arthropod on Earth. They initially borrow shells, but then develop their own hard exoskeleton. Coconut crabs hide in holes during the day and, like the land hermit crab, forage at night. Land crabs are omnivorous and eat foods such as fruits, seeds, plants, rotting wood, dead insects, and carrion. Coconut, land, hermit and mangrove crabs are all found in various locations of DoD property within the Study Area. Threats to these species include rats, feral pigs, dogs, monitor lizards, and humans (U.S. Department of the Navy 2013a).

3.10.2.2.1.5 Guam National Wildlife Refuge and Overlay Units

The Guam National Wildlife Refuge was established in 1993 to protect and recover ESA-listed species, protect habitat, control non-native species (with an emphasis on the brown treesnake control), protect cultural resources, and provide public recreational and educational opportunities.

The Guam National Wildlife Refuge contains three major administrative units, two of which are considered “overlay refuge units” of DoD-administered properties. Overlay refuge units were established through a Memorandum of Understanding, signed by representatives from the Navy, Air Force, and the USFWS. The establishment and management of the overlay refuge units on military lands provides a commitment by the military and the USFWS to institute a coordinated program centered on the protection of threatened and endangered species and other native flora and fauna, maintenance of native ecosystems, and the conservation of native biological diversity in cooperation with the Guam Division of Aquatic and Wildlife Resources, and in support of the military mission (U.S. Department of the Navy 2013a). The three Guam National Wildlife Refuge units are described below:

- **Ritidian Unit:** The Ritidian Unit, in northern Guam, is approximately 772 ac. (312.4 ha), including approximately 370 ac. (149.7 ha) of land and 401 ac. (162.3 ha) of submerged lands. The Unit includes a densely vegetated coastal plain bounded on one side by sheer limestone cliffs jutting to approximately 200 ft. (61.0 m) above sea level. Native vegetation on the Ritidian Unit includes high-quality coastal strand, backstrand, and limestone forest natural communities; a sandy beach; and nearshore marine habitats to the depth of approximately 98.4 ft. (30 m). The terrestrial lands on the Ritidian Unit are designated Critical Habitat for the endangered Mariana crow, the endangered Guam Micronesian kingfisher, and the threatened Mariana fruit bat. Management programs at the Ritidian Unit focus on preserving and restoring essential wildlife habitat, and protection and recovery of endangered and threatened species. Protecting habitat for endangered species also conserves a rich diversity of other plant and animals species. The Ritidian Unit supports a diversity of tropical trees, shrubs, vines, ferns, cycads, grasses, and other species that, in turn, provide habitat for native birds, the Mariana fruit bat, tree snails, coconut crabs, land crabs, skinks, geckos, and myriad native insects.
- **Andersen Air Force Base Overlay Unit:** The 10,219 ac. (4,135.5 ha) Air Force Unit at Andersen AFB in northern Guam is contiguous with the Ritidian Unit and includes high-quality native limestone forest, coastal strand, and backstrand natural communities and beaches. The Air Force Unit supported some of the last remaining endangered Mariana crows on Guam, threatened Mariana fruit bats, and endangered *Serianthes nelsoni* trees in the wild, and supports a diversity of other native wildlife and plant species.
- **Navy Overlay Unit:** The Navy Unit includes approximately 12,237 ac. (4,952.1 ha) of native habitats in north, central, and south Guam on six land tracts. High-quality habitats on the Navy Unit include limestone forest, backstrand, coastal strand, and beaches in northern and central Guam and ravine forests, limestone forests, mangroves, and wetlands in southern and central Guam. These areas provide habitat for a diversity of tropical plants and wildlife, including threatened Mariana fruit bats, endangered Mariana swiftlets, endangered Mariana moorhen, threatened green turtles, and a rich diversity of other plants, skinks, lizards, land snails, and land crabs. Several freshwater rivers and springs are located on Navy lands and support aquatic fauna.

3.10.2.2.2 Rota

Amar et al. (2008) assessed the trends in abundance of eight terrestrial bird species (Mariana crow, Micronesian honeyeater, Mariana fruit-dove, rufous fantail, Philippine turtle-dove, collared kingfisher,

black drongo, and Micronesian starling) on Rota between 1982 and 2004. Only the Micronesian starling increased in abundance. While the introduction of brown treesnakes on Guam has caused the collapse of Guam's native bird populations, brown treesnakes are not the cause of declines in Rota's bird populations (Amar et al. 2008). A nonessential experimental population of Guam rails was established on Rota. Suggested reasons for the decline of the Mariana crow and Rota bridled white-eye on Rota include the impact of introduced predators other than the brown treesnake or habitat loss and degradation of the native tropical forest (Craig and Taisacan 1994, Plentovich et al. 2005). For the Mariana crow, human persecution is also suspected, due to conflicts over land development and habitat protection (Plentovich et al. 2005).

Like Guam, several mammalian species have been intentionally or accidentally introduced to Rota. Feral ungulates (deer and pigs) negatively impact the natural regeneration of native forest in the Sabana region (U.S. Fish and Wildlife Service 2006c). Other mammals such as introduced rats and feral cats are present on Rota.

As stated previously, training activities on Rota described in this EIS/OEIS are limited to Rota International Airport and other areas in conjunction with the CNMI and local Rota government (see Figure 3.10-2). These locations are in previously developed areas.

3.10.2.2.3 Tinian Military Lease Area

Indigenous wildlife species on Tinian reported in the most recent Integrated Natural Resources Management Plan (U.S. Department of the Navy 2013a) include 46 bird species, the majority of which are classified as migratory birds under the MBTA; one bat species (Mariana fruit bat); seven reptile species (two sea turtles, three geckos, and two skinks); and two land crustaceans (coconut crab and land hermit crab). The Mariana common moorhen is reported from the area as well (Amidon 2009). Special-status species are addressed separately below.

3.10.2.2.3.1 Birds

A total of 18 land bird species were detected during one or more of the three surveys conducted between 1982 and 2008 on Tinian (Amidon 2009; Kessler and Amidon 2009, Camp et al. 2012). The most abundant native species were the bridled white-eye, rufous fantail, collared kingfisher, island-collared dove, white-throated ground dove, Mariana fruit dove, white tern, Tinian monarch (see additional discussion below), Micronesian honeyeater, Micronesian starling, and yellow bittern. Monthly monitoring by the Navy and periodic monitoring by CNMI Department of Fish and Wildlife were also conducted and support these observations. Of these species, the bridled white-eye and rufous fantail were the most abundant. The abundance of collared kingfisher, white-throated ground dove, rufous fantail, Micronesian starling, and yellow bittern increased since 1982 while the abundance of Tinian monarch, Mariana fruit dove, and Micronesian honeyeater decreased since 1982 (Camp et al. 2012). Feral chickens are also abundant throughout Navy-leased lands on Tinian (U.S. Department of the Navy 2013a).

The Tinian monarch is an endemic land bird species that nests in limestone, secondary, and tangantangan forest habitats. It was federally delisted in 2004. The status of the Tinian monarch was monitored by the USFWS for a period of 5 years, ending in 2009 (Amidon 2009).

3.10.2.2.3.2 Mammals

Introduced mammals on Tinian include cattle, rats, mice, shrews, cats, and dogs. Wiewel et al. (2009) found the Malaysian black rat to be the most abundant species of rat on Tinian. Densities of the Asian

house shrew (*Suncus murinus*) are high in native and tangantangan forest; house mice (*Mus musculus*) are also present (Wiewel et al. 2009). All three species are known to severely impact biodiversity of Pacific islands. Rodents and shrews are predators of native birds, lizards, insects, and snails. Rats' omnivorous diet also includes native plants, seeds, and fruit. Changes in forest composition are associated with high rodent density. Aguiguan, an island approximately 5 mi. (8 kilometers [km]) off of Tinian, supports Pacific sheath-tailed bats. Similar habitats occur on Tinian; however, the Pacific sheath-tailed bat is assumed to be extirpated from Tinian because of a lack of sightings. The Pacific sheath-tailed bat is considered a candidate for ESA listing.

Philippine deer were introduced from Saipan and Rota to Tinian in the 1960s, and were subsequently extirpated through intensive hunting activities through the early 1980s (Wiles 1990). Approximately 500 feral goats inhabited the southeastern coast in the early 1900s before the population was either killed or captured for sale on Saipan (Wiles 1990). Apart from some domesticated goats on farms, it is unclear whether a feral herd still exists on the island (U.S. Department of the Navy 2013a).

3.10.2.2.3.3 Reptiles and Amphibians

Several native reptile species were identified on a recent survey, including the snake-eyed skink, found adjacent to Unai Chulu and in a monitoring plot just northeast of North Field (U.S. Fish and Wildlife Service 2009d). The tide-pool skink was reported as common in the *Pemphis acidula* vegetation zone north of Unai Chulu and thought likely to be present in similar habitat at other locations (U.S. Fish and Wildlife Service 2009d). In 2008 surveys, the blind snake was found in both mixed and limestone forest, but elsewhere in the Mariana Islands, this species has been reported in tangantangan thickets (U.S. Fish and Wildlife Service 2009d).

3.10.2.2.3.4 Invertebrates

Tinian's terrestrial native invertebrate fauna include two crustaceans and one land snail. The coconut crab is a highly valued game species in the CNMI and serves important ecological functions such as dispersing seeds and as scavengers. Hermit crabs are more associated with coastal environments, but some may be found inland. Like coconut crabs, hermit crabs are important scavengers. Tree snails (Partulid snails) are found on Tinian, although populations are likely impacted by Mankowar flatworm predation (U.S. Department of the Navy 2013a). The Langford tree snail and humped tree snail are considered candidates for ESA listing.

3.10.2.2.4 Farallon de Medinilla

3.10.2.2.4.1 Birds

FDM is recognized by regional ornithologists as an important bird area for many species of seabirds and migrant shorebirds (Lusk et al. 2000; U.S. Department of the Navy 2013a; U.S. Fish and Wildlife Service 1990, 1998, 2008a). These seabird and shorebird species are discussed in Section 3.6 (Marine Birds).

The island collared dove and Eurasian tree sparrow are the only introduced bird species recorded from FDM (Lusk et al. 2000; U.S. Department of the Navy 2013a). Sparrows are believed to have colonized FDM from Saipan (Lusk et al. 2000). Four sparrows were observed in 1996 (Lusk et al. 2000), but none were recorded in August 2008 (U.S. Department of the Navy 2008a, c). The ESA-listed Micronesian megapode, which breeds on FDM, is discussed in more detail in Section 3.10.2.3.8 (Micronesian Megapode/Sasangat (*Megapodius laperouse laperouse*)).

3.10.2.2.4.2 Mammals

Incidental observations of fruit bats during recent bird surveys, along with fishermen reports from the early 1970s, suggest a small number of fruit bats use FDM, possibly as a stopover location while transiting between islands. Fruit bats are discussed in more detail below. The only other mammalian species known to occur on the island are introduced small-sized rats, believed to be *Rattus exulans*. A common observation during recent natural resource surveys (U.S. Department of the Navy 2008a, c), it is believed that rats negatively impact breeding activities for seabirds and shorebirds on the island (U.S. Department of the Navy 2013a).

3.10.2.2.4.3 Reptiles and Amphibians

Only two species of reptiles are reported on FDM—the Pacific blue-tailed skink (*Emoia caeruleocauda*) and the oceanic snake-eyed skink (*Cryptoblepharus poecilopleurus*) (U.S. Department of the Navy 2008a). No observations of brown treesnakes have been reported on the island.

3.10.2.2.4.4 Invertebrates

Inventories for invertebrate species have not been conducted on this island; accounts of invertebrates have been provided as incidental observations during other natural resource survey efforts. For instance, coconut crabs, including one female with eggs, were observed on FDM in August 2008 (U.S. Department of the Navy 2013a).

3.10.2.3 Endangered Species Act Listed Species

3.10.2.3.1 *Serianthes nelsonii* (Hayun Lagu or Tronkon Guafi)

3.10.2.3.1.1 Status and Management

The *Serianthes* tree is one of the largest native trees in the Mariana Islands. Tree heights may reach 118 ft. (36.0 m), with a trunk diameter (measured at breast-height) reaching 6.6 ft. (2.0 m). Mature individuals frequently have large spreading crowns, with several of the largest trees on Rota having crown diameters of 69 to 75 ft. (21 to 23 m). The *Serianthes* tree was listed as endangered under authority of ESA on 18 February 1987 (52 C.F.R. 4907–4910), and is listed as endangered by both Guam and CNMI (Guam Public Law 15–36, Commonwealth of the Northern Mariana Islands Public Law 2-51). Critical Habitat is not designated for this species.

A number of factors are involved in the decline of this species; however, these causes are poorly studied. Based on initial investigations and field observations, the primary threat on both Rota and Guam is a lack of regeneration probably caused by the browsing of seedlings by deer and by predation on seeds by insects. Other threats include browsing by feral pigs and cattle, typhoon damage, habitat loss, inbreeding, wild fires, and insect infestations (U.S. Department of the Navy 2013a).

3.10.2.3.1.2 Population and Abundance

According to the most current estimate from the CNMI, there are believed to be less than 40 mature trees left; however, only one mature tree is believed to be present on Guam, located near Ritidian Point on the upper plateau (located on Andersen AFB). In 1992, super typhoon Omar killed one mature tree on Guam (also on Andersen AFB), but five wild seedlings were observed near the felled native adult. Protective fencing was erected around the seedlings in an effort to protect them from feral ungulates, but by 1994 only one seedling had survived (U.S. Fish and Wildlife Service 1994). In 2002, super typhoon Pongsona partially uprooted this young tree. This tree suffered regular heavy herbivory from butterfly larvae (an unidentified yellow butterfly with green larvae). As of 2011, this tree was not alive (U.S. Department of the Navy 2013a).

In the 1990s, the University of Guam planted 50 seedlings within Area 50 on Andersen AFB; none are known to have survived. In 1999, 20 *Serianthes* tree seedlings from Rota were planted as a joint effort by USFWS, University of Guam, and Andersen AFB in limestone forest along a utility access road in Tarague Basin. Each seedling was protected from ungulate browsing with a wire enclosure. As of 2010, four of the original 20 seedlings survive, surrounded by a wire exclosure fence. As of 2014, two surviving trees are located in the Tarague area, and one mature tree is located on the upper plateau at Ritidian.

3.10.2.3.1.3 Biology, Ecology, and Behavior

New leaves are produced continually throughout the year, but production is sensitive to the dry season (January to June), a time when most branches are dormant. Mature seed pods on Rota were reported during all seasons, and seed crops can be large, with 500 to 1,000 pods (U.S. Fish and Wildlife Service 1994). The age and size necessary for reproduction is unknown, but flowers and pods were seen on a tree known to be 10 years old with a diameter of 7.5 inches (in.) (19 centimeters [cm]). On Rota, Mariana fruit bats were observed to feed on *Serianthes* flowers, which may be a method of pollination; however, the most important pollinators are likely birds (U.S. Fish and Wildlife Service 1994).

3.10.2.3.1.4 Status within the Mariana Islands Training and Testing Study Area

As discussed above, the last mature *Serianthes* tree on Guam is located at on the upper plateau above Ritidian Point on Andersen AFB, and as of 2014, another two immature trees are located in Tarague Basin (also on Andersen AFB) (U.S. Department of the Navy 2013a). On Rota, the trees are located in mature limestone forests along cliffline forests of the Sabana region and As Matmos cliffs. No training activities occur in these areas.

3.10.2.3.2 *Nesogenes rotensis* (No Known Common or Local Name)

3.10.2.3.2.1 Status and Management

Nesogenes rotensis is a low-growing herbaceous (non-woody) plant with small, opposite, broadly lance-shaped, coarsely toothed leaves, restricted to Rota. *Nesogenes rotensis* was listed as endangered on April 8, 2004 (FR 04-7934). No critical habitat is designated for this species.

3.10.2.3.2.2 Population and Abundance

One population of fewer than 100 plants was reported in 1982 at the Poña Point Fishing Cliff public park land, owned by and under the jurisdiction of the CNMI Division of Forestry and Wildlife (U.S. Fish and Wildlife Service 2006c). In 1994, Raulerson and Rinehart (1997) recorded a population of about 20 plants, occupying 240 square yards (yd.²) (200 square meters [m²]) of habitat at the Poña Point Fishing Cliff. Biannual surveys for this species have been conducted since 2001 at Poña Point Fishing Cliff. A direct count was made on June 27, 2000. At that time there were 80 individuals within an approximate area of 960 yd.² (800 m²). In May and November 2001, direct counts made by staff from the CNMI Division of Forestry and Wildlife identified 458 and 579 adult plants, respectively. No individuals plants were observed in May or November of 2003 following super typhoon Pongsona, but subsequent surveys in 2005 found 20 individual plants (U.S. Fish and Wildlife Service 2006c).

3.10.2.3.2.3 Biology, Ecology, and Behavior

Little is known of the life history or ecology of *Nesogenes rotensis*. Based on information from collections and observations, *Nesogenes rotensis* flowers in March, April, May, and November (Raulerson and Rinehart 1997). It was observed in fruit in January, March, and November (Raulerson and Rinehart 1997). All available information and recent observations suggest that these plants are perennials, but their above-ground parts die back annually (U.S. Fish and Wildlife Service 2006c).

3.10.2.3.2.4 Status within the Mariana Islands Training and Testing Study Area

The current distribution of this plant is restricted to Poña Point Fishing Cliff and As Matmos Cliffs. The Navy does not train these areas. Threats to *Nesogenes rotensis* include typhoons; ungulate impacts associated with herbivory, trampling, rooting; disease; decreased genetic variability; and pests.

3.10.2.3.3 *Osmoxylon mariannense* (No Known Common or Local Name)

3.10.2.3.3.1 Status and Management

Osmoxylon mariannense is a spindly, soft-wooded tree in the ginseng family, which can reach 33 ft. (10 m) in height. *Osmoxylon mariannense* was listed as endangered on 8 April 2004 (FR 04-7934). No critical habitat is designated for this species.

3.10.2.3.3.2 Population and Abundance

This species is endemic to Rota. Currently, the number of individuals remaining in the wild is unknown. (U.S. Fish and Wildlife Service 2012b). Individuals found in the wild have been reported along unimproved roads crossing the top of the Sabana Plateau (U.S. Fish and Wildlife Service 2006c). This distribution is possibly an artifact of limited access for surveys, as large areas of the Sabana away from the roads are difficult or dangerous to survey due to natural topography and large, often hidden holes left from abandoned mining activities.

3.10.2.3.3.3 Biology, Ecology, and Behavior

Little is known of the life history or ecology of *Osmoxylon mariannense*. It occurs as an understory species in mixed ocshal forests (limestone forests with *Hernandia labyrinthica* and *Pisonia umbellifera* dominating), and is often hard to see until some trunks are tall enough to mingle with the trunks of the other two species (Raulerson and Rinehart 1997). There are conflicting reports about the habitat requirements of *Osmoxylon mariannense*. The seeds of *Osmoxylon mariannense* are difficult to germinate, which may be due to production of “false seeds” (structures that appear to be seeds) or low viability rates (U.S. Fish and Wildlife Service 2006c).

3.10.2.3.3.4 Status within the Mariana Islands Training and Testing Study Area

Threats to *Osmoxylon mariannense* include habitat degradation due to ungulate herbivory, decreased genetic diversity, disease, and pests. No training activity on Rota overlaps with the Sabana.

3.10.2.3.4 Mariana Swiftlet/Yayaguak (*Aerodramus bartschi*)

3.10.2.3.4.1 Status and Management

The Mariana swiftlet was listed as endangered on 27 August 1984 (49 FR 33881–33885). No Critical Habitat for this species is designated.

3.10.2.3.4.2 Population and Abundance

The Mariana swiftlet occurs on Guam (in three known caves within the Naval Base Guam Munitions Site), Aguiguan Island, and Saipan, and the swiftlet is considered extirpated from Tinian and Rota (Cruz et al. 2008). The swiftlet was once thought to be very abundant on Guam. Rota was once thought to support large populations of swiftlets, as evidenced by prehistoric guano and bone deposits, persistent unused nests, and ethnographic reports (Steadman 1999).

3.10.2.3.4.3 Biology, Ecology, and Behavior

The Mariana swiftlet nests and roosts in limestone caves with entrances typically as high as at least 6.2 ft. (1.9 m). In suitable caves, nesting occurs in the dark areas (troglic zone), which is facilitated by the

swiftlet's ability to echolocate. By nesting in total darkness, the birds escape harassment from visually oriented predators. As a further protection, this swiftlet often selects nest sites on the highest parts of the cave, often choosing clefts in the cave roof, overhanging walls, or stalactites. These caves are occupied throughout the year (U.S. Fish and Wildlife Service 1991).

Nests are cup shaped, constructed of moss or other plant material, and adhered together with saliva. The nesting season lasts between January and July, although it may be year round (Jenkins 1983). A clutch typically consists of only one egg. Incubation period lasts at least 12 days, followed by a long period for fledging to occur, perhaps up to 35 days. Foraging habitat is found in a wide range of areas, but ridge crests and open grassy savanna areas where they capture small insects while flying are favored (U.S. Fish and Wildlife Service 1991). Recent studies involving guano analyses on Aguiguan Island (Valdez et al. 2011) and Saipan and Rota (Kershner et al. 2007) suggest that preferred prey species are members of Hymenoptera, a large order of insects comprising of sawflies, wasps, bees, and flying ants. Flying ants were the dominant prey species identified in guano deposits in swiftlet caves on Aguiguan Island, but the prey species may vary depending on surrounding habitats and seasonal availability of different insect species (Valdez et al. 2011).

