

3.9 TERRESTRIAL BIOLOGY

This section describes the existing conditions of the terrestrial biological resources on Tinian and Pagan. The analysis of terrestrial biological resources focuses on species and vegetation communities crucial to the functions of biological systems, of special public importance, or that are protected under federal or local law or statute. When species are mentioned for the first time in this section they are listed using the common name followed by the scientific name in parentheses; thereafter, only the common name is used. If there is no accepted English common name, then only the scientific name is used. Appendix L, *Biological Resources Supporting Documentation* identifies the Chamorro and Carolinian names where applicable and provides more detailed information on selected species of interest found on Tinian and Pagan.

The region of influence for terrestrial biology includes the northern portion of the Tinian International Airport, the Military Lease Area on Tinian, and the entirety of Pagan.

3.9.1 Definition

For the purposes of this document, terrestrial biology is divided into three categories: vegetation communities, wildlife, and special-status species.

3.9.1.1 Vegetation Communities

Vegetation communities include dominant plant species that occur within the project areas. Unvegetated, disturbed, and/or developed habitats are also discussed in this section. Vegetation communities were mapped and described in vegetation assessments or survey reports and delineated by either analysis of imagery, field observations, or a combination of these two methods. For Tinian, the vegetation community categories generally follow those defined by the U.S. Forest Service in their CNMI vegetation mapping project using high resolution aerial imagery (U.S. Forest Service 2006). For Pagan, the vegetation community categories generally follow those defined by Rogers (2010) during island-wide landcover mapping using aerial imagery, followed by ground-truthing at points within some of the delineated vegetation communities. Some category names were modified to make vegetation community names consistent for both Tinian and Pagan.

3.9.1.2 Wildlife

The wildlife section includes all common animal species: birds, mammals, reptiles, amphibians, and invertebrates. The discussion is subdivided into native and non-native species. Brief descriptions and life history information for wildlife species of special interest are detailed in Appendix L, *Biological Resources Supporting Documentation*.

3.9.1.3 Special-status Species

Special-status species include: (1) those listed as threatened or endangered under the federal Endangered Species Act that currently occur in the wild on Tinian or Pagan, (2) species proposed for listing under the federal Endangered Species Act, (3) species protected under the Migratory Bird Treaty Act, (4) those designated by legislative authority in the CNMI as threatened and endangered, and (5)

Species of Special Conservation Need as identified in the CNMI's Comprehensive Wildlife Conservation Strategy. Brief descriptions and life history information for Endangered Species Act-listed and proposed species and CNMI-listed species are detailed in Appendix L, *Biological Resources Supporting Documentation*.

3.9.2 Regulatory Framework

A variety of laws, regulations, executive orders, plans, and policies, such as the Endangered Species Act and the Migratory Bird Treaty Act, are applicable to the proposed action and alternatives for terrestrial biology.

- Federal Endangered Species Act (16 U.S. Code §§ 1531–1544)
- Migratory Bird Treaty Act (16 U.S. Code §§ 703–712)
- Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds
- Executive Order 13112, Invasive Species

These are described in detail in Appendix E, *Applicable Federal and Local Regulations*.

3.9.3 Methodology

3.9.3.1 Study Areas

Project-specific biological surveys for the following species or groups were conducted within study areas on Tinian that lacked sufficient or current data to evaluate potential impacts from proposed activities described in this EIS/OEIS: federally endangered Mariana common moorhen (*Gallinula chloropus guami*) and Micronesian megapode (*Megapodius laperouse laperouse*); native birds, including those protected under the Migratory Bird Treaty Act; and species proposed for listing under the Endangered Species Act (e.g., tree snails) (DoN 2014a). Surveys were conducted at representative locations (i.e., study areas) within the region of influence, and findings from these locations are assumed to be representative of other areas not surveyed that possess similar habitat attributes. The survey report is presented in Appendix L, *Biological Resources Supporting Documentation*, and provides figures depicting the individual study areas for each species surveyed. Previous survey reports by the DoN and U.S. Fish and Wildlife Service were also used to assess the status and presence of additional biological resources on Tinian and Pagan (e.g., Mariana fruit bat [*Pteropus mariannus mariannus*] and nesting sea turtles; see [Table 3.9-1](#) and [Section 3.9.3.2](#), *Data Sources and Surveys*).