3.10.2.3.4.4 Status within the Mariana Islands Training and Testing Study Area

The Mariana swiftlet is known to nest in only three caves on Guam within the Naval Base Guam Munitions Site (Mahlac, Maemong, and Fachi caves), as shown in Figure 3.10-5. The Navy, USFWS, and Guam Division of Aquatic and Wildlife Resources have been monitoring the populations at these caves for 23 years (U.S. Department of the Navy 2013a). The Mariana swiftlet has maintained a small population of about 400–500 birds through the 1980s and 1990s, and overall increases are continuing through the present. Although small fluctuations in the population have been documented during this period, there was no significant growth. Brown treesnake traps were initially deployed outside Mahlac Cave in 2000. Declines of swiftlet numbers were noted after major typhoon events, the last major typhoon to hit Guam and the CNMI was Typhoon Pongsona in 2002 (U.S. Department of the Navy 2013a). The population of Mariana swiftlets appears to be increasing, as shown in Figure 3.10-6. The population in 2012 was estimated to be between 1,100 and 1,500 birds. Foraging likely occurs throughout Naval Base Guam Munitions Site, and may include other surrounding locations. Swiftlet populations on Saipan are also increasing, and brown treesnakes are not believed to be present in those caves. The general locations of the known swiftlet caves on Saipan are shown in Figure 3.10-7. The Saipan Mapri Maneuver Area does not contain nesting caves, but the area may be used for foraging (Mosher 2014).

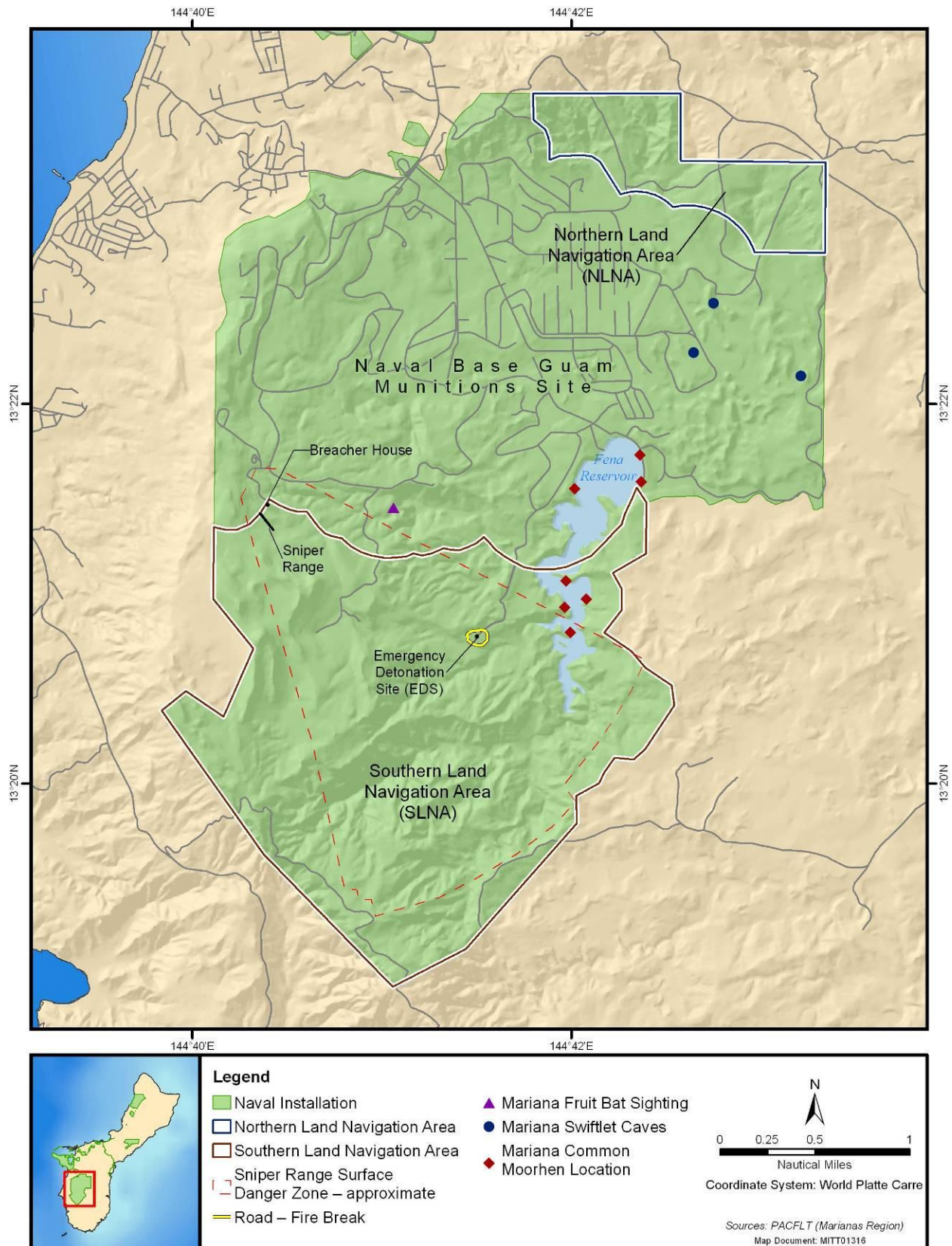
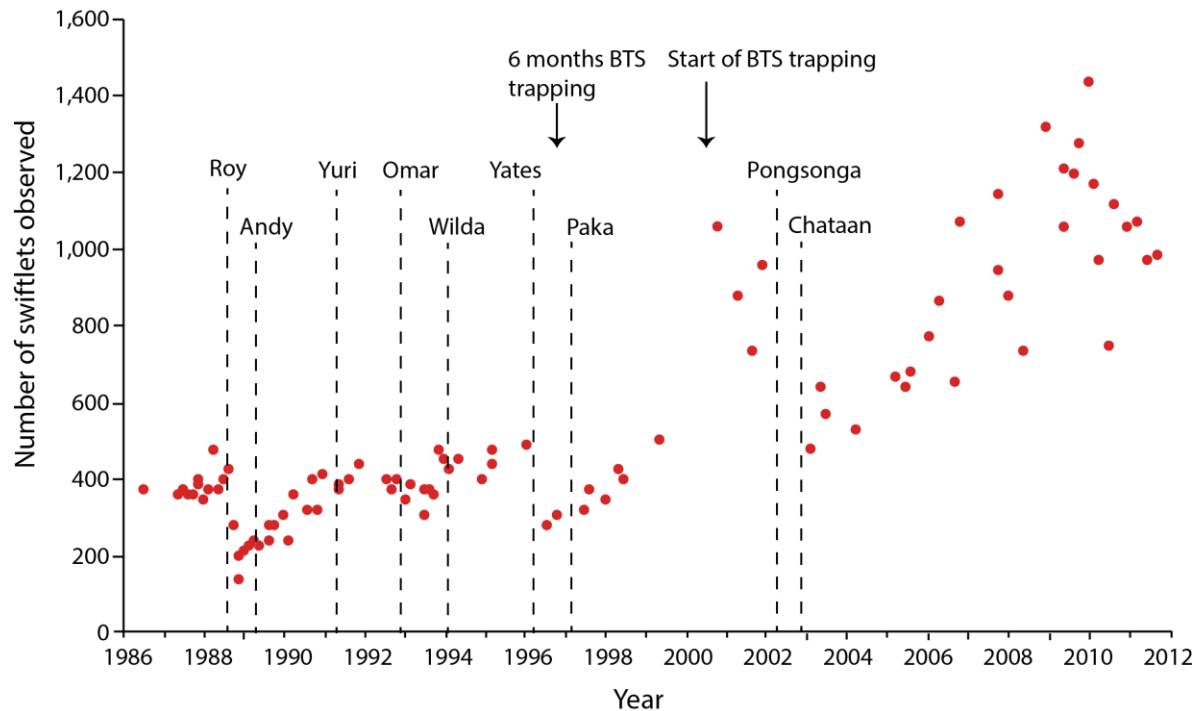


Figure 3.10-5: Naval Base Guam Munitions Site and Mariana Swiftlet Cave Locations



Notes: 1. Typhoons are shown on the graph where wind speeds were measured on Guam to be greater than 100 mph. 2. Typhoon occurrences and swiftlet data are indexed to Fiscal Years, beginning in October.

Figure 3.10-6: Mariana Swiftlet Population Data from Mahlac Cave, Naval Munitions Site, 1986–2012

3.10.2.3.5 Mariana Crow/Aga (*Corvus kubaryi*)

3.10.2.3.5.1 Status and Management

The Mariana crow was listed as endangered on 27 August 1984 (49 FR 33881-33885). On 28 October 2004, approximately 376 ac. (152.2 ha) were designated as Critical Habitat for the Mariana crow on Guam, and 6,033 ac. (2,441.5 ha) were designated on Rota (69 FR 629446). All Critical Habitat for the species on Guam is found on the fee simple portion of the Guam National Wildlife Refuge.

On Guam, its decline is due to predation by the introduced brown treesnake. On Rota, declines are associated with homestead development, resort and golf-course construction, and agricultural settlement. Additional threats include poaching, nest predation, disturbance by introduced species and feral cats, and disease (U.S. Department of the Navy 2013a).

3.10.2.3.5.2 Population and Abundance

The distribution of Mariana crows among habitats is similar on Guam and Rota. Mariana crows are known to use secondary, coastal, ravine, and agricultural forests, including coconut plantations (Jenkins 1983), but all evidence indicates they are most abundant in native limestone forests (Michael 1987; Morton 1996).

On Rota, breeding crows on six study areas averaged one pair per 50 ac. (20 ha) of forested habitat, and each territory was dominated by native forest (U.S. Fish and Wildlife Service 2006b, 2009a). Pair densities ranged from one per 91 ac. (37 ha) in relatively fragmented forest, to as high as one pair per 30 ac. (12 ha) in mostly intact limestone forest along a coastal terrace. Territories were aggressively defended from July through January, although established pairs occupied these areas throughout the year.

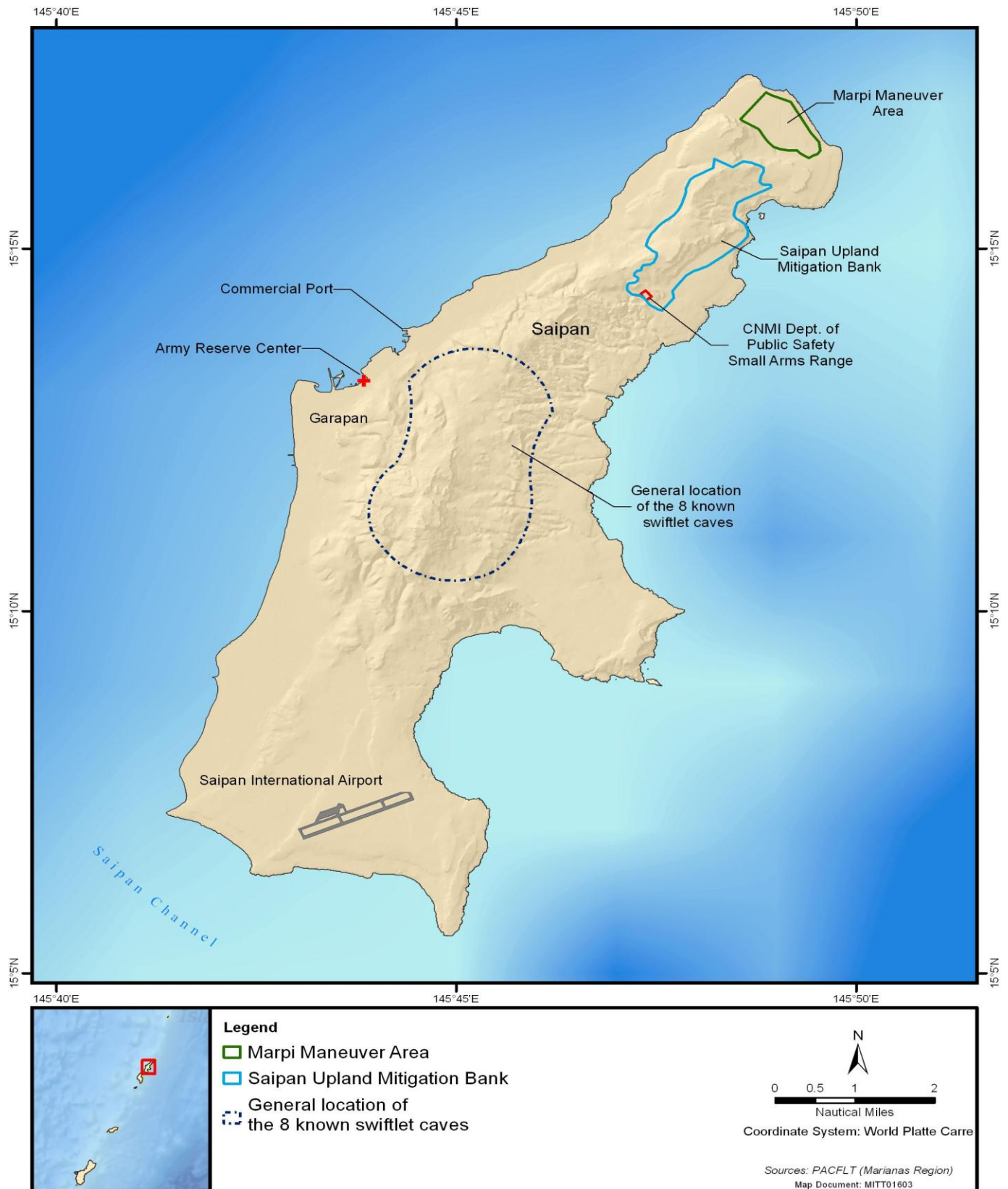


Figure 3.10-7: General Location of Mariana Swiftlet Caves on Saipan

3.10.2.3.5.3 Biology, Ecology, and Behavior

Mariana crows are omnivorous and forage at all heights in the forest and on the ground. They are observed feeding on a variety of native and non-native invertebrates, reptiles, young rats, and birds' eggs, as well as on the foliage, buds, fruits, and seeds of at least 26 plant species (Jenkins 1983; Michael 1987; Tomback 1986). Preferred nesting trees differ on Guam and Rota. Mariana crow nests on Guam were found in 11 tree genera, all but one of which are native. Most nests are located high in emergent nunu or yoga trees (Morton 1996). On Rota, crows primarily use both mature and secondary limestone forests. Of 156 nest sites on Rota, 39 percent and 42 percent were in mature and secondary limestone forest, respectively. Individual nest trees averaged 6.7 in. (17.0 cm) diameter at breast height and 28.5 ft. (8.69 m) high. Canopy cover over nest sites averaged 93 percent and was never less than 79 percent. Nests were located at least 950 ft. (290 m) from the nearest road and 203 ft. (61.9 m) from the nearest forest edge, in areas with forest canopy cover that averaged 93 percent. The distances from edges strongly suggest that nesting crows are sensitive to disturbance by humans.

3.10.2.3.5.4 Status within the Mariana Islands Training and Testing Study Area

As of February 2009, two Mariana crows remained at Andersen AFB Munitions Storage Area, both male (U.S. Department of the Navy 2013a). As of July 2011, a single male Mariana crow remained on Andersen AFB. This last remaining crow was last seen in August 2011. Continuing surveys have not located the crow again, and natural resource specialists on Guam believe the Mariana crow has been extirpated from Guam (SWCA Environmental Consultants 2012). Mariana crows on Rota are located in mature limestone forest areas, secondary forests, and strand forests. These areas are not used for training; however, potential training locations may be located near nesting and foraging areas for Mariana crows.

3.10.2.3.6 Mariana Common Moorhen/Pulattat (*Gallinula chloropus guami*)

3.10.2.3.6.1 Status and Management

The Mariana common moorhen was listed as endangered in 1984 (49 FR 33881-33885). No Critical Habitat is designated for this species.

The main threat to this species is loss and degradation of wetland habitat, including filling, alteration of hydrology, invasion of habitat by nonnative plants, and unrestricted grazing. The second-greatest threat is predation by introduced species. Other natural or manmade factors that threaten the species are environmental contaminants and fires (U.S. Department of the Navy 2013a).

3.10.2.3.6.2 Population and Abundance

The Mariana common moorhen was historically restricted to wetland areas of Guam, Saipan, Tinian, and Pagan, the only islands within the Marianas supporting sufficient wetlands capable of supporting the Mariana common moorhen. Major wetland areas of Guam apparently supported substantial populations, particularly marshes, taro patches, and rice fields. The greatest historical concentrations on Guam appeared to be in Agana Swamp, along the Ylig River in southern Guam. Other large populations in the CNMI were associated with Hagoi on Tinian and Lake Susupe on Saipan (Takano and Haig 2004). The Pagan population is believed to be extirpated due to ash and cinder fallout from a 1981 eruption of Mount Pagan, as well as ungulate impacts to wetland vegetation. Paleobiological evidence suggests that moorhens occurred in prehistoric times on Rota approximately 1,500 to 2,000 years ago. The prehistoric extirpation of this species from Rota has been attributed to draining of wetlands, natural degradation of wetlands over time due to sea level changes (Stinson et al. 1991), and hunting and predation by introduced predators (Stinson et al. 1991).

3.10.2.3.6.3 Biology, Ecology, and Behavior

Breeding is assumed to occur year-round for the Mariana common moorhen, as nests were located in all months except for October (Takano and Haig 2004). Similar subspecies in Hawaii build nests by folding over emergent vegetation into a platform nest. Apparently, vegetation structure is more important than species composition for nest construction and nest location, and nesting is apparently associated with water depth and availability of screening vegetation (Jenkins 1983; U.S. Fish and Wildlife Service 1990).

Clutch sizes of four to eight eggs for the Mariana common moorhen are recorded, although clutch sizes of similar subspecies were observed as high as 13 eggs. Incubation lasts approximately 22 days, and chicks hatch precocial and swim away from the nest shortly after hatching, but remain dependent on the parent birds for several weeks.

3.10.2.3.6.4 Status within the Mariana Islands Training and Testing Study Area

A survey of Mariana common moorhens on Guam was conducted in 2001 (Takano and Haig 2004). Three wetlands in Naval Base Guam Munitions Site were surveyed, including Fena Reservoir, Fena Dam spillway, and the Naval Magazine Pond. Surveys were conducted during the dry season when Mariana common moorhens were expected to be more concentrated on perennial wetlands and therefore easier to count. Of the 90 birds estimated to be on Guam during the survey, 38 birds were located on wetlands in the Naval Base Guam Munitions Site, 33 of which were using Fena Reservoir. Since 2001, eutrophication of Fena Reservoir following a typhoon resulted in the loss of *Hydrilla verticillata*, a non-native water plant used by moorhens as a nesting substrate. The Mariana common moorhen population at the reservoir subsequently declined dramatically (U.S. Fish and Wildlife Service 2010a).

Wetland habitat suitable for the Mariana common moorhen exists on Naval Base Guam Main Base. Moorhens are known to occupy these wetlands at least during the wet season and possibly also in the dry season if open water habitat remains present. Two Mariana common moorhens were observed at the San Luis Ponds during a recent survey in 2010 and 2011. Moorhens are not known to nest at any of the wetlands on Naval Base Guam. The Camp Covington wetland on Naval Base Guam was identified as a habitat requiring species-specific surveys to determine whether the Mariana common moorhen is present. Eleven listening survey stations were placed within the Camp Covington wetland during a 2009 endangered species survey. Moorhens were observed nesting in the Camp Covington wetland area in 2012 (U.S. Department of the Navy 2013a).

Since the construction of an 18-hole golf resort on the north coast of Rota in the early 1990s, moorhens have colonized polishing ponds associated with waste water treatment infrastructure for the resort. The polishing ponds contain suitable nesting habitat. Successful nesting was confirmed in 1996 (Worthington 1998). These areas are not used for military training activities.

On Tinian, monitoring surveys began at Hagoi in 1998 and are performed (generally) on a monthly basis at the end of each month. As index surveys, the surveys document population trends over time, but do not estimate the actual number of animals in the population. Yearly averages of the monthly monitoring program show that 2003, 2007, and 2011 were peak years for Mariana common moorhen numbers at Hagoi (16.9, 17.1, and 15.7, respectively), and troughs during 1999 and 2005 (10.1 and 9.9, respectively). The number of birds observed appears to correlate to periodic dry conditions at the Hagoi wetland (Hagoi was completely dry in April 2005 and in 2010); however, it is unknown if the apparent fluctuation in Mariana common moorhen numbers observed at Hagoi reflect true population changes, emigration or immigration, or observer bias (U.S. Department of the Navy 2008d, 2013a). Mahlang and Bateha are the other two wetlands within the Tinian MLA. As with Hagoi, the Navy does not conduct any training

activities in wetland areas. Nest locations for moorhens on Tinian for 2011 and 2012 survey seasons are shown in Figure 3.10-8.

3.10.2.3.7 Guam Micronesian Kingfisher/Sihek (*Todiramphus cinnamomina cinnamomina*)

3.10.2.3.7.1 Status and Management

The Guam Micronesian kingfisher was listed as endangered on 27 August 1984 (49 FR 33881-33885). On 28 October 2004, approximately 376 ac. (152 ha) on Guam were designated as Critical Habitat for the Guam Micronesian kingfisher (69 FR 629446). All Critical Habitat for this subspecies is found on the fee simple portion of the Guam National Wildlife Refuge.

3.10.2.3.7.2 Population and Abundance

This subspecies of the Guam Micronesian kingfisher (*Todiramphus cinnamomina cinnamomina*) is endemic to Guam. The other two subspecies occur on the islands of Pohnpei (*Todiramphus cinnamomina reichenbachii*) and Palau (*Todiramphus cinnamomina pelwensis*). The Guam Micronesian kingfisher was considered “fairly common” and occurred throughout forested areas on Guam shortly after World War II (Jenkins 1983). Populations in southern and central Guam disappeared by the 1980s (Jenkins 1983) and only 3,023 individuals were recorded in 1981 in northern Guam (U.S. Fish and Wildlife Service 2008b). This population subsequently declined rapidly, and by 1985 only 30 individuals were recorded on Guam (U.S. Fish and Wildlife Service 2008b). This subspecies was believed extirpated by 1988, primarily because of predation by the brown treesnake (Fritts and Leasman-Tanner 2001; U.S. Fish and Wildlife Service 2008b). Guam Micronesian kingfishers survive in captive programs that seek to breed kingfishers and maintain the population until habitats are suitable for reintroduction. GovGuam Division of Aquatic and Wildlife Resources, as well as various zoos in the United States, maintain kingfishers in captivity.

3.10.2.3.7.3 Biology, Ecology, and Behavior

The Guam Micronesian kingfisher feeds both on invertebrates and small vertebrates, including insects, segmented worms, hermit crabs, skinks, geckoes, and possibly other small vertebrates (Jenkins 1983). This species typically forages by perching motionless on exposed perches and swooping down to capture prey on the ground (Jenkins 1983). Guam Micronesian kingfishers also will capture prey from foliage and were observed gleaning insects from tree bark (U.S. Fish and Wildlife Service 2008b).

This subspecies nests in cavities, and breeding activity appears to be concentrated from December to July (Jenkins 1983). Nests are reported in a variety of trees, including nunu, *Cocos nucifera*, *Artocarpus* spp., umumu, and fai’a (Jenkins 1983; U.S. Fish and Wildlife Service 2008b). Pairs may excavate their own nests in soft trees, arboreal termite nests, arboreal fern root masses, or they may utilize available natural cavities such as broken tree limbs (U.S. Fish and Wildlife Service 2008b), and excavation of cavities may be important in pair-bond formation and maintenance (Jenkins 1983).

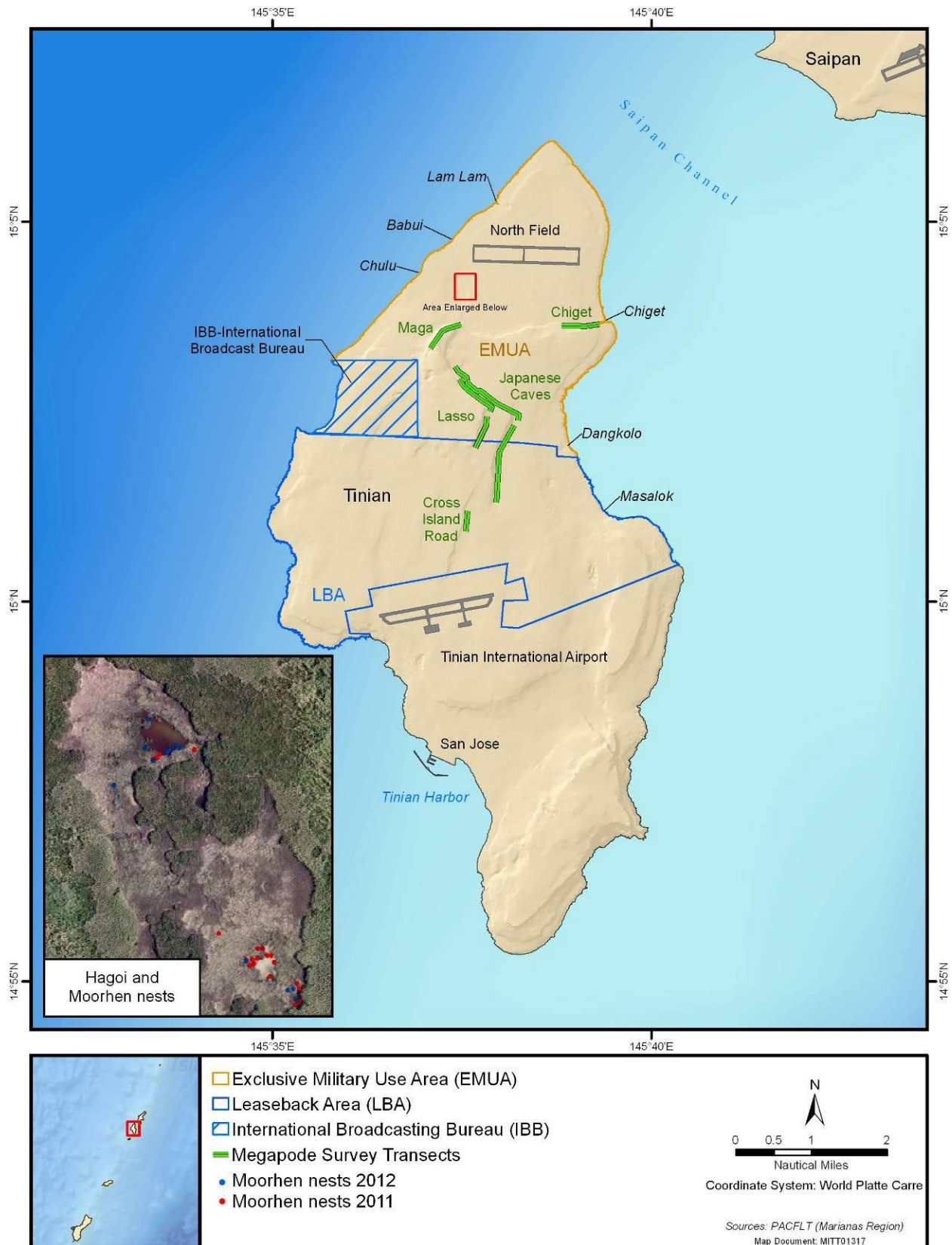


Figure 3.10-8: Tinian Military Lease Area and Mariana Common Moorhen Nest Locations

Both male and female Guam Micronesian kingfishers incubate eggs and brood and feed nestlings (Jenkins 1983). Clutch sizes from wild populations were either one or two eggs (Jenkins 1983) while clutch sizes of one to three eggs are reported in the captive populations (U.S. Fish and Wildlife Service 2008b). Incubation, nestling, and fledgling periods for populations of Guam Micronesian kingfishers in the wild are unknown. However, incubation and nesting periods of captive birds averaged 22 and 33 days, respectively (U.S. Fish and Wildlife Service 2008b).

Jenkins (1983) reported that the Guam Micronesian kingfisher nest and feed primarily in mature, secondary growth, and, to a lesser degree, in scrub limestone forest. It is also found in coastal strand vegetation containing coconut palm as well as riparian habitat. However, Jenkins (1983) reported that it was probably most common along the edges of mature limestone forest. Few data exist about specific kingfisher nest sites in the wild, but in one study in northern Guam 16 nest sites were correlated with closed canopy cover and dense understory vegetation. In this study, nest cavities were excavated in the soft, decaying wood of large, standing dead trees averaging 17 in. (43 cm) in diameter (U.S. Fish and Wildlife Service 2008b). Research on the Pohnpei Micronesian kingfisher indicates an area of approximately 20–25 ac. (8.1–10.1 ha) of mixed forest, and open area may be needed to support a pair of kingfishers. It should be noted that Micronesian kingfisher territories may differ from Pohnpei Micronesian kingfisher territories due to differences in forest structure on Guam and Pohnpei (Mueller-Dombois and Fosberg 1998).

3.10.2.3.7.4 Status within the Mariana Islands Training and Testing Study Area

The Guam Micronesian kingfisher is currently extirpated and is not found in the Study Area.

3.10.2.3.8 Micronesian Megapode/Sasangat (*Megapodius laperouse laperouse*)

3.10.2.3.8.1 Status and Management

The Micronesian megapode was first listed as endangered in 1970 (under the Endangered Species Conservation Act, 35 FR 8491-8498). No Critical Habitat is designated for this species. Threats to this species include habitat loss from typhoons and volcanic activity, damage by feral herbivores, historical hunting and illegal egg collection, increased tourism, and predation by introduced predators (U.S. Department of the Navy 2013a).

3.10.2.3.8.2 Population and Abundance

Small remnant populations are known to exist on the southern Mariana Islands of Aguiguan, Saipan, and FDM; larger populations are reported on uninhabited northern islands of Anatahan, Guguan, Sarigan, Alamagan, Pagan, Asuncion, Maug, and possibly Agrihan (U.S. Fish and Wildlife Service 1998, U.S. Department of the Navy 2013a). Megapodes observed on Tinian are believed to be transient and do not breed on Tinian (U.S. Department of the Navy 2013a, 2013b).

3.10.2.3.8.3 Biology, Ecology, and Behavior

Micronesian megapodes are generally dependent on native limestone forest, but may occasionally use native and non-native secondary forest adjacent to limestone forest. Micronesian megapode primarily select nest sites in sun-warmed cinder fields on volcanic islands and exposed limestone flats, but may nest in roots of rotting trees, logs, and in patches of rotting sword grass. The breeding season for Micronesian megapodes is reported on Saipan to begin in November and last through December, although the season may be year-round (U.S. Fish and Wildlife Service 1998). Megapodes are considered “incubator” birds because they rely on external energy sources, such as solar heat, volcanic activity, or heat produced from microbial decomposition of organic matter as heat sources for incubation. Multiple eggs are laid singly in a breeding season, each egg is laid after an interval of approximately 1 week.

Chicks emerge from nests super-precocial and able to function (and fly) independent of the parent birds (U.S. Fish and Wildlife Service 1998).

3.10.2.3.8.4 Status within the Mariana Islands Training and Testing Study Area

Surveys on FDM in 1996 documented the presence of the Micronesian megapode (Lusk et al. 2000; U.S. Fish and Wildlife Service 1998). From this survey, it was estimated that a population of 10 Micronesian megapodes were on FDM (Kessler and Amidon 2009; Lusk et al. 2000; U.S. Fish and Wildlife Service 1998). However, due to an incoming typhoon, biologists were only on the island for about 5.5 hours, so this estimate was based on limited data. FDM was surveyed more thoroughly in December 2007 by Navy biologists, which provided an estimate of 21 adult pairs (U.S. Department of the Navy 2008a, c). The northern part of FDM was surveyed for megapodes in April 2013 immediately following range clearance actions. Range safety restrictions precluded the same geographic coverage as the 2007 survey. Eleven birds were detected during this more limited survey (U.S. Department of the Navy, 2013b). Mitigation measures specified in previous consultations coupled with the restricted access preventing poaching activities, may have benefited megapodes on FDM. The mitigation measures included maintaining a no fire zone on the northern portion of the island and the use of inert ordnance in an area south of the no fire zone (explosive ordnance is deployed to the south of this area).

On Tinian, Micronesian megapodes have been previously reported but never in great numbers (O'Daniel and Kreuger 1999; U.S. Department of the Navy 2008a, d). Micronesian megapodes have been sighted on Tinian within forested portions of the Maga area to the northeast of the Voice of America Relay Station, a small section of native forest adjacent to Cross Island Road in the Bateha area and the Mount Lasso area south of the overlook on the ridgeline (O'Daniel and Kreuger 1999). Based on these sightings and other suitable habitat indicators, the Navy established monitoring transects in 1999, which were surveyed on a monthly basis through 2012 using point count stations (where trained observers listened for responses to recorded megapode vocalizations). These surveys are now conducted on an annual basis (U.S. Department of the Navy 2013a). One megapode was observed on Tinian during recent annual surveys in February 2013. Prior to this detection, one megapode was observed in February 2004 and two others in June 2005 by biologists transiting between point count stations (U.S. Department of the Navy 2013a).

On Saipan, Amidon et al. (2011) estimated a population between 130 and 174 Micronesian megapodes. Previous studies on Saipan provide lower island-wide population estimates, but these lower estimates are likely due to a less thorough survey effort relative to the 2010 surveys on Saipan (Amidon et al. 2011). Almost all of the detections on Saipan occurred in native limestone forest, including small remnant patches. Amidon et al. (2011) included a transect adjacent to the Saipan Marpi Maneuver Area, and verified the continued persistence of megapode populations below the Marpi cliffs (the Saipan Marpi Maneuver Area is north of and below the Marpi cliffs). Remnant patches of limestone forest occur within the Saipan Marpi Maneuver Area and may support Micronesian megapodes.

3.10.2.3.9 Guam Rail/Ko'ko' (*Rallus owstoni*)

3.10.2.3.9.1 Status and Management

The Guam rail was listed as endangered on 27 August 1984 (49 FR 33991-33885). No Critical Habitat for this species has been designated for the Guam rail. An experimental population has been established on Rota since reintroductions began in the late 1980s on the Sabana Plateau and in the I'Chinchon Bird Sanctuary. The USFWS has designated Guam rails released on Rota as a "nonessential experimental population," where the released rails on Rota are nonessential to the continued existence of the species. Members of a nonessential experimental population are treated as a species proposed for ESA

listing. In other words, federal agencies are not required to consult with the USFWS pursuant to Section 7(a)(2) of the ESA for potential impacts to Guam rails on Rota, and are only required to confer with the USFWS if a proposed action is likely to jeopardize the continued existence of the Guam rail. A Safe Harbor Agreement was established in 2008 on Cocos Island to allow for management actions and reintroductions of Guam rails on Cocos Island.

3.10.2.3.9.2 Population and Abundance

The Guam rail is endemic to Guam. This species was once distributed throughout Guam but by 1981 a population of approximately 2,300 birds existed only in northern Guam (U.S. Fish and Wildlife Service 1990). In 1983, it was estimated that fewer than 100 individuals remained and it was considered extirpated by 1987 (Beauprez and Brock 1999). A captive breeding program began in 1983, which relocated individuals from the wild to breeding facilities on Guam (Guam Division of Aquatic and Wildlife Resources 2006). As of 2005, 173 individuals were found in captivity in zoological institutions on the U.S. mainland and Guam Division of Aquatic and Wildlife Resources captive propagation facilities (Guam Division of Aquatic and Wildlife Resources 2006; U.S. Fish and Wildlife Service 2006a). In addition, Guam Division of Aquatic and Wildlife Resources is releasing rails on Cocos Island (off southern Guam). Efforts to establish an experimental population on the island of Rota have been underway since 1989 (Beauprez and Brock 1999). The current population on Rota is estimated to be approximately 40 to 70 individuals (U.S. Department of the Navy 2013a; U.S. Fish and Wildlife Service 2006a). Releases of rails on Cocos Island and Rota were preceded by predator eradication and reduction programs (e.g., removal of rats and monitor lizards) at release sites (Brooke 2012).

3.10.2.3.9.3 Biology, Ecology, and Behavior

Guam rails are territorial ground nesters that breed year-round (Jenkins 1983); however, peak breeding may occur during the rainy season (July through November) (U.S. Fish and Wildlife Service 1990). Clutches typically consist of three to four eggs and broods range from one to four chicks. Guam rails are omnivorous but appear to prefer animal matter over vegetable foods. They are known to eat gastropods, skinks, geckos, insects, carrion, seeds, and palm leaves. This species is believed to prefer secondary vegetation, although it was found in all habitats except wetlands, and savanna and mature forest may be marginal habitats (Jenkins 1983).

3.10.2.3.9.4 Status within the Mariana Islands Training and Testing Study Area

There are no Guam rails currently located at Andersen AFB, or on any other DoD property.

3.10.2.3.9.5 Nightingale Reed-Warbler/Ga'ga' Karisu (*Acrocephalus luscini*)

3.10.2.3.9.6 Status and Management

The nightingale reed-warbler was listed as endangered on 2 June 1970 (35 FR 8491-8498). The Saipan Upland Mitigation Bank was established in 2004 to provide perpetual conservation and management for endangered nightingale reed-warbler and other native species within the bank boundaries (Herod and William 2008). Further, the Saipan Upland Mitigation Bank is a mitigation option for eligible projects that will result in unavoidable impacts to the nightingale reed-warbler. Past and present threats to this species include loss and degradation of habitat (including wetland destruction and degradation due to feral ungulates); predation by introduced predators such as the brown treesnake, rats, and monitor lizard; and volcanic activity (U.S. Fish and Wildlife Service 2010b).

3.10.2.3.9.7 Biology, Ecology, and Behavior

The nightingale reed-warbler may be characterized as a secretive species that prefers screening provided by dense underbrush. Like many warbler species, the male is vocal and aggressive toward

conspecific intruders. Mosher and Fancy (2002) observed two peak breeding periods from January through March (dry season) and from July through September (wet season), and active nests were found in all months except November and December.

Most birds found on Saipan occur in thicket-meadow mosaics, forest edge, reed-marshes, and forest openings, and are largely absent from mature native forest, beach strand, and swordgrass vegetation community types (Camp et al. 2009). Nightingale reed-warblers were observed to prey on insects by gleaning invertebrates from live and dead leaves (Craig 1992). Other food sources include snails and lizards (Marshall 1949).

3.10.2.3.9.8 Status within the Mariana Islands Training and Testing Study Area

Marpi Maneuver Area on Saipan contains suitable habitat for the nightingale reed-warbler. Craig (1992) surveyed the Marpi area and detected reed-warblers in areas, including the Marpi Maneuver Area.

3.10.2.3.10 Rota Bridled White-Eye/Nosa Luta (*Zosterops rotensis*)

3.10.2.3.10.1 Status and Management

The Rota bridled white-eye was listed as endangered on 22 January 2004 (69 FR 3022–3029). The Rota bridled white-eye has critical habitat designated on Rota (2,594 ac. [1,050 ha]). Current threats include habitat loss and degradation, predation by introduced rats and black drongos (*Dicrurus macrocercus*), and susceptibility of the single small population to random catastrophic events, such as typhoons. In addition, establishment of a new predator, such as the brown treesnake or avian diseases, such as West Nile virus, also threaten recovery of the species (U.S. Fish and Wildlife Service 2006b).

3.10.2.3.10.2 Biology, Ecology, and Behavior

Rota bridled white-eye primarily forage in the outer canopy of forests for insects, fruit, or nectar, and the majority of foraging observations were reported in yoga, nonak, pengua, and ahgao. Rota bridled white-eye nests are reported in fai'a, nonak, yoga, and *Acacia confusa* trees 10–49 ft. (3–15 m) tall and 1–24 in. (2.5–61 cm) in diameter (U.S. Fish and Wildlife Service 2006b).

Breeding was observed between December and August (U.S. Fish and Wildlife Service 2006b). Because this time period covers portions of both the wet season and dry season, the species may breed year round, similar to the Guam bridled white-eye (Marshall 1949; Jenkins 1983). Rota bridled white-eye nests are cup-like and typically suspended between branches and branchlets or leaf petioles (U.S. Fish and Wildlife Service 2006b).

3.10.2.3.10.3 Status within the Mariana Islands Training and Testing Study Area

The Rota bridled white-eye is endemic to Rota. Currently, the species is primarily restricted to mature forests above 490 ft. (150 m) in the Sabana region of Rota. There is no military training in these areas.

3.10.2.3.11 Mariana Fruit Bat/Fanihi (*Pteropus mariannus mariannus*)

3.10.2.3.11.1 Status and Management

The Guam population of the Mariana fruit bat was listed as endangered on 27 August 1984 (49 FR 33881–33885). However, in 2005, the subspecies was listed as threatened throughout the Mariana archipelago and downlisted to threatened on Guam (70 FR 1190–1210). On 28 October 2004, approximately 376 ac. (152 ha) were designated as Critical Habitat for the Mariana fruit bat on Guam (69 FR 629446). All Critical Habitat for the species is found on the fee simple portion of the Guam National Wildlife Refuge. Threats to this species include illegally hunting, predation by the brown

treesnake, deforestation for development, and overgrazing by introduced species. Random events such as typhoons and volcanic eruptions are also a potential, direct threat to the species (U.S. Fish and Wildlife Service 2009c).

3.10.2.3.11.2 Biology, Ecology, and Behavior

During the day, the Mariana fruit bat roosts in colonies of a few to rarely up to 2,000 animals (Utzurum et al. 2003); as well as in non-colonial roost sites. Bats are typically grouped into harems (one male and two to fifteen females) or bachelor groups (predominantly males); some single males reside at the colony's periphery (Morton and Wiles 2002). On Guam, the average estimated sex ratio in one colony varied from 37.5 to 72.7 males per 100 females. A smaller number of Mariana fruit bats roost solitarily away from the colony (Janeke 2006). Reproduction in Mariana fruit bats was observed year-round on Guam and on Rota; individual females have a single offspring each year (Pierson et al. 1996). Glass and Taisacan (1988) suggest that the peak birthing season may occur during May and June. Although specific data for the Mariana fruit bat are lacking, other species of bats within the family Pteropodidae have one offspring per year, generally are not sexually mature until at least 18 months of age, and have a gestation period of 4–6 months (Epstein et al. 2009). The average lifespan of this species is unknown; the average longevity of a similar species in Australia is 4–5 years, with a maximum of 8 years (Vardon and Tidemann 2000).

Colonial roost sites are an important aspect of the Mariana fruit bat biology because they are used for sleeping, grooming, breeding, and intra-specific interactions (Wiles et al. 1989). Published reports of roost sites on Guam indicate these sites occur in mature limestone forest and are found within 328 ft. (100 m) of 262–591 ft. (80–180 m) tall clifflines. Native forest habitat is also an important aspect of Mariana fruit bat biology as it is also used for roosting, feeding, etc., by non-colonial Mariana fruit bats. On Guam, Mariana fruit bats roost in mature nunu and chopak trees but will also roost in other tree species such as gago, pengua (*Macaranga thompsonii*), panao, and fagot. On other islands in the Mariana archipelago, Mariana fruit bats were observed in secondary forest and gago groves (Glass and Taisacan 1988). Factors involved in roost site selection are not clear, but data from Guam indicate that some sites may be selected for their inaccessibility by humans and thus limited human disturbance. Mariana fruit bats will abandon roost sites if disturbed and are reported to move to new locations up to 6 mi. (9.7 km) away (U.S. Fish and Wildlife Service 1990).

Several hours after sunset, Mariana fruit bats depart their roost sites to forage for fruit and other native and non-native plant materials such as leaves and nectar (Janeke 2006; U.S. Fish and Wildlife Service 1990). This species feeds on a variety of plant material but is primarily frugivorous (Wiles et al. 1989). Specifically, Mariana fruit bats forage on the fruit of at least 28 plant species, the flowers of 15 species, and the leaves of two plant species. Some plants used for foraging include dukduk, papaya, *Cycas micronesica*, nunu, kafo, *Cocos nucifera*, and *Terminalia catappa*. Many of these plant species are found in a variety of forested habitats on Guam, including limestone, ravine, coastal, and secondary forests (Donnegan et al. 2004; Raulerson and Rinehart 1991).

3.10.2.3.11.3 Status within the Mariana Islands Training and Testing Study Area

Non-colonial Mariana fruit bat roost throughout Northwest Field, Tarague basin, Jinapsan Beach area, Guam National Wildlife Refuge lands, Naval Communications Site, and private lands in northern Guam. Three solitary Mariana fruit bats were sighted on Navy lands during 90 hours of observations at 14 different survey locations (U.S. Department of the Navy 2008b). Two sightings were on Naval Communications Site, one below the cliff-line in the northern section of the Haputo Ecological Reserve near Falcona, and the other was seen flying westward across Route 3A from Andersen AFB onto Naval

Communications Site (U.S. Department of the Navy 2008b). The island-wide population on Guam is likely not to exceed 50 Mariana fruit bats (U.S. Department of the Navy 2013a). The last colony of Mariana fruit bats on Guam was located at Pati Point on Andersen AFB. This colony no longer exists, and Mariana fruit bats persist on Andersen AFB as solitary individuals (SWCA Environmental Consultants 2012). Bats were seen sporadically on the Naval Base Guam Munitions Site between 1985 and 1999 (Morton and Wiles 2002). In 2010, three sightings of the same individual Mariana fruit bat were reported within the Naval Base Guam Munitions Site. Seven detections of one Mariana fruit bat in flight, each on a different day, were recorded at Naval Base Guam Munitions Site between 10 May and 22 June 2012. It could not be determined if these observations represent one bat or multiple bats.

On Rota, Mariana fruit bats are found in mature limestone forests and coconut groves on the island. Military training activities do not occur in these areas.

On Tinian, few Mariana fruit bats were observed during surveys although island residents report occasionally seeing Mariana fruit bats (U.S. Department of the Navy 2008a). During surveys in 1979, two Mariana fruit bats were observed in the Kastiyu forest and an island-wide estimate of 25–100 was based on available forest habitat. Surveys in 1994 and 1995 did not observe Mariana fruit bats; however, two incidental sightings were reported from other locations on Tinian. No Mariana fruit bats were sighted during two surveys in 2000; however, Mariana fruit bats also reside on Aguiguan and travel to Tinian to forage (Cruz et al. 1999, 2000, 2002). In June 2005, approximately five Mariana fruit bats were seen in the cliff-line forest during a routine forest bird survey of the Maga bird transect (U.S. Department of the Navy 2008a). Because of the few numbers of bat observations and the likelihood that Mariana fruit bats observed on Tinian are not residents, the Mariana fruit bat should be considered incidental on Tinian.

FDM may serve as a stopover location for Mariana fruit bats while transiting between islands. Incidental observations of Mariana fruit bats during recent bird surveys, along with fisherman reports from the early 1970s, suggest a small number of Mariana fruit bats use FDM. Use of the island by Mariana fruit bats may have been higher prior to the use of the island as a bombing range. Also, historical photographs appear to show more intact forested areas on the mesic flats area of the northern portion of the island, which would have provided foraging and roosting habitats on FDM (U.S. Department of the Navy 2013a).

3.10.2.4 Species Considered as Candidates for Endangered Species Act Listing

3.10.2.4.1 Plant Species

Fourteen species of plants proposed by the USFWS for ESA listing may occur on islands that support military training activities. These species include *Eugenia bryanii*, *Cycas micronesica*, *Psychotria malaspinae*, *Tinospora homosepala*, *Bulbophyllum guamense*, *Dendrobium guamense*, *Heritiera longipetiolata*, *Maesa walker*, *Nervilia jacksoniae*, *Solanum guamense*, *Tabernaemontana rotensis*, *Tuberolabium guamense*, *Hedyotis megalantha*, and *Phyllanthus saffordii*.

Status within the Mariana Islands Training and Testing Study Area

All but two of the species proposed for listing are dependent on intact limestone forest habitats. Although these species may occur on military owned or leased lands, training activities discussed in this EIS/OEIS would not occur in these intact limestone forest habitats. Two species are associated with savanna habitats found on the southern portion of Guam—*Hedyotis megalantha* is a small perennial herb and *Phyllanthus saffordii* is a woody shrub. Although these species may occur in the Naval Base Guam Munitions Site, the only known occurrence on Guam of *Hedyotis megalantha* is on the Sigua

highlands outside of Naval Base Guam Munitions Site. *Phyllanthus saffordii* is known from only four locations on Guam, none of which are believed to be located on military property.

3.10.2.4.2 Invertebrate Species

Four snails in the Partulid family are collectively known as “akaleha” in Chamorro—the humped tree snail (*Partula gibba*), the Guam tree snail (*Partula radiolata*), the fragile tree snail (*Samoana fragilis*), and Langford tree snail (*Partula langfordi*). The shell of the humped tree snail is described as somewhat enlarged resembling a hump in a conical shape with four to five whorls. The shell color is chestnut brown to whitish yellow, or occasionally purple with a white or brown line along the suture between the whorls on the shell (U.S. Fish and Wildlife Service 2008c, d). The humped tree snail was added to candidate listing in 1994 by the USFWS (U.S. Fish and Wildlife Service 2008c). The candidate status was reaffirmed most recently in 2012 by the USFWS (U.S. Fish and Wildlife Service 2012a).

The shell of a Guam tree snail is described as somewhat oblong and having a conical shape with five whorls. The shell color is pale straw yellow with darker axial rays and brown lines (U.S. Fish and Wildlife Service 2008d). The Guam tree snail was added to candidate listing in 1994 by the USFWS (U.S. Fish and Wildlife Service 2008d). The candidate status was reaffirmed in 2005 by the USFWS (U.S. Fish and Wildlife Service 2008d). The fragile tree snail was added to candidate listing in 1994 by the USFWS (U.S. Fish and Wildlife Service 2012). The candidate status was reaffirmed in 2012 (U.S. Fish and Wildlife Service 2012b).

Threats to the partulid snails include historical (following World War II) loss of native forest habitat, typhoons, overbrowsing by introduced ungulates, and market collection of tree snails. Predation by the alien rosy carnivore snail (*Euglandina rosea*) and the alien Manokwar flatworm (*Platydemis manokwari*) is a serious threat to the survival of tree snails from the Mariana Islands (U.S. Department of the Navy 2013a; U.S. Fish and Wildlife Service 2012b).

The Mariana eight-spot butterfly (*Hypolimnys octocula mariannensis*) and the Mariana wandering butterfly (*Vagrans egistina*) are two species in the Nymphalid family of butterflies that are candidates for ESA listing. Both butterflies are known in Chamorro as the “Ababang” and in Carolinian as “Libwueibogh,” and are believed to be endemic to Rota and Guam (Hawley and Castro 2008). Like most nymphalid butterflies, orange and black are the primary colors exhibited by these species. Females are larger than males, appear brighter orange in color than males, and have black bands across the top margins of both pairs of wings. Males are predominantly black with an orange stripe running vertically on each wing. Mariana wandering butterflies do not have an orange stripe, but rather one large orange blot on each wing characterizes this species. The candidate status for these two species was re-affirmed in 2012 (U.S. Fish and Wildlife Service 2012a).

Threats to these butterfly species include predation by ants, parasitism by small wasps, and extremely low numbers (U.S. Fish and Wildlife Service 2008e, 2012b). These butterflies were apparently always uncommon and declined primarily due to browsing of the two host plants by introduced deer and other ungulates. The Mariana eight-spot butterfly is believed to have been extirpated from Saipan, but occurs rarely in Guam’s northern forests. During surveys conducted in 1995, areas of Saipan supported healthy populations of the host plants, but no butterflies were observed (Scheiner and Nafus 1996).

Host plants for the Mariana eight-spot larvae include two native herbaceous plants, *Procris pedunculata* and *Elatostema calcareum*. These forest fleshy herbs only grow on karst limestone within limestone

forests. *Maytenus thompsoni* is the host plant primarily associated with Mariana wandering butterfly larvae (Hawley and Castro 2008).

Status within the Mariana Islands Training and Testing Study Area

The humped tree snail is the most widely distributed partulid snail in the Mariana Islands (Kerr 2013) and likely occurs within intact limestone forests on Andersen AFB, Naval Base Guam Telecommunications Site at Finegayan, and intact limestone forest areas within the Tinian MLA. The Guam tree snail has a wide distribution on Guam and also likely occurs in intact forest areas of Andersen AFB and Navy-owned lands. The fragile treesnail is generally restricted to limestone forests of northern Guam (Kerr 2013) and potentially occurs in intact limestone forests of Andersen AFB, Naval Base Guam Telecommunications Site at Finegayan. The Langford tree snail does not occur on DoD-owned or leased lands, and is restricted to Aguiguan. It should be noted that military training activities described in this EIS/OEIS do not occur in these intact limestone forest areas that may be inhabited by Partulid snails.

Mariana wandering butterflies have been extirpated from Guam but are still found on Rota. Mariana eight-spot butterflies are still extant on Rota and northern limestone forests of Guam. Two Mariana eight-spot butterflies were observed in 2006 (Lawrence 2006) along a rocky pinnacle karst area toward Pati Point on Andersen AFB. A recent survey conducted by Hawley and Castro (2008) did not find either butterfly on Tinian; however, host plants for these species were identified. Mariana wandering butterflies and Mariana eight-spot butterflies occur in intact limestone forests characterized by rough terrain where no military training activities occur.

3.10.2.4.3 Sheath-Tailed Bats (*Emballonura semicaudata rotensis*)

The subspecies of the Pacific sheath-tailed bat known to occur throughout the Mariana Islands has not been well studied, and all available information indicates that this insectivorous bat is restricted to Aguiguan (U.S. Fish and Wildlife Service 2009d). Pacific sheath-tailed bats are known to only roost in caves. In 2008, surveys on Aguiguan were completed along with limited acoustical detection sampling on Tinian (using equipment designed to detect echolocating bats). No bats were detected on Tinian in 2008.

Status within the Mariana Islands Training and Testing Study Area

There have been no recent records of Pacific sheath-tailed bats on Tinian (U.S. Fish and Wildlife Service 2009d). There are habitats on Tinian that are similar to habitats located on Aguiguan (which is located 5 mi. [8 km]) away from Tinian. Mount Lasso is within the Tinian MLA, but the Kastiyu Forest area is on southern Tinian outside of the Tinian MLA.

3.10.3 ENVIRONMENTAL CONSEQUENCES

This section presents the analysis of potential impacts on terrestrial species 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 terrestrial species in general, by taxonomic groups, and in detail for species listed under the ESA (Section 3.10.2, Affected Environment). For this EIS/OEIS, terrestrial species are evaluated as groups of species characterized by distribution, body type, or behavior relevant to the stressor being evaluated. Vegetation communities and the habitats for species these communities support are evaluated based on location of the training activities, the habitats these training areas support, and the type of stressors that are introduced into these habitats. Activities are evaluated for their potential effect on vegetation communities, wildlife communities, and in general, on each taxonomic grouping, and on the ESA-listed species considered in

this analysis (see Section 3.10.1.1.1, Endangered Species Act Listed Species and Designated Critical Habitat). As described in Section 3.10.2 (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.

General characteristics of all potential stressors were introduced in Section 3.0.5.3 (Identification of Stressors for Analysis). Certain activities on land take place on specific islands and within specific areas of islands. The stressors vary in intensity, frequency, duration, and location within the Study Area. The stressors applicable to terrestrial species in the study area and analyzed below include the following:

- Acoustic (explosives noise, weapons firing noise, and aircraft noise)
- Physical disturbance and strike (aircraft and aerial targets, military expended materials, ground disturbance, and wildfires)
- Secondary (introduction of invasive species)

The specific analysis of the training activities presented in this section considers the relevant components and associated data within the geographic location of the activity (see Tables 2.8-1 and 2.8-2) and the resource. There are no applicable testing activities to terrestrial resources, and therefore they are not analyzed.

3.10.3.1 Acoustic Stressors

This section evaluates the potential for non-impulse and impulse acoustic stressors to impact terrestrial species during training activities on land training areas within the Study Area. There are no testing activities that occur on land that require introducing sound into the environment. These stressors are associated with explosive detonations, aircraft noise, and weapons firing. 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 terrestrial animals from acoustic and explosive stressors include disturbance of foraging, roosting, or breeding; degradation of foraging habitat; and degradation of habitats. Table 3.10-5 lists each substressor, where they occur, and what species potentially are impacted by the activity.

Table 3.10-5: Acoustic Substressors in Land Training Areas and Terrestrial Resources Potentially Impacted

Acoustic Substressor	Land Training Area	Terrestrial Resource Potentially Impacted
Explosives and Weapons Firing Noise	Andersen AFB (Pati Point CATM Range, Pati Point EOD Range)	Mariana fruit bat, Mariana crow (believed to be extirpated) Non-ESA listed forest birds (e.g., Micronesian starlings)
	Naval Base Guam Main Base (Orote Point Known Distance Range,	None
	Naval Base Guam Munitions Site (emergency detonation site)	Mariana swiftlet Mariana common moorhen Mariana fruit bat
	Naval Base Guam Telecommunications Site (Finegayan Small Arms Range)	None
	FDM	Micronesian megapode Mariana fruit bat Non-ESA listed forest birds (e.g., Micronesian starlings, white-throated ground dove)
Aircraft Noise	Andersen AFB	Mariana fruit bat, Mariana crow (believed to be extirpated) Non-ESA listed forest birds (e.g., Micronesian starlings)
	Naval Base Guam Main Base	Mariana common moorhen Non-ESA listed terrestrial birds (e.g., yellow bittern)
	Naval Base Guam Munitions Site	Mariana swiftlet Mariana common moorhen Mariana fruit bat
	Tinian MLA	Micronesian megapode Mariana fruit bat Non-ESA listed forest birds (e.g., Tinian monarch)
	Rota	Mariana fruit bat Mariana crow
	FDM	Micronesian megapode Mariana fruit bat Non-ESA listed forest birds (e.g., Micronesian starlings, white-throated ground dove)

Notes: Andersen AFB = Andersen Air Force Base, CATM = Combat Arms and Maintenance Range, EOD = Explosive Ordnance Detonations, ESA = Endangered Species Act, FDM = Farallon de Medinilla, Tinian MLA = Tinian Military Lease Area

3.10.3.1.1 Impacts from Explosives and Weapons Firing Noise

The potential for animals to be exposed to explosions depends on several factors, including the presence of animals 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. 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), bow shock waves (pressure waves from projectiles flying through the air), and substrate vibrations (combinations of explosion, recoil, or vehicle motion with the ground). Noise 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. These types of sound are distinguished here as they differ in their effects. Continuous sounds can result in hearing damage while impulses typically elicit physiological or behavioral responses.

Continuous or repetitive loud noise appears to cause stress and vascular alteration (including structural damage) in the ear and could be harmful when animals are already under metabolic stress such as starvation. Sound levels over 85 A-weighted decibels (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. Lifelong hearing loss (threshold shifts) can occur in birds; about half the duration of noise is needed to produce a threshold shift in birds as opposed to mammals.

High-frequency sounds (or ultrasound) are frequencies above the human auditory range limit. These sounds diminish very rapidly in air with distance from the source, and terrestrial animals 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 an animal was close enough to experience impacts from ultrasound, the animal would likely be impacted directly by the actual munitions (U.S. Fish and Wildlife Service 2010a).

Infrasound is present in blast and helicopter noise, but not heard by humans. This low frequency sound, outside the range of human hearing, attenuates less in air than audible sound, which means these noises can affect wildlife at longer distances. Birds may use infrasound for communication; however, the extent to which birds are affected by infrasound is speculative. 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.

Severe noise, even if the noise is short in duration, can result in 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. For example, common canaries (*Serinus canaria*) exposed to continuous loud noises experienced changes in hearing thresholds, especially at high frequencies (Larkin et al. 1996). While a study with parakeets (*Melopsittacus undulates*) indicated that a permanent threshold shift (lifelong hearing loss) was experienced at low frequencies only and nearly absent at higher frequencies (Larkin et al. 1996). Many birds appear to tolerate noise that can cause pain in humans, for example: seabirds at airports, wild turkeys (*Meleagris gallopavo*) near a rocket testing plant in Florida, and ospreys (*Pandion haliaetus*) at the Naval Surface Warfare Center, Dahlgren (Larkin et al. 1996). These varied responses are often attributed to habituation, where after a period of exposure to a stimulus, an animal stops responding to the stimulus. In general, a species can often habituate to human-generated noise when the noise is not followed by an adverse impact. Even when a species appears to be habituated to a noise, the noise may produce a metabolic or stress response (increased heart rate results in increased energy expenditure) although the response may or may not lead to changes in overall energy balance.

In addition to physical damage to the ear, noise also produces other physiological and behavioral responses. The behavioral effects of military-related noise to wildlife have been investigated numerous times with mixed results (VanderWerf 2000); it is difficult, therefore, to generalize predictions about potential responses of Micronesian megapodes to noise based on data from other species. To summarize, noise can produce a variety of physiological impacts and behavioral responses in wildlife. Noise not only affects an individual but can affect the overall population. Hearing impairment, both temporary and permanent, can decrease viability or reproductive success, particularly when mate attraction and territory protection depend on calling or singing normally. Hearing impairment can also decrease the ability to detect and warn others of predators. 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 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. Wildlife response to noise may also be more intense at night, if the species rely more on auditory cues than visual cues at night. Additionally, young animals may be more susceptible to hearing loss from noise exposure than adults; however, an experiment with common canaries did not show a differential response with age (Larkin et al. 1996).

Studies focusing on responses of birds on land to explosive noise show 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 howitzers, 60 and 81 millimeter 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-pound (lb.) bombing occurred. Anecdotal observations indicate the burrowing owl (*Athene cuniculariaflorida*) persists at Eglin AFB on a bombing range where a variety of inert ordnance (rockets, missiles, and bombs including a 21,700 lb. massive ordnance air blast bomb) has been used over the last 24 years (U.S. Fish and Wildlife Service 2010a). 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 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.

Impact Areas and Special Use Areas on FDM

The training activities that have the greatest impact on vegetation and wildlife communities within the impact areas on FDM are those that result in (1) percussive force from the use of explosive munitions, and (2) habitat alteration associated with ground disturbance and wildfires from explosive munitions.

FDM has four impact areas, a special use area on the northern portion of the island, and a special use area on the land bridge. Targeting of areas inside of the special use areas and other areas outside of impact areas are prohibited. In other words, all areas outside of the impact areas are considered “no-fire areas.” Any ordnance that inadvertently lands outside of impact areas including special use areas and in

water must be reported to MIRC Operations, in accordance with Commander, U.S. Naval Forces Marianas Instruction (COMNAVMARIANASINST) 3500.4A (U.S. Department of the Navy 2013d). The impact areas and special use areas are described below:

- **Northern Special Use Area.** Reserved for direct action (tactical air control party) type exercises and personnel recovery. This area is about 41 ac. (17 ha), and includes a landing zone.
- **Impact Area 1.** This area contains high-fidelity target structures and is comprised of vehicle shells and cargo containers. This area is authorized for inert ordnance only, and operators are required to report any live ordnance mistakenly dropped into Impact Area 1 to JRM Operations. Impact Area 1 contains nine targets of varying shapes and sizes, including four vehicles and five targets comprised of shipping containers. As shown in Figure 3.10-9, the target vehicles, rectangular target, the square target, and the L-shaped target only receive lightweight inert ordnance less than 100 lb. Strafing is prohibited on these targets. The H-shaped target may be targeted with inert ordnance less than 500 lb. with strafing also prohibited. The E-shaped target may be targeted with inert ordnance not exceeding 2,000 lb., and strafing is authorized on this target. Impact Area 1 is about 21 ac. (8.5 ha).
- **Impact Area 2.** Impact area 2 may be used for both live and inert ordnance. Strafing is permitted in this area. Impact Area 2 is about 22 ac. (9 ha).
- **Land Bridge.** Ordnance is prohibited from impacting the land bridge to the greatest extent possible. Operators are required to report ordnance observed impacting the land bridge.
- **Impact Area 3.** This area is south of the land bridge and is used for live and inert ordnance. Strafing is permitted in this area. Impact Area 3 is about 11 ac. (4.5 ha).
- **Non-contiguous Point Targets.** These targets are used for firing at vertical targets on the cliff, as part of Naval surface fire support training. There are six targets, all along the western side of FDM.

The potential for impacts resulting from direct strikes from inert munitions is orders of magnitudes lower than that from explosive munitions, particularly heavyweight explosive bombs (U.S. Department of the Navy 2010). Weapons use (i.e., direct strike) impacts are analyzed in Section 3.10.3.2.2 (Impacts from Military Expended Materials Including Explosive Munitions Fragments).

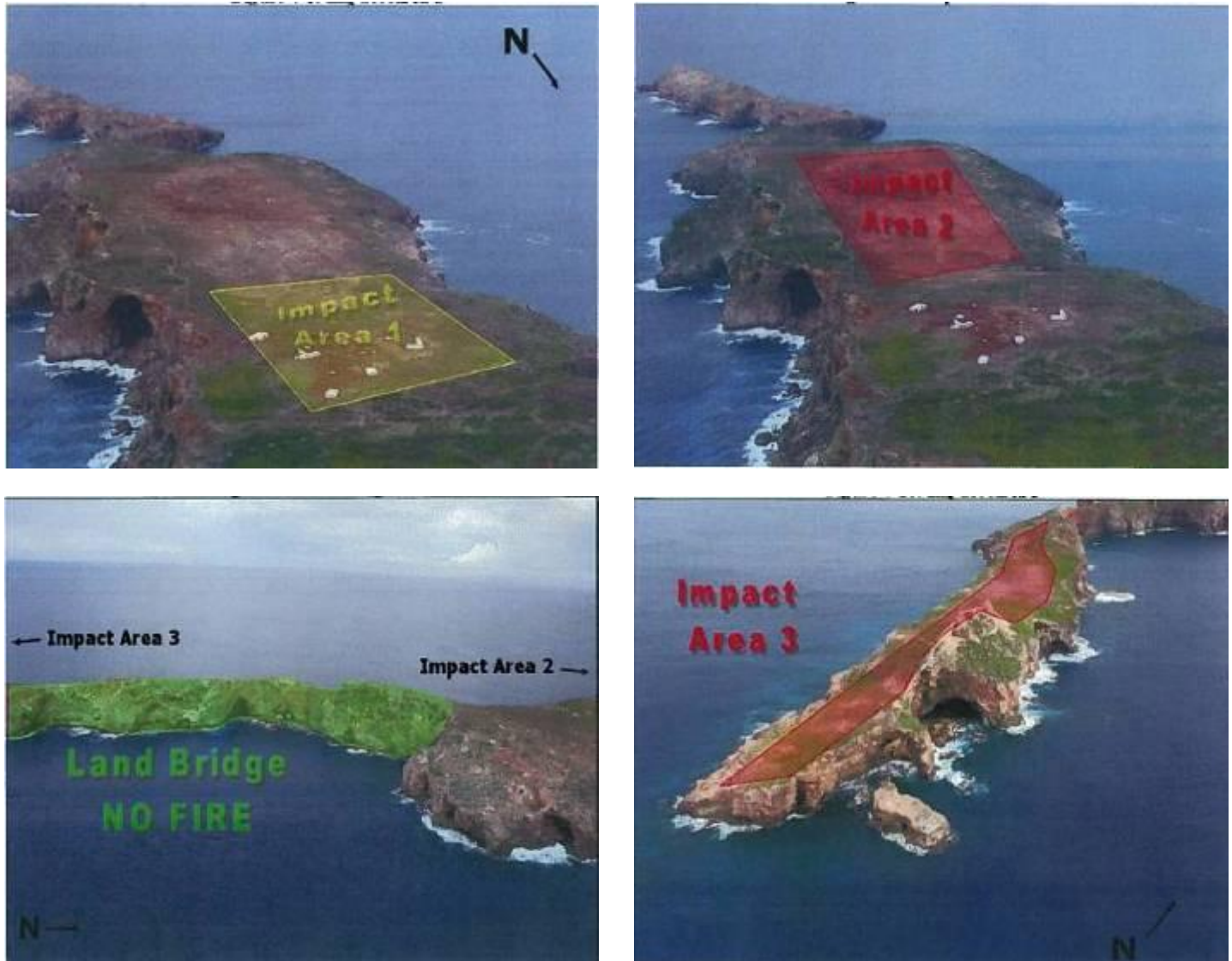
3.10.3.1.1.1 No Action Alternative

Training Activities

As shown in Table 2.8-1 of Chapter 2 (Description of Proposed Action and Alternatives), land-based detonations occur primarily on FDM as part of strike warfare and firing exercises; however land detonations for training associated with unexploded ordnance discovery/disposal training and improvised explosive device training occur at Andersen AFB on Guam (Pati Point Explosive Ordnance Disposal Range). Weapons firing activities under the No Action Alternative occur at ranges on Guam. Fixed-wing and rotary-wing air to ground gunnery exercises and missile exercises occur on FDM, as well as during ship-based fire support for amphibious warfare training.

Land-based detonations at the Pati Point Explosive Ordnance Disposal Range were the subject of earlier consultations between Andersen AFB and the USFWS (U.S. Department of the Navy 2009; U.S. Fish and Wildlife Service 2010a). The Pacific Islands Fish and Wildlife Office concluded that activities at the Pati Point Explosive Ordnance Disposal Range would not adversely affect ESA-listed species. Because of the current status of the Mariana crow on Guam, it is unlikely that any remnant crows would be near explosive training at the range. Other species thought to be absent from habitats surrounding the Pati Point Range (Guam rail, Guam Micronesian kingfisher, Mariana common moorhen) will not be impacted. Transiting Mariana fruit bats, however, may experience temporary behavioral changes associated with

birds, such as the Micronesian starling. Bats may exhibit behavioral responses to explosive noise, particularly at Pati Point ranges. These infrequent detonations are not expected to induce adverse population effects. It should be noted that Micronesian starling numbers are increasing in developed areas of Andersen AFB. These detonation activities occur on hardened surfaces and do not present a wildfire risk or impacts to vegetation communities.



Source: Commander, U.S. Naval Forces Marianas Instruction 3500.4A (Chapter 4).

Figure 3.10-9: Detailed View of Impact Areas and Special Use Areas on FDM

Explosive noise from strike warfare training at FDM impacts wildlife assemblages (primarily avifauna), and ESA-listed species (Lusk et al. 2000). Section 3.6 (Marine Birds) discusses the impacts to FDM's bird populations resulting from explosive noise. Section 3.10.3.2.4 (Impacts from Wildfires) and Section 3.10.3.2.2 (Impacts from Munitions Strike) discuss the potential impacts that explosions have on vegetation communities through a history of intense bombardment. Table 3.0-22 lists representative ordnance use on FDM under the No Action Alternative.

Mariana fruit bats on FDM may be transient bats (bats from other islands). The limited forest structure and composition currently found on FDM may support a small number of year-round residents. Natural resource experts expressed concern that volcanic eruptions could displace fruit bats to other islands (e.g., from Anatahan to FDM), thereby exposing an increased number of bats to potential impacts of military training on FDM (U.S. Fish and Wildlife Service 2006a, 2010a). It should be noted that after the Anatahan eruption began in 2003, the number of bat observations on other islands did not increase. However, the genetic variation demonstrated by fruit bats found in the far northern islands of the Mariana Archipelago and those bats found in the southern islands suggests that interisland movements do occur and are sufficient for northern bats and southern bats to not be classified as separate species or sub-species (Brown et al. 2011).

The Micronesian megapode would be exposed to noise and pressure waves from explosions on FDM from strike warfare and firing exercises. Response of the Micronesian megapode to explosive noise has not been evaluated under scientific investigation (U.S. Fish and Wildlife Service 2010a); however, Micronesian megapodes are vocal and presumably find mates and defend territories by duetting (U.S. Fish and Wildlife Service 1998). Therefore, explosive noise and pressure waves generated from explosions would impact the Micronesian megapode if it physically damages the ears such that an individual cannot hear and locate a mate; produces abnormal calls (hearing impaired learning) and cannot attract a mate; or is unable to defend a territory.

Other concerns from noise impacts to avian species are related to nesting and impacts to eggs or chicks (i.e., mortality through kicking eggs or young out of the nest during flushing, exposing young to temperature changes, failing to feed and care for young during nest flushing, exposing eggs and young to increased predation). Micronesian megapodes generally bury their eggs in mounds in which temperature is controlled by sources other than the bird (U.S. Fish and Wildlife Service 2010a). Chicks are precocial, able to fly upon emergence from the egg and not requiring parental care (U.S. Fish and Wildlife Service 1998). Therefore, behavioral responses typical to other avian species are not likely to result in adverse impacts to eggs, chicks, or juveniles of Micronesian megapodes.

Besides the Micronesian megapode, terrestrial bird species do not likely breed on FDM. There are a few terrestrial bird species that visit the island, such as the fork-tailed swiftlet, Eurasian tree-sparrow, and cattle egret. While visiting FDM, or using FDM as stopover habitat along migration routes, these birds would be exposed to noise and pressure waves from explosions on FDM from strike warfare and firing exercises. Some birds may be killed or injured during these activities, or expend energy stores needed for migration to avoid perturbations generated by explosions.

There are a number of protective measures used on FDM that minimize potential adverse impacts associated with explosives to Micronesian megapodes and habitats used by megapodes and other terrestrial animals. The protective measures were included in the 2010 USFWS Biological Opinion that included the Navy's use of FDM (U.S. Fish and Wildlife Service 2010a). The measures include maintaining prohibitions on targeting the northern end of the island (which continues to support higher stature trees), placing of targets within impact areas, and maintaining prohibitions on the use of cluster bombs, bombs greater than 2,000 lb. net explosive weight (NEW), fuel-air explosives, and incendiary devices.

Pursuant to the ESA, sound generated from explosions and weapons firing on land during training activities under the No Action Alternative will not affect the Serianthes tree, Osmoxylon mariannense, Nesogenes rotensis, Rota bridled white-eye, Guam rail, Guam Micronesian kingfisher, Mariana common moorhen, Mariana crow, Mariana swiftlet, and nightingale reed-warbler. Explosions on FDM may affect, and are likely to adversely affect, the Micronesian megapode and Mariana fruit bat.

Critical Habitats on Guam or Rota will not be affected by explosive noise or weapons firing noise.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), explosions and weapons firing on land during training activities under the No Action Alternative will not result in significant adverse effects on terrestrial bird populations.

Testing Activities

There are no testing activities that occur on land. Therefore, there are no potential impacts on terrestrial species or habitats.

3.10.3.1.1.2 Alternative 1

Training Activities

The number of detonations as part of explosive ordnance disposal and improvised explosive training will not change in Alternative 1, relative to the No Action Alternative. Therefore, the conclusion of the impacts on wildlife communities, ESA-listed species, and other terrestrial bird species not listed under the ESA on Guam associated with explosive noise is the same.

The FDM range is operated in accordance with COMNAVMARIANASINST 3500.4a, into which the terms and conditions specified in the 2010 Biological Opinion as amended (U.S. Fish and Wildlife Service 2010a), have been incorporated. Based on the ordnance expenditures authorized under the 2010 Biological Opinion, 516 tons is the maximum NEW authorized. In 2012, 331 tons NEW were dropped over the course of the year. Under Alternative 1, the Navy proposes to increase the number of strike warfare training exercises to allow for a maximum NEW of 1,484 tons.

As stated previously, the most important stressors to wildlife communities, including Micronesian megapodes and Mariana fruit bats on FDM are (1) percussive force from the use of explosive munitions, and (2) habitat alteration associated with ground disturbance and wildfires from explosive munitions. It should be noted that direct strike from inert munitions is far less likely to impact a megapode or bat relative to the potential for blast effects associated with explosive munitions, especially heavy weight munitions. Direct strike (by projectiles and explosive munition fragments) is analyzed in Section 3.10.3.2 (Physical Stressors). Although exposures to Micronesian megapodes, and potentially Mariana fruit bats, are expected to increase under Alternative 1 compared to the No Action Alternative, the expected impacts on any individual bird would remain the same for all three alternatives. For the same reasons provided in Section 3.10.3.1.2.1 (No Action Alternative), explosive noise may impact the Micronesian megapode if it physically damages the ears such that: an individual cannot hear and locate a mate; produces abnormal calls (hearing impaired learning) and cannot attract a mate; or is unable to defend a territory. As discussed under the No Action Alternative, there are a few terrestrial bird species that visit the island, such as the fork-tailed swiftlet, Eurasian tree-sparrow, and cattle egret. While visiting FDM, or using FDM as stopover habitat along migration routes, these birds would be exposed to noise and pressure waves from explosions on FDM from strike warfare and firing exercises. These exposures would increase under Alternative 1. Some birds may be killed or injured during these activities, or expend energy stores needed for migration to avoid perturbations generated by explosions.

The Navy will continue to implement protective measures to minimize the impacts on terrestrial species and habitats, pursuant with the USFWS Biological Opinion for Mariana Islands Range Complex (MIRC) training activities (U.S. Fish and Wildlife Service 2010a).

Pursuant to the ESA, sound generated from explosions and weapons firing on land during training activities under Alternative 1 will not affect the Serianthes tree, Osmoxylon mariannense, Nesogenes rotensis, Rota bridled white-eye, Guam rail, Guam Micronesian kingfisher, Mariana common moorhen, Mariana crow, Mariana swiftlet, and nightingale reed-warbler. Explosions on FDM may affect, and are likely to adversely affect, the Micronesian megapode and the Mariana fruit bat.

Critical Habitats on Guam or Rota will not be affected by explosive noise or weapons firing noise.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), explosions and weapons firing on land during training activities under Alternative 1 will not result in significant adverse effects on terrestrial bird populations.

Testing Activities

Under Alternative 1, there are no testing activities that would involve explosions on land. Therefore, there are no potential impacts on terrestrial species or habitats.

3.10.3.1.1.3 Alternative 2

Training Activities

The number of detonations as part of explosive ordnance disposal and improvised explosive training will not change in Alternative 2, relative to the No Action Alternative. Therefore, the conclusion of the impacts on wildlife communities, ESA-listed species, and other terrestrial bird species not listed under the ESA on Guam associated with explosive noise is the same.

On FDM, the explosive munitions use proposed under Alternative 2 differs only in the 2,000 lb. bomb category. Under Alternative 2, an additional 579 bombs in this category would be dropped relative to Alternative 1.

Although exposures to Micronesian megapodes, and potentially Mariana fruit bats, 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 all three alternatives. Exposures to Micronesian megapodes, Mariana fruit bats, and the few terrestrial bird species that visit FDM would increase under Alternative 2 relative to the No Action Alternative. Some birds may be killed or injured during these activities, or expend energy stores needed for migration to avoid perturbations generated by explosions.

The Navy will continue to implement protective measures to minimize the impacts on terrestrial species and habitats, pursuant with the USFWS Biological Opinion for MIRC training activities (U.S. Fish and Wildlife Service 2010a).

Pursuant to the ESA, sound generated from explosions and weapons firing on land during training activities under Alternative 2 will not affect the Serianthes tree, Osmoxylon mariannense, Nesogenes rotensis, Rota bridled white-eye, Guam rail, Guam Micronesian kingfisher, Mariana common moorhen, Mariana crow, Mariana swiftlet, and nightingale reed-warbler. Explosions on FDM may affect, and are likely to adversely affect, the Micronesian megapode and Mariana fruit bat.

Critical Habitats on Guam or Rota will not be affected by explosive noise or weapons firing noise.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), explosions and weapons firing on land during training activities under Alternative 2 will not result in significant adverse effects on terrestrial bird populations.

Testing Activities

Under Alternative 2, there are no testing activities that would involve explosions on land. Therefore, there are no potential impacts on terrestrial species or habitats.

3.10.3.1.2 Impacts from Aircraft Noise

3.10.3.1.2.1 No Action Alternative

Training Activities

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 AFB, Tinian landing beaches, and some transits to FDM and to training areas and drop zones at sea. Some training involving combat search and rescue training activities may occur at Rota International Airport.

Andersen AFB completed an aircraft noise and wildlife response study at Northwest Field, Munitions Storage Area, and Pati Point to monitor the effects of noise events associated with aircraft operations to the Mariana fruit bat and Mariana crow (SWCA Environmental Consultants 2009). The study monitored various behaviors of individual bats during periods of no aircraft noise and periods of take-offs and landings, and flushing behaviors associated with the former colony location at Pati Point. No flushing of the entire Mariana fruit bat colony was observed during any aircraft overflight activity (SWCA Environmental Consultants 2009). Flushing episodes associated with overflights were infrequent at less than 5 percent (on 228 occasions) but increased to 6 percent for overflights above 100 dB (in the SWCA study, noise was measured in dBC, or decibels referenced to the carrier). In all flushing events, noise levels remained above 75 dBC for between 31 and 87 seconds. The majority of flush events involved less than three individuals at one time (SWCA Environmental Consultants 2009). On one occasion, 14 fruit bats simultaneously flew from their colony roost sites and circled the main colony and surrounding cliff line. Noise from the aircraft peaked at 121.1 dBC and lasted almost 35 seconds (above 75 dBC), causing between 38 and 50 percent of the fruit bats to flush. Flushed individuals were in flight for a relatively short period, generally resettling between 7 and 10 minutes after first flight.

The most complete dataset on Guam for noise effects on Mariana crows comes from Morton's 1996 study of aircraft overflights and effects on crows at Andersen AFB (Morton 1996). At the time of Morton's study, eight pairs of Mariana crows remained on Guam, four pairs had established territories under low-altitude flight lines at Andersen AFB. Crows responded to some low-altitude aircraft overflights (less than 600 ft. [183 m]) with distress and flight, which disrupted nest building activities, incubation of eggs, and nest attendance. A subsequent noise study was completed by Andersen AFB in 2009 (SWCA Environmental Consultants 2009), a time when the last two crows on Guam inhabited the

Munitions Storage Area of Andersen AFB. On three occasions, fighter aircraft departed from either the north or south runway of Andersen AFB and flew around the south side of the Munitions Storage Area. Although both crows were alert and aware of the noise, neither departed the nest site. No direct overflights or noise level data were recorded during these occasions (SWCA Environmental Consultants 2009).

Micronesian starlings nest and forage in and adjacent to the developed portions of Andersen AFB, and have likely habituated to aircraft noise. Their reported increased on Guam suggest that the population of this species is not adversely affected by aircraft noise (U.S. Department of the Navy 2013a).

Fena Reservoir is a 203 ac. (82 ha) lake within the Naval Base Guam Munitions Site and supports a Mariana moorhen population (Guam Division of Aquatic and Wildlife Resources 2006). Helicopter-based fire bucket training occurs near the Fena Spillway on a regular basis, along with frequent overflights of HC-25s. In April 2009, two moorhens were observed near the spillway foraging in nearby aquatic vegetation, and during the wet season of 2008, six moorhens were observed in the shallower portions of the reservoir (U.S. Fish and Wildlife Service 2009b). Any moorhens that are at Fena Reservoir at the time of helicopter-based training will be exposed to noise and visual disturbance. Noise from helicopter overflights most likely adversely affect moorhens by masking predator approaches and mating calls. Other limiting factors seem to be more important, such as the decline of some aquatic emergent vegetation species since noise events for helicopter operations are short term. No noise studies have been conducted to measure responses of Mariana common moorhens to military noise (such as helicopter overflights). To minimize effects of this training activity, Navy natural resource specialists with specific Mariana common moorhen experience monitor any moorhens for behavioral responses during the first three fire bucket training exercises. In addition, the Navy maintains altitude restrictions over Fena Reservoir for helicopters and fixed wing aircraft outside the helicopter fire bucket training area. Continued use of the area may suggest an ability for the moorhen to acclimate to periodic increases in noise.

Other than the Mariana common moorhen, the only native resident terrestrial bird known to occur at Naval Base Guam Munitions Site is the yellow bittern. Population trends are not available for this species at this installation (U.S. Department of the Navy 2013a).

On Rota, aircraft noise would be generated by helicopters during combat search and rescue training activities. Typically, the Navy uses H-60 helicopters to practice day or night rescues of personnel in a simulated hostile area with the expectation of combat resistance. Crews typically include Naval special warfare personnel or combat trained personnel with rescue swimmer and medical qualifications. This activity is mostly restricted to the Rota International Airport; however, other locations may be used in coordination with local authorities (e.g., Rota's mayor office). Helicopters may also transit out to sea for rescue swimmer training.

The Rota International Airport is located on the east side of Rota (see Figure 3.10-2) and is near the critical habitat designation for the Mariana crow and foraging areas for the Mariana fruit bat. The Sabana Plateau is on the western portion of the island (the location of Rota bridled white-eyes and critical habitat, at least one of Mariana fruit bat colonial roosts and Mariana fruit bat critical habitat, and other important habitats associated with the Sabana Plateau). Low altitude overflights do not occur in critical habitat designations or designated conservation areas. Because the combat search and rescue training occurs near occupied habitat for the Mariana crow, aircraft noise may affect the Mariana crow. Combat search and rescue training, however, occurs infrequently on Rota, with the majority of these

training activities scheduled to occur on Guam. Adverse effects to the Mariana crow are not anticipated because critical habitat areas are avoided and this training activity occurs infrequently.

Mariana fruit bats are generally more active at night (a primary time for foraging when bats would fan out over Rota from roost locations). Because suitable foraging habitat is adjacent to the Rota International Airport, helicopter noise may affect the Mariana fruit bat. Adverse effects associated with this training activity are not anticipated to include injury or mortality and be limited to minor behavioral changes.

Pursuant to the ESA, noise generated from aircraft overflights over land during training activities under the No Action Alternative will not affect the Serianthes tree, Osmoxylon mariannense, Nesogenes rotensis, Rota bridled white-eye, Guam rail, Guam Micronesian kingfisher or the nightingale reed-warbler. Noise generated from aircraft overflights may affect, but not likely adversely affect, the Mariana common moorhen, Mariana crow, Mariana fruit bat, Mariana swiftlet, and the Micronesian megapode.

Critical Habitats on Guam or Rota will not be affected by aircraft noise.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), noise generated from aircraft overflights over land under the No Action Alternative will not result in significant adverse effects on terrestrial bird populations.

Testing Activities

There are no testing activities that occur on land. Therefore, there are no potential impacts on terrestrial species or habitats.

3.10.3.1.2.2 Alternative 1 and Alternative 2

Training activities under Alternative 1 and Alternative 2 would increase fixed- and rotary-wing aircraft overflights throughout the Study Area. Most helicopter training would occur adjacent to areas at Naval Base Guam Apra Harbor, Andersen AFB, Tinian landing beaches, and some transits to FDM and to training areas and drop zones at sea. Most increases would occur at FDM with five-fold increase in the number of sorties associated with bombing exercises during strike warfare training. Most of these flights, however, would be at high altitudes to reduce intensity of the sound.

Combat search and rescue training on Rota under Alternative 1 and Alternative 2 will not change relative to the No Action Alternative. Therefore, aircraft overflights associated with training activities may affect, but not likely adversely affect, Mariana fruit bats and Mariana crows on Rota. Activities at Fena Reservoir (within Naval Base Guam Munitions Site) would not change under Alternative 1 or Alternative 2, and the number of helicopter training supporting insertion/extraction and urban warfare type training activities would not change above the No Action Alternative. Therefore, under Alternative 1 and Alternative 2, increases in activities that generate aircraft noise may affect, but not likely adversely affect, Micronesian megapodes at FDM.

As with the No Action Alternative and Alternative 1, aircraft noise would not adversely impact bird populations for species not listed under the ESA, but protected under the MBTA.

Pursuant to the ESA, sound generated from aircraft overflights over land during training activities under Alternative 1 or Alternative 2 will not affect the Serianthes tree, Osmoxylon mariannense, Nesogenes rotensis, Rota bridled white-eye, Guam rail, Guam Micronesian kingfisher or the nightingale reed-warbler. Sound generated from aircraft overflights may affect, but not likely adversely affect, the Mariana common moorhen, Mariana crow, Mariana fruit bat, Mariana swiftlet, and the Micronesian megapode.

Critical Habitats on Guam or Rota will not be affected by aircraft noise.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), noise generated from aircraft overflights over land under Alternative 1 or Alternative 2 will not result in significant adverse effect on terrestrial bird populations.

Testing Activities

There are no testing activities that occur on land. Therefore, there are no potential impacts on terrestrial species or habitats.

3.10.3.2 Physical Stressors

This section describes the potential impacts to wildlife and ESA-listed terrestrial species by aircraft and aerial targets, military expended material strike including explosive munitions fragments, ground disturbance, and wildfires at FDM. Table 2.8-1 in Chapter 2 (Description of Proposed Action and Alternatives) lists activity types, number of activities, and locations where these activities occur that involve physical stressors. Aircraft include fixed-wing and rotary-wing aircraft; munitions include small, medium, and large caliber non-explosive and explosive rounds, as well as rockets, missiles, and bombs; ground disturbance includes trampling (foot traffic) and bivouac training; and wildfires result from ignition of vegetation from munitions use. Aerial targets are used at high altitudes and away from land areas; therefore, the potential for strike of terrestrial animals is discounted and not analyzed further in this EIS/OEIS. These activities vary in location and potentially impact different species based on the species distribution, status within the training area, habitats within the training area, and the type of activity. Table 3.10-6 lists each substressor, where they occur, and what species potentially are impacted by the activity. Physical disturbance and strike of seabird and shorebird species (including ESA-listed) seabird species are addressed in Section 3.6.3.3 (Physical Stressors).

3.10.3.2.1 Impacts from Aircraft and Aerial Target Strike

Wildlife aircraft strikes are a serious concern for the Navy and Air Force 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.

Although 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). Potential for wildlife strike 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). Typical flight altitudes during air-to-surface bombing exercises are from 500 to 5,000 ft. (150 to 1,500 m) above ground level. Most fixed-wing aircraft flight hours (greater than 90 percent) occur at distances greater

than 12 nm offshore. Approximately 95 percent of bird flight during migration occurs below 10,000 ft. (3,000 m), with the majority below 3,000 ft. (900 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. (150 m). Air Force data support this statistic, showing that approximately 70 percent of collisions at U.S. Air Force-administered airfields occur below 500 ft. (150 m) (U.S. Department of Defense 2012). Collisions, however, have been recorded at elevations as high as 12,139 ft. (3,700 m) (Buchanan 2011). The Micronesian megapode and Mariana fruit bat are not expected to occur above 500 ft. (152.4 m) above ground level; therefore, these species would not likely be impacted by aircraft overflights and are not carried forward for analysis at FDM.

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 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 AFB to implement a Bird/Animal Aircraft Strike Hazard Plan. The Andersen AFB Bird/Animal Aircraft Strike Hazard plan provides guidance for reducing the incidents of bird strikes in and around areas where flight training is being conducted. At Andersen AFB, 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. Several common bird species that might be present and pose a hazard to military aircraft include shorebirds, black drongos, Micronesian starlings, Eurasian tree sparrows, island collared doves, and Mariana fruit bats (U.S. Department of the Navy 2013a). Mariana fruit bats have been struck by aircraft at Andersen AFB; these animals are primarily active at night and are relatively less maneuverable than birds. Helicopter flights would occur closer to the shoreline where sheltering, roosting, and foraging of birds occur. Helicopters can hover and fly low and are used to tow electromagnetic devices as well as for other military activities at sea. This combination would increase the chances of a helicopter strike of a bird. Additional details on typical altitudes and characteristics of aircraft used in the Study Area are provided in Section 3.0.5.3 (Identification of Stressors for Analysis).

3.10.3.2.1.1 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 as described in further detail in Table 2.8-1 in Chapter 2 (Description of Proposed Action and Alternatives) and in Section 3.0.5.3 (Identification of Stressors for Analysis).

Exposures to birds and fruit bats to potential aircraft strikes 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. As a standard operating procedure, aircraft avoid large flocks of birds to minimize the safety risk to personnel from 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. Mariana fruit bats would not likely be impacted by aircraft strike because of (1) the relatively low height this species typically transits between roost sites and foraging areas, and (2) the likelihood that Mariana fruit bats would avoid loud sound generated by aircraft by remaining in the forest canopy or moving away from the sound source. Mariana fruit bats that fly at altitudes above the cliffline at Andersen AFB would be within flight paths of planes on approach and take-off. However, the potential for strike is low (because of nocturnal activity of bats and the noise generated by approaching aircraft).

With the exception of the Mariana crow (which is likely extirpated), the only other native terrestrial birds species that occur at Andersen AFB are the Micronesian starling and the yellow bittern. As stated previously, this species is increasing in numbers at Andersen AFB. In the unlikely event of an aircraft strike, the death or injury of a low number of birds would not adversely impact the Micronesian starling bird population.

As described in Section 3.10.3.1.2 (Impacts from Aircraft Noise), low level helicopter training occurs at Fena Reservoir as part of helicopter bucket training. This activity occurs where Mariana common moorhens may be located; however, the noise of the activity would likely cause Mariana common moorhens to move away from the sound source. Therefore, although Mariana common moorhens would be likely disturbed by noise of helicopters, direct strike of a moorhen is unlikely. Based on the infrequent use of the Fena Reservoir area by Mariana fruit bats (as described previously), the primarily nocturnal activity of bats on Guam, and the lack of night-time helicopter flights, Mariana fruit bats would unlikely be struck by helicopter trainings at Naval Base Guam Munitions Site. Mariana swiftlets leave caves located on the facility primarily at dawn and return at night. Some swiftlets, however, may leave caves during nesting periods to incubate eggs and to feed hatchlings. Further, flight restrictions in place because of explosive safety arcs limit the location of low-level helicopter flights, which reduces the potential for low-level interactions with Mariana fruit bats, Mariana swiftlets, or birds otherwise protected by the MBTA.

At the Rota International Airport, combat search and rescue training occurs in areas adjacent to habitats used by Mariana crows and Mariana fruit bats. This training activity, however, is generally confined to the airfield where these species are unlikely to occur. Trainings may also occur in open areas in coordination with local authorities. The likelihood for aircraft strike during combat search and rescue training should be considered extremely low because of the infrequent occurrence of the training activity and the locations of where these training activities are actually scheduled. Night exercises would increase exposures to the Mariana fruit bats because fruit bats disperse from colonies or solitary roosts at night in search of foraging trees across the island. These night dispersions may co-occur with combat search and rescue low-level flights in open areas. Because the training activities that occur at night are infrequent, and the training activities are generally associated with open areas, the likelihood of injury or mortality of a Mariana fruit bat is discountable.

Table 3.10-6: Physical Disturbance and Strike Substressors in Land Training Areas and Terrestrial Resources Potentially Impacted

Substressor	Land Training Area	Terrestrial Resource Potentially Impacted
Aircraft and aerial target strike	Andersen AFB	Mariana fruit bat, Mariana crow (believed to be extirpated) Non-ESA listed forest birds (e.g., Micronesian starlings)
	Naval Base Guam Munitions Site/ Fena Reservoir	Mariana fruit bat Mariana common moorhen Mariana swiftlet Non-ESA listed forest birds e.g., Micronesian starlings)
	Rota (Rota International Airport)	Mariana fruit bat Mariana crow Non-ESA listed forest birds
	Tinian MLA	Micronesian megapode Non-ESA listed forest birds (e.g., Tinian monarch)
	FDM	Micronesian megapode Mariana fruit bat Non-ESA listed forest birds (e.g., Micronesian starlings, white-throated ground dove)
Military expended materials	FDM	Micronesian megapode Mariana fruit bat Non-ESA listed forest birds (e.g., Micronesian starlings, white-throated ground dove)
Ground disturbance (Pedestrian and vehicular traffic)	Naval Base Guam Munitions Site (Northern Land Navigation Area and Southern Land Navigation Area)	Mariana swiftlet Mariana common moorhen Mariana fruit bat Vegetation communities Non-ESA listed forest birds (e.g., yellow bittern)
	Tinian MLA	Micronesian megapode Vegetation communities Non-ESA listed forest birds (e.g., Tinian monarch)
	Marpi Maneuver Area (Saipan)	Nightingale reed-warbler Mariana fruit bat Micronesian megapode Vegetation communities Non-ESA listed forest birds (e.g., rufous fantail)
	FDM	Micronesian megapode Mariana fruit bat Vegetation communities Non-ESA listed forest birds (e.g., Micronesian starlings, white-throated ground dove)
Wildfires	FDM	Micronesian megapode Mariana fruit bat Vegetation communities Non-ESA listed forest birds (e.g., Micronesian starlings, white-throated ground dove)

Notes: Andersen AFB = Andersen Air Force Base, ESA = Endangered Species Act, FDM = Farallon de Medinilla, Tinian MLA = Tinian Military Lease Area

Low-level helicopter flights may also occur over the Tinian MLA. Flight restrictions are in place for intact limestone forest locations and wetland areas of the Tinian MLA to minimize disturbance to the Micronesian megapodes and Mariana common moorhens. These birds transit between habitats within the Tinian MLA and between Tinian and other islands; therefore, these birds could be struck by aircraft. The likelihood of strike of these birds is small because moorhens and megapodes would likely respond to aircraft noise and avoid the collision.

Pursuant to the ESA, aircraft and aerial target strikes during training activities under the No Action Alternative will not affect the Serianthes tree, Osmoxylon mariannense, Nesogenes rotensis, Rota bridled white-eye, Guam rail, Guam Micronesian kingfisher, nightingale reed-warbler, Mariana crow. Aircraft and aerial target strikes during training activities under the No Action Alternative may affect, but not likely adversely affect, the Mariana fruit bat, the Micronesian megapode, Mariana common moorhen, or Mariana swiftlet.

Critical Habitats on Guam or Rota will not be affected by potential aircraft and aerial target strikes.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), aircraft and aerial target strikes under the No Action Alternative will not result in significant adverse effects on terrestrial bird populations.

Testing Activities

There are no testing activities that occur on land. Therefore, there are no potential impacts on terrestrial species or habitats.

3.10.3.2.1.2 Alternative 1 and Alternative 2

Training Activities

Training activities under Alternative 1 and Alternative 2 would increase fixed- and rotary-wing aircraft overflights throughout the Study Area. No new land training areas are proposed for overflights under Alternative 1 or Alternative 2. As with the No Action Alternative, most helicopter training would occur adjacent to areas at Naval Base Guam Apra Harbor, Andersen AFB, Tinian landing beaches, and some transits to FDM and to training areas and drop zones at sea. Most increases would occur at FDM with a five-fold increase in the number of sorties associated with bombing exercises during strike warfare training. Most of these flights, however, would be at high altitudes where wildlife species, including ESA-listed species, would not co-occur with aircraft.

Pursuant to the ESA, aircraft and aerial target strikes during training activities under Alternative 1 and Alternative 2 will not affect the Serianthes tree, Osmoxylon mariannense, Nesogenes rotensis, Rota bridled white-eye, Guam rail, Guam Micronesian kingfisher, nightingale reed-warbler, or Mariana crow. Aircraft and aerial target strikes during training activities under the No Action Alternative may affect, but not likely adversely affect, the Mariana fruit bat, the Micronesian megapode, Mariana common moorhen, or Mariana swiftlet.

Critical Habitats on Guam or Rota will not be affected by potential aircraft and aerial target strikes.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), aircraft and aerial target strikes under Alternative 1 and Alternative 2 will not result in significant adverse effects on terrestrial bird populations.

Testing Activities

Under Alternative 1 and Alternative 2, there are no testing activities that would involve aircraft overflights over land. Therefore, potential aircraft strikes of terrestrial species or habitats during testing activities would not occur.

3.10.3.2.2 Impacts from Military Expended Materials Including Explosive Munitions Fragments

This section analyzes the strike potential to birds of the following categories of military expended materials: (1) non-explosive practice munitions, and (2) fragments from high-explosive munitions. Expended materials other than ordnance, such as sonobuoys, vessel hulks, and expendable targets, are not used in terrestrial habitats, and are therefore not included in the analysis. Live-fire training occurs on contained ranges, breacher houses, and MOUT-type training facilities within the Study Area's land training areas; however, these areas contain berms or bullet traps that would prevent small arms munitions from entering into terrestrial habitats. At-sea ranges, such as small arms training for boarding exercises, occur sufficiently far from land and do not warrant analysis for impacts to terrestrial species and habitats. Munitions are only dropped on FDM; therefore, only activities that expend munitions that occur at FDM are included for analysis.

At FDM, there is potential for munitions to strike the Micronesian megapode. As stated in Section 3.10.2.3.8 (Micronesian Megapode/Sasangat (*Megapodius laperouse laperouse*))), FDM supports a number of Micronesian megapodes and, therefore, concentrations of birds at different times of year are likely to co-occur with training exercises. Megapodes on FDM have persisted on FDM through various phases of intense bombardment of the island from the 1970s to the present. The history of the military use of FDM is summarized in Section 3.10.2.1.5 (Farallon de Medinilla), and a brief summary of human exploitation prior to military use of the island is provided in Section 3.6.2.5 (Rookery Locations and Breeding Activities within the Mariana Islands Training and Testing Study Area). In the range area on FDM where ordnance is restricted to inert munitions, vertical vegetation structure and surface cover is greater than in range areas where high explosive ordnance is permitted (U.S. Department of the Navy 2008c). Micronesian megapodes have been observed within the inert munitions area, although at lower densities relative to areas north of the "special use area" where no live-fire training occurs (U.S. Department of the Navy 2008c).

As stated previously, the potential for injury to Micronesian megapodes on FDM, and potentially Mariana fruit bats that may occur on the island, associated with direct strike from inert munitions is considerably lower than the potential for blast effects associated with explosive munitions. This is especially true with heavy weight munitions. By way of example, a single Mk 84 (2,000 lb. explosive bomb) has a hazardous fragment distance of over 1,000 ft. (300 m) (U.S. Department of Defense 2004). This will result in an area, within which animals could be injured or killed and habitat disturbed, of approximately 60 ac. (24 ha). For a single Mk 48 (25 lb. non-explosive practice bomb), an animal would need to be directly struck, or in very close proximity to the area of impact. Allowing for a conservative estimate of an injury zone to be defined as 3 ft. from the impact, the resultant area would be just over 9 square feet (ft.²) (0.8 m²). For a 20 millimeter projectile, the zone of potential injury would be a smaller area, conservatively estimated at 0.5 ft.² (0.05 m²). Hundreds of thousands of 20 millimeter 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.

3.10.3.2.2.1 No Action Alternative

Training Activities

Under the No Action Alternative, use of inert and live-fire target areas on FDM is expected to impact Micronesian megapodes. Most of these impacts are associated with the use of explosive munitions described above in Section 3.10.3.1.1 (Impacts from Explosions and Weapons Firing). Approximately five pairs of Micronesian megapodes (extrapolated from survey data) may be using the area around the inert and live-fire target areas on FDM and are at risk for a direct strike from ordnance (U.S. Department of the Navy 2009; U.S. Fish and Wildlife Service 2010a). Mariana fruit bats are not likely to be struck by munitions because bats are expected to occur only in the relatively closed-canopy forests in the “special use area” where ordnance is not used. FDM is also believed to be rarely used by foraging bats transiting between lands (U.S. Fish and Wildlife Service 2010a). The possibility of injury to or mortality of individual transient fruit bats may be low, but is not negligible.

The Navy’s range manual for the use of FDM contains training restrictions that reduce the potential for direct strike by munitions. For instance, reducing the potential for direct strike from munitions of megapodes and transiting fruit bats is achieved by implementing targeting and weapons restrictions for the northern portion of FDM. Use constraints include targeting restrictions on missile, firing, gunnery exercises, and other amphibious assault exercises. No weapons system is targeted north of the designated “No Fire Line.” Bombing exercise restrictions include: (1) targeting three impact areas (only two are for live ordnance) located on the interior plateau of the island and the southern peninsula (the impact areas total approximately 34 ac. (114 ha), which accounts for 20 percent of the island’s area); (2) prohibiting cluster bombs and fuel-air explosives or incendiary devices; and (3) placement of targets away from the most sensitive areas, such as seabird nests, and potential roosting sites for transient Mariana fruit bats.

There are a few terrestrial bird species that visit the island, such as the fork-tailed swiftlet, Micronesian starling, Eurasian tree-sparrow, and cattle egret. Breeding for these and other terrestrial bird species is unlikely due to the limited amount of habitat available. While visiting FDM, or using FDM as stopover habitat along migration routes, these birds would be exposed to direct strike by munitions on FDM from strike warfare and firing exercises. Some birds may be killed or injured during these activities, or expend energy stores needed for migration to avoid perturbations generated by weapons firing.

There are a number of protective measures for FDM that minimize potential adverse impacts associated with weapons firing to Micronesian megapodes and habitats used by megapodes and other terrestrial animals. The protective measures were included in the 2010 USFWS Biological Opinion for the Navy’s use of FDM (U.S. Fish and Wildlife Service 2010a). The measures include maintaining prohibitions on targeting the northern end of the island (which continues to support higher stature trees), placing of targets within impact areas, and maintaining prohibitions on the use of cluster bombs, bombs greater than 2,000 lb. NEW, fuel-air explosives, and incendiary devices.

Pursuant to the ESA, munitions strike on FDM during training activities under the No Action Alternative will not affect the Serianthes tree, Osmoxylon mariannense, Nesogenes rotensis, Rota bridled white-eye, Guam rail, Guam Micronesian kingfisher, nightingale reed-warbler, Mariana common moorhen, Mariana crow, or Mariana swiftlet. Munitions strike may affect, and are likely to adversely affect, the Micronesian megapode and Mariana fruit bat on FDM.

Critical Habitats on Guam or Rota will not be affected by munitions strike.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), munitions strike on FDM under the No Action Alternative will not result in significant adverse effects on terrestrial bird populations.

Testing Activities

There are no testing activities that occur on land. Therefore, there are no potential impacts on terrestrial species or habitats.

3.10.3.2.2.2 Alternative 1

Training Activities

Table 3.0-22 lists the number of bombs, projectiles, missiles, and rockets that may be dropped on FDM under Alternative 1. The activities and type of military expended materials under Alternative 1 would be expended in the same geographic locations as the No Action Alternative.

Specifically at FDM, the number of bombs, projectiles, missiles, and rockets targeting range portions of the island would increase by a factor of five. Most of these increases are associated with small caliber rounds (an increase from 2,900 under the No Action Alternative to 42,000 under Alternative 1). While increased ordnance use may increase exposure to direct strike, percussive force, and the direct and indirect effects of wild land fire, limiting ordnance use to existing impact areas (totaling 34 ac. [114 ha]) would minimize effects to Micronesian megapodes and transient Mariana fruit bats. Limiting explosive ordnance use to existing and defined impact areas will minimize effects on vegetation composition and structure outside of the impact zones. Therefore, impacts for the Micronesian megapode and the Mariana fruit bat are the same under Alternative 1 as with the No Action Alternative.

As described above, a few terrestrial bird species visit FDM, such as the fork-tailed swiftlet, Eurasian tree-sparrow, and cattle egret. While visiting FDM, or using FDM as stopover habitat along migration routes, exposure to munitions strike would increase under Alternative 1. Some birds may be killed or injured during these activities, or expend energy stores needed for migration to avoid perturbations generated by weapons firing. Breeding for these species does not occur on FDM, and these species are relatively common in other areas within the Mariana Islands. The death, injury, or disturbance of a few individuals of these species visiting FDM would not adversely affect populations.

Pursuant to the ESA, munitions strike on FDM during training activities under Alternative 1 would have no effect on the Serianthes tree, Osmoxylon mariannense, Nesogenes rotensis, Rota bridled white-eye, Guam Micronesian kingfisher, nightingale reed-warbler, Mariana common moorhen, Mariana crow, or Mariana swiftlet. Munitions strikes may affect, and are likely to adversely affect, the Micronesian megapode and Mariana fruit bat on FDM.

Critical Habitats on Guam or Rota will not be affected by munitions strike.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), munitions strike on FDM under Alternative 1 will not result in significant adverse effects on terrestrial bird populations.

Testing Activities

Under Alternative 1, there are no testing activities that would involve weapons firing on land or toward land-based targets. Therefore, there would be no potential strike of wildlife or plant species from weapons firing during testing activities under Alternative 1.

3.10.3.2.2.3 Alternative 2

Training Activities

Appendix A (Training and Testing Activities Descriptions) lists the training and testing activities that use ordnance on FDM. The number of ordnance use on FDM is summarized for Alternative 2 in Table 3.0-22. The activities and type of military expended materials under Alternative 2 and would be expended in the same geographic locations as the No Action Alternative.

As with Alternative 1, the number of bombs, projectiles, missiles, and rockets targeting range portions of FDM would increase by a factor of five. Alternative 2 differs from Alternative 1 in that 579 more bombs up to 2,000 lb. NEW would be dropped on FDM. As with Alternative 1, most of these increases in ordnance use on FDM are associated with small caliber rounds (an increase from 2,900 under the No Action Alternative to 42,000 under Alternative 2). Limiting explosive ordnance use to existing and defined impact areas will minimize effects on vegetation composition and structure outside of the impact zones. Therefore, impacts on the Micronesian megapode and the Mariana fruit bat are the same under Alternative 2 as with the No Action Alternative.

As described above, a few terrestrial bird species visit FDM, such as the fork-tailed swiftlet, Eurasian tree-sparrow, cattle egret. While visiting FDM, or using FDM as stopover habitat along migration routes, exposure to munitions strike would increase under Alternative 2. These birds would be exposed to more bomb fragments under Alternative 2, relative to Alternative 1. Some birds may be killed or injured during these activities, or expend energy stores needed for migration to avoid perturbations generated by weapons firing. Breeding for these species does not occur on FDM, and these species are relatively common in other areas within the Mariana Islands. The death, injury, or disturbance of a few individuals of these species visiting FDM would not adversely affect populations.

Pursuant to the ESA, munitions strike on FDM during training activities under Alternative 2 would have no effect on the Serianthes tree, Osmoxylon mariannense, Nesogenes rotensis, Rota bridled white-eye, Guam Micronesian kingfisher, nightingale reed-warbler, Mariana common moorhen, Mariana crow, or Mariana swiftlet. Munitions strikes may affect, and are likely to adversely affect, the Micronesian megapode and Mariana fruit bat on FDM.

Critical Habitats on Guam or Rota will not be affected by munitions strike.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), munitions strike on FDM under Alternative 2 will not result in significant adverse effects on terrestrial bird populations.

Testing Activities

Under Alternative 2, there are no testing activities that would involve weapons firing on land or toward land-based targets. Therefore, there would be no potential strike of wildlife or plant species from weapons firing during testing activities under Alternative 2.

3.10.3.2.3 Impacts from Ground Disturbance

This section assesses the potential of ground disturbing activities, such as vehicular and pedestrian movements as part of land navigation training and field training exercises. As shown in Table 2.8-1, these exercises may occur on Guam (Southern Land Navigation Area and Northern Land Navigation Area within Naval Base Guam Munitions Site), within Tinian MLA, within the Marpi Maneuver Area on Saipan, and north of the no-fire line on FDM (associated with direct action tactical air control training activities).

3.10.3.2.3.1 No Action Alternative

Training Activities

Under the No Action Alternative, ground disturbance could result from vehicular movements and pedestrian foot traffic as part of field training exercises, airfield seizure activities, and airfield expeditionary training activities. See Table 2.8-1 for a list of these training activities and locations within the Study Area, and the annual estimate of how many exercises would occur under the No Action Alternative.

Field training exercises would occur in areas known to support foraging swiftlets and their roosting and nesting caves. However, the Navy does not train within 328.1 ft. (100 m) of a cave entrance on Guam, and no training will occur within or near caves on Saipan. No foraging habitat (forests or grasslands in which they fly over to capture insects) will be removed due to training, and overflight restrictions are in place to minimize disturbance to fruit bats, moorhens, and swiftlets. The use of incendiary training materials is limited such that fires in forested habitats are unlikely.

On Tinian, non-ESA listed forest birds use limestone forests and tangantangan thickets within the Tinian MLA. Micronesian megapode habitat is found in relatively intact limestone forest areas and in associated edge habitats. Megapode detections are rare on Tinian, and the first megapode sighting in recent years occurred in the spring of 2013 (U.S. Department of the Navy 2013a). A subsequent survey on Tinian in the winter of 2014 did not detect megapodes. Any megapodes utilizing Tinian habitats are most likely transients. The very rare sightings of megapodes on Tinian during surveys makes any potential adverse effects unlikely. There are also a number of bird species not listed under the ESA that reside on Tinian. The rufous fantail, Micronesian starling, Tinian monarch, and bridled white-eye nest within the Tinian MLA in both tangantangan thickets and mature limestone forests found along cliffs. As

most field training exercises are expected to occur on hardened surfaces, impacts to vegetation communities and species using these areas as habitats are not expected. Some field exercises, however, may occur in tangantangan forests surrounding the airfield. Further, there are training area restrictions that prohibit military training activities in ecologically sensitive areas (e.g., Hagoi and other wetlands within the Tinian MLA), where Mariana common moorhens nest and forage, along with other native terrestrial birds, migrants, and potential Mariana fruit bats in the vegetation surrounding the wetlands and in intact limestone forests (U.S. Department of the Navy 2013a).

On Saipan, the nightingale reed-warbler and non-ESA listed forest bird species may utilize portions adjacent to or within pedestrian maneuver areas for army reserve units. Training within the Marpi tract is expected to be infrequent and limited to pedestrian land navigation training in open areas. Training restrictions during peak breeding periods (April through June and October through December) will be implemented to the maximum extent practical. Non-ESA listed forest birds described in Section 3.10.2.1.4 (Saipan Marpi Maneuver Area) will not be impacted because of the infrequent use of the area by military personnel.

On FDM, limited pedestrian traversing would occur near the helicopter landing zone, as part of direct action tactical air control training activities. Under the No Action Alternative, three direct action activities would occur on FDM. Because traversing the site would be limited between the control tower and the landing zone, it is unlikely that this limited pedestrian traffic would cause any ground disturbance or damage vegetation. Micronesian megapodes north of the no-fire line would likely experience temporary behavioral impacts (moving away from personnel), but the disturbance would likely have already occurred due to the approach and departure of the helicopter transporting the direct action personnel. Because of the limited nature of the ground disturbance activities associated with this direct action training type, and the infrequent occurrence of the activity on FDM, impacts are expected to be limited to temporary behavioral impacts with no injury or mortality to megapodes.

Pursuant to the ESA, ground disturbance resulting from land and field training exercises under the No Action Alternative will not affect the Serianthes tree, Osmoxylon mariannense, Nesogenes rotensis, Rota bridled white-eye, Guam Micronesian kingfisher, Mariana crow, Mariana common moorhen, or Mariana fruit bat. Ground disturbance may affect, but not likely adversely affect, the Mariana swiftlet, Micronesian megapode, and the nightingale reed-warbler.

Critical Habitats on Guam or Rota will not be affected by ground disturbing activities.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), ground disturbance resulting from land and field training exercises under the No Action Alternative will not result in significant adverse effects on terrestrial bird populations.

Testing Activities

Under the No Action Alternative, no testing events would occur on land or impact terrestrial species or habitats.

3.10.3.2.3.2 Alternative 1 and Alternative 2

Under both Alternatives 1 and 2, direct action trainings on FDM would increase to 18 per year. This would increase exposures of megapodes and fruit bats to pedestrian traffic; however, traversing the site would be limited to the area surrounding the helicopter landing zone, north of the “no fire line.” Because of the limited nature of the ground disturbance activities associated with this direct action

training type, and the infrequent occurrence of the activity on FDM, impacts are expected to be limited to temporary behavioral impacts with no injury or mortality to megapodes.

Pursuant to the ESA, ground disturbance resulting from land and field training exercises under Alternative 1 or Alternative 2 would have no effect on the Serianthes tree, Osmoxylon mariannense, Nesogenes rotensis, Rota bridled white-eye, Guam Micronesian kingfisher, Mariana crow, Mariana common moorhen, or Mariana fruit bat. Ground disturbance may affect, but not likely adversely affect, the Mariana swiftlet, Micronesian megapode, and the nightingale reed-warbler.

Critical Habitats on Guam or Rota will not be affected by ground disturbing activities.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), ground disturbance resulting from land and field training exercises under Alternative 1 or Alternative 2 will not result in significant adverse effects on terrestrial bird populations.

Testing Activities

There are no testing activities that involve ground disturbance; therefore, testing activities will have no impact on terrestrial species or habitats.

3.10.3.2.4 Impacts from Wildfires

This section provides an assessment of wildfire potential associated with training activities in land training areas within the Study Area, and how wildfires could impact species and habitats. There is minimal risk for training activities to start wildfires on Guam, Rota, Tinian, or Saipan. Training activities that occur here follow restrictions in COMNAVMARIANASINST 3500.4A to minimize the potential for wildfires. Live ordnance use on FDM has created burnovers of vegetation areas within the impact areas.

Training (foot and vehicle land navigation, sniper training, small field exercises) in the Northern Land Navigation Area and other areas of the Naval Base Guam Munitions Site, as well as with field training exercises within the Andersen AFB, Tinian MLA, and Saipan Marpi Maneuver Area, could start a wildfire; however, the use of incendiary training materials is limited such that fires in forested habitats are unlikely. A fire management plan was developed by the U.S. Forest Service to minimize impacts associated with wildland fires (U.S. Department of the Navy 2009). To date, no wildland fires have been ignited within the Naval Base Guam Munitions Site due to military activity. Fires that have burned areas within the Naval Base Guam Munitions Site originated off DoD properties and were generally associated with trash burning (U.S. Department of the Navy 2009). In addition, the existing configuration of firebreaks and road networks generally confines fires to upland savanna portions of the Naval Base Guam Munitions Site so they do not reach wetland habitats (U.S. Department of the Navy 2009). Wildfires on Andersen AFB are less frequent, and none have been attributed to training exercises (U.S. Department of the Navy 2009).

The Tinian MLA, particularly around Tinian North Field, is composed of large areas of tangantangan, secondary forest, and open fields. Grass fires are common on Tinian and are more likely to occur during the dry season. Most fires are intentionally lit. Fires initiated in open fields have the potential to persist when forest habitat is reached, resulting in a direct threat to federally listed species (U.S. Department of the Navy 2009). Incidental sightings of intentionally set fires have occurred in the Tinian MLA. Some speculate the fires may have been started by locals to facilitate collection of coconut crabs or scrap metal (U.S. Department of the Navy 2013a).

The potential impacts of wildfire on terrestrial species and habitats will focus on FDM, where the use of live fire and explosive munitions is authorized. Fire season should be considered year-round at FDM; 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 wildlife at FDM by changing the physical and biological characteristics of the area, which subsequently degrades habitats and reduces the forage base. Physical features that will be exposed to heat and flames include soil structure and microclimate conditions. Fire has been shown to increase soil temperatures, alter soil moisture holding capacity, and modify soil rainfall infiltration (Neary et al. 2005). These physical features are indirectly exposed to post-fire erosion and alterations of light and shade, temperature, humidity, and wind as a result of vegetation destruction. 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 invasion may occur following removal of shrub and tree canopy (D'Antonio and Vitousek 1992; Tunison et al. 2001). Chemical features that will be exposed to heat, flames, smoke, and ash include soil nutrients and water, which will be indirectly exposed to post-fire changes in content and cycling rates. Soil nutrient availability will be altered through volatilization of certain elements to the atmosphere in smoke (e.g., carbon, nitrogen, and sulfur), conversion to more available forms in the ash (e.g., potassium, phosphorus, and divalent cations), wind dispersal of the ash, and surface erosion (Agee 1993).

Biotic features of the habitat that will be exposed to heat, flames, smoke, and ash include all living organisms in the exposure area, litter layers on the forest floor, organic matter within the surface soil horizon, and seeds within the litter and surface soil. These types of organic matter are typically used in megapode nests for incubation of eggs via heat from decomposition. Forage organisms will be directly exposed to injury or death, and seeds, litter, and organic matter will be directly exposed to destruction and loss (Cochrane 2003). These effects, in turn, will indirectly expose soil to long-term changes in fertility and structure as a result of disrupted decomposition and nutrient cycling processes, reduced nutrient and water retention by organic matter, increased nutrient losses in runoff and leaching, and reduced ecosystem primary production due to loss of leaf area and photosynthesis (Cochrane 2003).

As discussed in Section 3.10.2.1.5 (Farallon de Medinilla) and evidenced in Figure 3.10-4, military bombardment has reduced forested portions of FDM, primarily within impact areas. Forests can continue to degrade as ground cover loses canopy closure, thereby reducing fuel moisture content in vegetation and facilitating fires spreading into areas outside the impact areas. Further, invasive herbaceous vegetation can quickly colonize the newly opened habitats, which increases fine fuel loading and the ability of fires to spread. 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 to 50 fresh bomb craters and a large section of the island burned to bare earth (Lusk et al. 2000; U.S. Fish and Wildlife Service 1998).

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 terrestrial birds and tree nesting seabirds (Lusk et al. 2000).

3.10.3.2.4.1 No Action Alternative, Alternative 1, and Alternative 2

Training Activities

Training activities that involve high 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 Proposed Action and Alternatives). Although the use of ordnance with high explosives increases from the No Action Alternative to Alternative 1, and from the No Action Alternative to Alternative 2, the potential for wildfire is the same for all alternatives.

Cluster bombs, live cluster weapons, live scatterable munitions, fuel-air explosives, incendiary devices, and bombs greater than 2,000 lb. are prohibited on FDM. It should be noted that some munitions contain a small amount of phosphorous for spotting charges, and smoke markers are used in some direct action training activities. Phosphorous is not a main constituent to any munitions used on FDM. The live-fire weapons allowed are only used in impact areas authorized for live and inert ordnance. The areas for target placement only support low growing vegetation because of long-term training with explosives. Due to the lack of fuels in the area, explosions have not resulted in wildfires. Dense vegetation grows on the northern portion of the island within the special use area, which could create a wildfire if weapons are misfired. However, this dense vegetation and shaded canopy of trees in the northern portion of the island likely increases the moisture content of vegetation, thereby decreasing the ability of fires to spread into the special use area.

Mariana fruit bat sightings are very rare on FDM—the last sighting, of a single fruit bat, was reported in 2008 (U.S. Department of the Navy 2013a). Catastrophic events within the Mariana archipelago may temporarily cause populations of fruit bats to fluctuate on different islands, although some movement between islands seems to be a natural occurrence. These events may result from typhoons, poaching, or volcanic eruptions. Catastrophic events and other factors may cause Mariana fruit bat populations on FDM to temporarily increase, thereby exposing transient and permanent resident bats to potential harassment and harm associated with live-fire training. FDM may support a small number of year-round residents, and Mariana fruit bats can be assumed to utilize FDM as a resting point for longer inter-island movements. Due to infrequent transient use of FDM by Mariana fruit bats, and the location of likely foraging and roosts confined to the northern portion of the island (within the special use area), impacts associated with wildfires occurring primarily in the central portion of the island would be unlikely.

As described above, munitions use on FDM can ignite wildfires. Wildfire intensity may vary based on the amount and type of munitions, wind speed, levels of humidity, seasonal variation in vegetation thickness and composition, and successional state of vegetation. Micronesian megapodes on FDM would be expected to fly away from smoke, but exposure to smoke inhalation would result in some form of respiratory distress (U.S. Fish and Wildlife Service 2010a). Direct mortality of megapodes could result from intensive respiratory distress or encirclement of burning vegetation. Megapode eggs, even in burrows, would not likely survive a wildfire overburn on FDM. Likewise, any fledglings within a burn area would be expected to suffer intensive respiratory distress, unable to flee smoke or burning vegetation. As stated above, fires are unlikely to spread to the northern portion of FDM; therefore, the northern

portion of the island would continue to serve as refugia for Micronesian megapodes that either reside in this area or for megapodes able to flee smoke and flames from target areas.

Pursuant to the ESA, wildfires resulting from explosive munitions and bombardment of FDM under the No Action Alternative, Alternative 1 or Alternative 2 will not affect the Serianthes tree, Osmoxylon mariannense, Nesogenes rotensis, Rota bridled white-eye, Guam Micronesian kingfisher, Mariana crow, Mariana common moorhen, Mariana swiftlet, or nightingale reed-warbler. Wildfires may affect, but not adversely affect the Mariana fruit bat. Wildfires may affect and are likely to adversely affect, Micronesian megapodes on FDM.

Critical Habitats on Guam or Rota will not be affected by wildfires.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), wildfires resulting from explosive munitions and bombardment of FDM under the No Action Alternative, Alternative 1 or Alternative 2 will not result in significant adverse effects on terrestrial bird populations.

Testing Activities

No testing activities are included under the No Action Alternative. No testing activities for Alternative 1 or Alternative 2 involve munitions use at FDM. There are no impacts to terrestrial species and habitats from testing activities that use munitions.

3.10.3.3 Secondary Stressors

This section summarizes how secondary stressors (stressors that are not directly part of activities) can potentially impact terrestrial habitats and species. Specifically, this section addresses the potential of water quality stressors, air quality stressors, and for training activities to degrade island habitats within the Marianas through the accidental introduction of invasive species. Section 3.10.3.3.1 (Impacts from Invasive Species Introductions) discusses potential introduction pathways of invasive species associated with training activities described in this EIS/OEIS.

3.10.3.3.1 Impacts from Invasive Species Introductions

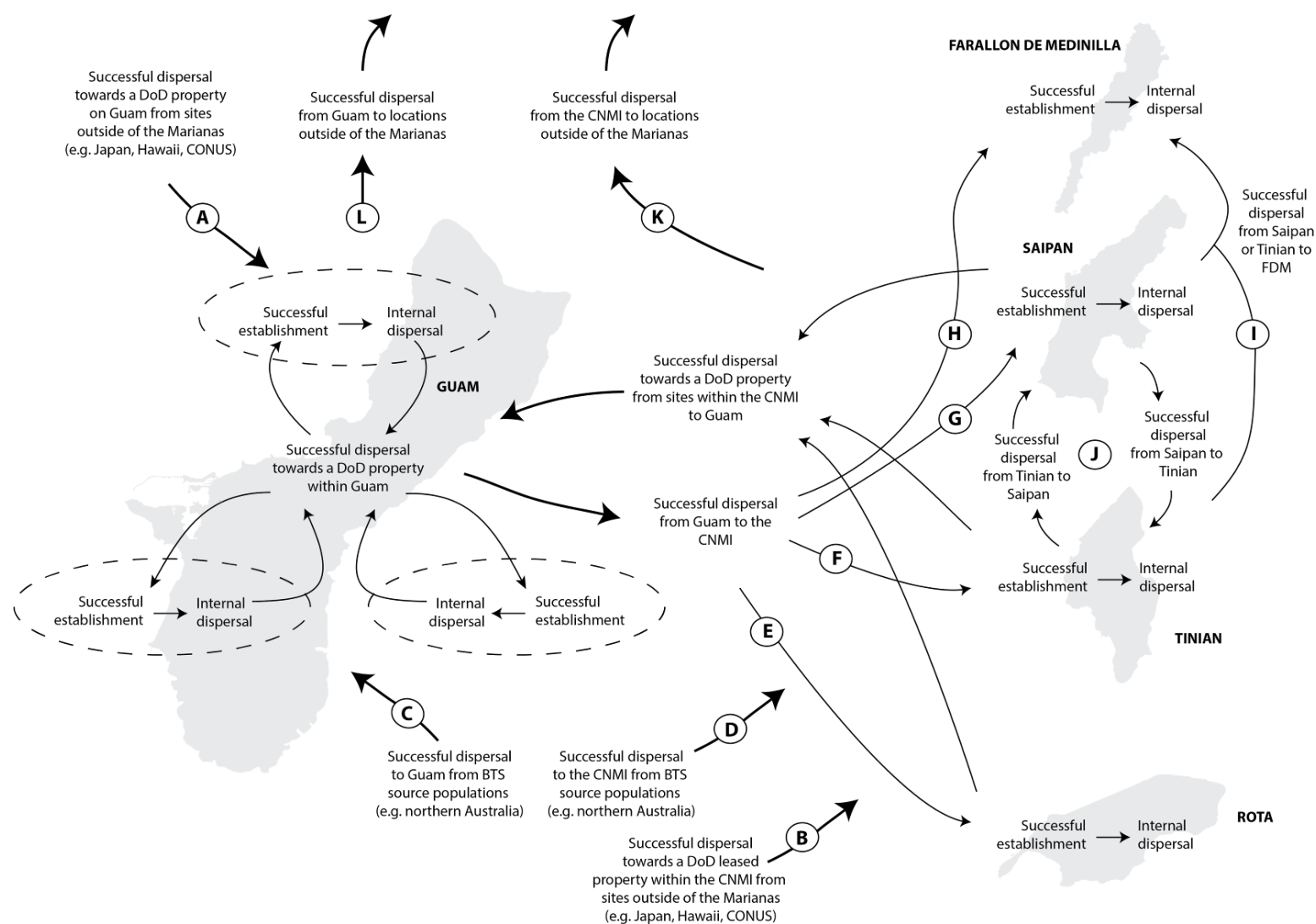
In general, a species introduction to terrestrial environments on Guam and the CNMI may be described in stages. First, species established in other areas or from their native ranges enter into dispersal pathways. As an example, pathways may include transportation modes (such as landing gear of airplanes or within cabin or cargo holds) or commercial pathways (trade in seeds, plant material, or animals). A second stage of the invasion process is the live release of species which, depending on the mode of introduction, is important because most species do not survive the transport (Thompson and Davis 2011). A third stage of invasion is that populations of species establish and adapt to new environments (Davis 2009). Figure 3.10-10 shows the general steps involved in the establishment and spread of invasive species associated with military training in the Marianas.

Pathways of invasive species associated with military training activities include various transport modes, such as marine transport (e.g., ballast water releases, biofouling of ship hulls), air transport (organisms transported in aircraft cabins, cargo holds, or landing gear), or land transports during intra-island movements (e.g., transporting of organisms from one training area to another attached to unclean vehicles). Personnel movements can also present introduction pathways. For instance, organisms (such as seed or other plant materials) can be transported on clothing or in gear. Figure 3.10-11 shows the potential introduction pathways of invasive species to terrestrial habitats associated with each warfare area identified in Chapter 2 (Description of Proposed Action and Alternatives).

Introduction pathways that originate on Guam and end on Rota, Tinian, Saipan, FDM, and other locations outside of the Mariana Islands present a potential hazard for brown treesnake dispersal. Also, pathways that carry equipment, material, munitions, and personnel from northern Australia to the Mariana Islands also present a potential danger for brown treesnake introduction. The Brown Tree Snake Control and Interdiction Requirements is included in the COMNAVMARIANASINST 3500.4A (dated 8 October 2013). This document describes roles and responsibilities for exercise planners to interdict and control brown treesnakes and to disseminate information to participants throughout the chain of command. Other policies and instructions associated with military training activities and potential invasive species introductions include Office of the Chief of Naval Operations Instruction 5090.1D (updated in 2013), Armed Forces Pest Management Board Technical Guide 31 (Armed Forces Pest Management Board 2012). Table 3.10-7 provides descriptions of potential invasive species pathways shown in Figure 3.10-10, as well as countermeasures and policies to reduce the number of potential species within pathways or to eliminate the potential for introduction through interdiction. In general, the military's strategy for addressing invasive species issues within the Marianas includes analyses of critical control points along potential introduction pathways, coordination with local and regional stakeholders, authoring exercise-specific interdiction plans, funding research for landscape-level control of invasive species (e.g., aerial bait drops for brown treesnake control), and regional participation in biosecurity planning.

The Navy cooperates with the USFWS, the U.S. Department of Agriculture Animal and Plant Health Inspection Service, and the U.S. Department of Agriculture Wildlife Services, as well as other government agencies and working groups to identify pathways associated with military activities in the Marianas. After identifying pathways associated with a particular activity, risks are reduced by implementing policies and procedures to reduce the likelihood of species to occur within a particular introduction pathway. For instance, all troops involved in training activities in land areas of the Study Area conduct self inspections to avoid potential introductions of invasive species to Guam and the CNMI. Troops inspect all gear and clothing (e.g., boots, bags, weapons, and pants) for soil accumulations, seeds, invertebrates, and possible inconspicuous stowaway brown treesnakes). The intent of this measure is to minimize the number of potentially invasive species in introduction pathways (U.S. Department of the Navy 2009; U.S. Fish and Wildlife Service 2010a).

The Navy also complies with DoD Transportation Regulations, Chapter 505 protocols, by implementing a 100 percent inspection of all outgoing vessels and aircraft with dog detection teams to meet 100 percent inspection goals for large-scale training activities (U.S. Department of Defense 2011). To mitigate the limited inspection capability of the U.S. Department of Agriculture Wildlife Service, the Navy notifies point of destination port or airport authorities in the event military units, vehicles, and equipment leave Guam without inspection.



Notes: CNMI = Commonwealth of the Northern Mariana Islands. DoD = Department of Defense. Arrows represent conceptual introduction pathways. Letters correspond to descriptions provided in Table 3.10-7. Islands are not drawn to scale.

Figure 3.10-10: Conceptual Model of Potential Invasive Species Pathways Associated with Military Training Activities

Table 3.10-7: Description of Potential Invasive Species Pathways and Interdiction Measures

Potential Introduction Pathway				Interdiction or Prevention Measure ⁴
Origin and Destination	Letter ¹	Pathway Description ²	Brown Treesnake Pathway? ³	
Outside of the Mariana Islands to Guam	A	All personnel pathways and transport modes.	No	Policy described in OPNAVINST 5090.1D Chapter 22-10.3 (ballast water), 5090.1D Chapter 22-13.2.1.2 (hull husbandry), and 5090.1D Chapter 24 (invasive plants, pest, and animal protocols). Adherence with AFPMB Technical Guide 31 protocols on vehicle/equipment washdown procedures and other APHIS PPQ inspection procedures for deployments and redeployments.
Outside of the Marianas to CNMI	B		No	
Northern Australia to Guam	C		Yes	
Northern Australia to CNMI	D		Yes	
Guam to Rota	E	All personnel pathways and some transport modes (e.g., ballast water, hull husbandry, food stores, landing gear, cabin and cargo holds).	Yes	Funding USDA-WS for interdiction of BTS at NBG Main Base and Andersen AFB (e.g., BTS trapping at piers, wharfs, flight lines) with goal of 100% inspections departing Guam. JRM funds interdiction at both installations. Coordination with appropriate regional stakeholders for exercise-specific measures, including redundant inspections on Rota, Tinian, and Saipan. Development of exercise-specific BTS interdiction implementation plans when exercises require transport of assets and personnel from Guam to CNMI. Funding of landscape-level research and pilot projects for BTS source population control on Guam.
Guam to Tinian	F	All personnel pathways and transport modes.	Yes	
Guam to Saipan	G	All personnel pathways and transport modes.	Yes	
Guam to FDM	H	Some personnel pathways (e.g., training gear, humans as disease vectors, consumables), and some transportation modes (helicopter cabins).	Yes	
Tinian/Saipan to FDM	I		No	5090.1D Chapter 24 (invasive plants, pest, and animal protocols).

Table 3.10-7: Description of Potential Invasive Species Pathways and Interdiction Measures (continued)

Potential Introduction Pathway				Interdiction or Prevention Measure ⁴
Origin and Destination	Letter ¹	Pathway Description ²	Brown Treesnake Pathway? ³	
Saipan to/from Tinian	J	All personnel pathways and transport modes.	No	OPNAVINST 5090.1D Chapter 24 (invasive plants, pest, and animal protocols).
CNMI to locations outside of Mariana Islands	K		No	Same as pathway A and B.
Guam to locations outside of the Marianas	L		Yes	Funding interdiction of BTS on DoD lands (e.g., BTS trapping at piers, wharfs, flight lines) with goal of 100% inspections departing Guam. Funding of landscape-level research and pilot projects for BTS source population control on Guam.

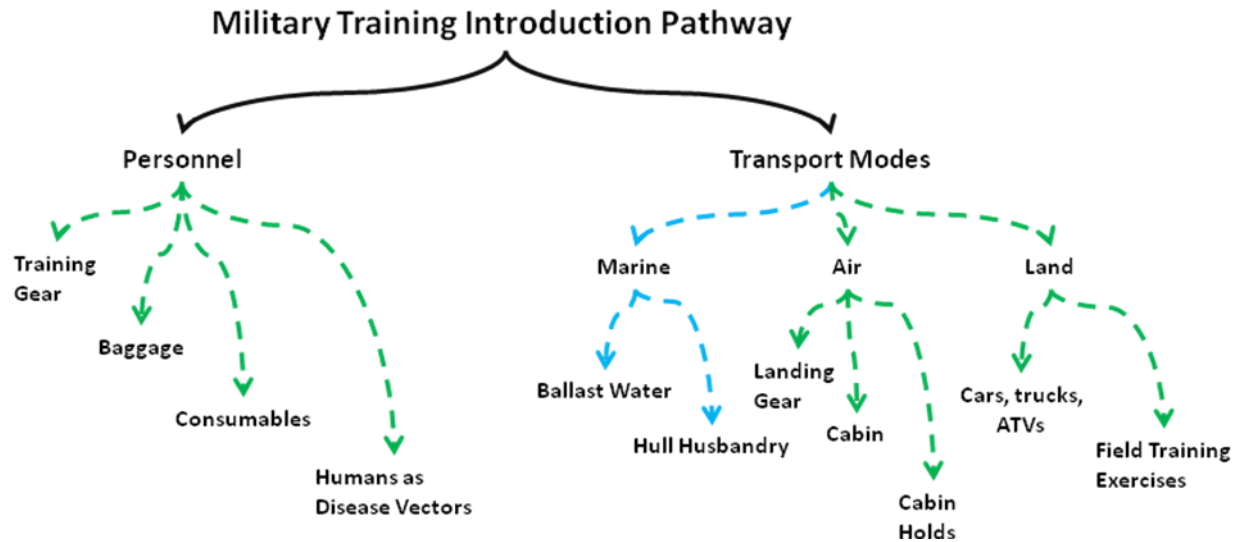
¹ Introduction pathway letter corresponds to the conceptual map of potential pathways shown in Figure 3.10-10.

² Pathway description corresponds to potential pathway diagram from military training activities shown in Figure 3.10-11.

³ Only pathways originating from Guam or from northern Australia are considered potential pathways for brown treesnake dispersal.

⁴ Interdiction and control measures for brown treesnakes are included in Commander, U.S. Naval Forces Marianas Instruction 3500.4A. The JRM INRMP addresses brown treesnake control for conservation purposes.

Notes: AFPMB = Armed Forces Pest Management Board, BTS = brown treesnake, CNMI = Commonwealth of the Northern Mariana Islands, DoD = Department of Defense, FDM = Farallon de Medinilla, INRMP = Integrated Natural Resources Management Plan, JRM = Joint Region Marianas, NBG = Naval Base Guam, OPNAVINST = Office of the Chief of Naval Operations Instruction



Source: Adapted from Lodge et al. (2006)

Figure 3.10-11: Potential Introduction Pathways of Invasive Species Associated with Military Training in the Marianas

In addition, the Navy routes inbound personnel and cargo for tactical approach exercises that require an uninterrupted flow of events direct to CNMI training locations to avoid Guam seaports and airfields to the extent possible. For example, a Hawaii-based unit destined to Tinian for anti-terrorism/urban warfare type training will travel direct to Tinian and only through Guam on the outbound journey.

Further, the Navy provides extensive funding for brown treesnake eradication efforts and research by other agencies. The Navy is also establishing quarantine areas for outbound cargo traveling from Guam to CNMI and locations outside the MITT Study Area.

3.10.3.3.1.1 No Action Alternative, Alternative 1, and Alternative 2

Training Activities

The No Action Alternative, Alternative 1, and Alternative 2 do not introduce additional pathways for invasive species to enter, establish, and spread from DoD installations and ranges within the Study Area. Further, protective biosecurity measures employed by the Navy reduce the number of invasive species within existing potential introduction pathways. In conclusion, training activities under the No Action Alternative, Alternative 1, or Alternative 2 would not increase risks to vegetation communities, wildlife resources, or ESA-listed species or habitats within the Study Area.

Pursuant to the ESA, secondary stressors associated with the potential introduction of invasive species to terrestrial habitats resulting from training activities under the No Action Alternative, Alternative 1, or Alternative 2 will not affect the Serianthes tree, Osmoxylon mariannense, Nesogenes rotensis, Rota bridled white-eye, Guam Micronesian kingfisher, Mariana crow, Mariana common moorhen, Mariana fruit bat, Mariana swiftlet, nightingale reed-warbler, or Micronesian megapode.

Secondary stressors will not affect Critical Habitats on Guam or Rota.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), secondary stressors associated with the potential introduction of invasive species to terrestrial habitats resulting from training activities under the No Action Alternative, Alternative 1, or Alternative 2 will not result in significant adverse effects on terrestrial bird populations.

Testing Activities

Because there are no testing activities associated with land-based training, testing activities would not introduce secondary stressors in terrestrial habitats and would not impact terrestrial biological resources.

3.10.3.3.2 Impacts from Water and Air Quality Stressors

The potential for water and air quality stressors associated with training and testing activities to indirectly affect terrestrial biological resources as secondary stressors were analyzed. The assessment of potential water and air quality stressors are in Section 3.1 (Sediments and Water Quality) and Section 3.2 (Air Quality); the assessment addresses specific activities in local environments that may affect terrestrial species and habitats.

3.10.3.3.2.1 No Action Alternative, Alternative 1, and Alternative 2

Training Activities

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 on Guam, Rota, Tinian, and Saipan would not adversely affect sediments, water, or air quality. Therefore, military activities would not indirectly impact terrestrial species or habitats on these islands. Within impact areas on FDM where explosive munitions are permitted, further erosion of soils may inhibit the long-term establishment of vegetation. The degradation of habitat associated with secondary stressors, therefore, may limit the natural succession of vegetation establishment if military use of FDM ceases in the future. Limiting the ability of damaged areas to recover would limit the recovery potential of the Micronesian megapode on FDM.

Pursuant to the ESA, secondary stressors associated with impacts to water and air quality resulting from training activities under the No Action Alternative, Alternative 1, or Alternative 2 will not affect the Serianthes tree, Osmoxylon mariannense, Nesogenes rotensis, Rota bridled white-eye, Guam Micronesian kingfisher, Mariana crow, Mariana common moorhen, Mariana swiftlet, nightingale reed-warbler, or Micronesian megapode. Secondary stressors may affect and are likely to adversely affect, Micronesian megapodes on FDM.

Secondary stressors will not affect Critical Habitats on Guam or Rota.

Under the MBTA regulations applicable to military readiness activities (50 C.F.R. Part 21), secondary stressors associated with impacts to water and air quality resulting from training activities under the No Action Alternative, Alternative 1, or Alternative 2 will not result in significant adverse effects on terrestrial bird populations.

Testing Activities

Because there are no testing activities associated with land-based training, testing activities would not introduce secondary stressors in terrestrial habitats and would not impact terrestrial biological resources.

3.10.4 SUMMARY OF POTENTIAL IMPACTS ON TERRESTRIAL SPECIES AND HABITATS

3.10.4.1 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 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 are summarized in Section 3.10.4.2 (Endangered Species Act Determinations).

There are generally two ways a terrestrial biological resource could be exposed to multiple stressors. The first would be if, for example, an animal 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 from each of the stressors and the response or lack of response to that stressor. Most activities as described in the Proposed Action involve multiple stressors; therefore, it is likely that if a receptor were within the potential impact range of those activities, it 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 animal 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., air to ground ordnance drops at FDM, aircraft take offs and landings at Andersen AFB, and routine activity locations) and in areas that individual animals frequent because it is within the animal's home range, migratory route, breeding area, or foraging area. Except for 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 animal would be exposed to stressors from multiple activities. However, animals with a small home range intersecting an area of concentrated military 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 has 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, terrestrial animals 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. Animals 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 military stressors, the synergistic impacts from the combination of military stressors on terrestrial animals 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). Potential impacts anticipated from the Proposed Action are summarized in Section 3.10.4.2 (Endangered Species Act Determinations).

3.10.4.2 Endangered Species Act Determinations

Based on the type of activities in the various land training areas of the MITT Study Area, the Navy presents the following summary of effects determinations to ESA-listed species and Critical Habitats.

3.10.4.2.1 Critical Habitats

3.10.4.2.1.1 Critical Habitats on Guam

Critical Habitat designations on Guam for the Mariana crow, Mariana fruit bat, and Micronesian kingfisher are confined to the terrestrial portions of the Guam National Wildlife Refuge fee simple portion (Ritidian Unit). Because training does not occur within the Ritidian Unit and there is no need for training to access the portion of the road that descends Ritidian Cliff to the Ritidian Unit, the Navy concludes that training and testing activities would have no effect on designated Critical Habitat on Guam.

3.10.4.2.1.2 Critical Habitats on Rota

Critical Habitat designations on Rota for the Mariana crow and Rota bridled white-eye occur entirely within areas where the Navy does not train; therefore, the Proposed Action would have no effect on or result in an adverse modification to the designated Critical Habitat units on Rota and would not disturb the various primary constituent elements. The Navy concludes that the designated Critical Habitat avoidance, invasive species interdiction, and control measures (described in Chapter 5) are sufficient to not affect designated Critical Habitat on Rota.

3.10.4.2.2 Summary of Endangered Species Act Effects Determinations

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. The Biological Opinion concluded that training activities within the Study Area would have no effect on the *Serianthes nelsonii*, *Osmoxylon mariannense*, *Nesogenes rotensis*, Guam Micronesian kingfisher, Guam rail, Mariana crow, Rota bridled white-eye, or critical habitat units on Guam and Rota. The Biological Opinion also concluded that training activities may affect, but are not likely to adversely affect, the nightingale reed warbler, Mariana swiftlet, and Mariana common moorhen. The Biological Opinion concluded that training activities may

affect, and are likely to adversely affect, the Micronesian megapode and the Mariana fruit bat. The Action Area (the area considered in the Section 7 ESA consultation, subject to direct and indirect effects) for the Biological Opinion issued by the USFWS in 2010 is the same area considered for analysis in this EIS/OEIS. 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. Table 3.10-8 summarizes the ESA determinations for each substressor analyzed in this EIS/OEIS.

The Navy also conducted an analysis of potential effects for species considered to be candidates for ESA listing. These species include the 22 species included in the USFWS Federal Register publication in September 2014. These species do not co-occur with military training activities described in this EIS/OEIS, either because the species has been extirpated from military training areas or because the species is confined to habitats within military properties or lease areas where training does not occur. Therefore, military training activities described in this EIS/OEIS will have no effect on species considered to be candidates for ESA listing.

3.10.4.3 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 terrestrial birds that occur in the Study Area, the Navy carried out a focused analysis for native land birds known to breed within the Study Area.

Pursuant with the DoD's obligations under 50 C.F.R. Part 21, the DoD will continue to implement training restrictions on FDM (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 National Resources Management Plan specifically designed to benefit native terrestrial birds (U.S. Department of the Navy 2013a).

Table 3.10-8: Summary of Endangered Species Act Effects Determinations for Endangered Species Act-Listed Terrestrial Species

Navy Activities and Stressors	Hayun Lagu (<i>Serianthes</i> tree)	Ko'ko' (Guam rail)	Sihek (Guam Micronesian kingfisher)	Pulattat (Mariana common moorhen)	Aga (Mariana crow)	Fanihi (Mariana fruit bat)	Yayaguak (Mariana swiftlet)	Sasangat (Micronesian megapode)	Ga'ga' Karisu (nightingale reed-warbler)	Nosa Luta (Rota bridled white-eye)
Acoustic Stressors										
Explosives, weapons firing, launch, and impact noise	NE	NE	NE	NE	NE	LAA	NE	LAA	NE	NE
Aircraft noise	NE	NE	NE	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NE
Physical Stressors										
Aircraft and aerial target strike	NE	NE	NE	NLAA	NE	LAA	NE	LAA	NE	NE
Military expended materials	NE	NE	NE	NE	NE	NLAA	NE	LAA	NE	NE
Ground disturbance	NE	NE	NE	NE	NE	NE	NLAA	LAA	NLAA	NE
Wildfires	NE	NE	NE	NE	NE	LAA	NE	LAA	NE	NE

Notes: NE = No effect; NLAA = May affect, not likely to adversely affect; LAA = May affect, likely to adversely affect

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