3.9.3.2 Data Sources and Surveys

Various biological surveys, which have been conducted in the study areas within the region of influence, were used as key sources of information for this section. These sources include the *Terrestrial Resource Surveys of Tinian and Aguiguan, Mariana Islands, 2008* (U.S. Fish and Wildlife Service 2009); *Marianas Expedition Wildlife Surveys 2010* (U.S. Fish and Wildlife Service 2010); *Update of Integrated Natural Resources Management Plan for Navy Leased Lands on Tinian and Farallon de Medinilla* (DoN 2010a); *Final Joint Region Marianas Integrated Natural Resources Management Plan* (DoN 2013a); *Survey Report: Terrestrial Biological Surveys on Tinian in Support of the Commonwealth of the Northern Mariana Islands Joint Military Training Environmental Impact Statement/Overseas Environmental Impact Statement* (DoN 2014a); EISs, Environmental Assessments, Biological Assessments, and resulting U.S.

Fish and Wildlife Service Biological Opinions for previous actions on military lands on Tinian; and internal DoN field survey reports. In addition to the numerous DoN surveys, site-specific natural resources Geographic Information System data for the region of influence were obtained from the U.S. Fish and Wildlife Service as of August 2013. A summary of terrestrial biological field studies conducted on Tinian and Pagan is provided in [Table 3.9-1](#).

Table 3.9-1. Terrestrial Biology Field Studies on Tinian and Pagan

Resource	Location	
	Tinian	Pagan
Vegetation	✓	✓
Wetlands	#	✓
Birds	✓, #	✓
Land mammals	✓	✓
Reptiles and amphibians	✓	✓
Federal Endangered Species Act-Listed Species		
Mariana common moorhen	✓, #	✓
Micronesian megapode	✓, #	✓
Mariana fruit bat	✓	✓
Sea turtles (nesting beaches)	✓	✓
Species Proposed for listing under the Federal Endangered Species Act		
Tree snails	✓, #	✓
Butterflies	✓	✓

Legend: ✓ = previous surveys and other data sources.

= surveys conducted for this EIS/OEIS (DoN 2014a); see Appendix L, *Biological Resources Supporting Documentation*.

3.9.4 Tinian

3.9.4.1 Vegetation Communities

Early reports of Tinian dating from the 1700s describe the island as having predominately limestone forest supporting trees such as *Pisonia grandis*, *Cerbera dilatata*, and *Guamia mariannae*. Tinian's native vegetation composition was largely impacted by agricultural and military use of the island, which began in the early 1800s and continued through World War II. In the 1920s, large sections of land were cleared by the Japanese to support sugarcane (*Saccharum* spp.) production. These fields were abandoned in the 1940s during World War II (Mueller-Dombois and Fosberg 1998). Aerial photographs reveal that World War II bombing, fires, and military reconstruction during and after the war significantly reduced the amount of native limestone forest on Tinian, and once-forested areas not under cultivation were susceptible to encroachment of the introduced non-native tangantangan (*Leucaena leucocephala*). Native limestone forests that once dominated the island were reduced to approximately 5% of the total vegetation cover (Camp et al. 2012; DoN 2013b).

Island-wide vegetation mapping was conducted in 2006 by the U.S. Forest Service (2006), and was updated in 2009 by the U.S. Fish and Wildlife Service (Amidon 2009) ([Table 3.9-2](#) and [Figure 3.9-1](#)). The 2009 vegetation assessment of Tinian noted that since the 1980s, the coverage of open fields decreased 11.6% while secondary forest coverage increased 10.3%, likely a result of succession as open areas became reforested over the previous two decades. Smaller changes included a decrease in tangantangan and an increase in urban land cover (Amidon 2009).

Table 3.9-2. Tinian Vegetation Communities (acres)

Vegetation Community	Military Lease Area	Non-Military Lease Area	Total
Native Limestone Forest	391.3	964.4	1,355.7
Mixed Introduced Forest	4,647.5	2,176.4	6,823.9
Tangantangan	5,988.1	2,446.1	8,434.2
Herbaceous-Scrub	2,921.8	1,885.1	4,806.9
Casuarina Forest	296.4	54.7	351.1
Coconut Forest	32.1	65.8	97.9
Beach Strand	394.7	156.3	551.0
Wetlands*	33.7	31.2	64.9
Agriculture	2.5	329.2	331.7
Barren (soil, sand, or rock)	65.1	134.8	199.9
Developed Land	536.1	1,433.1	1,969.2
Total	15,309.3	9,677.1	24,986.4

Note: *The term wetlands refers to the habitat type and is not meant to infer a jurisdictional determination of wetlands as defined under the Clean Water Act.

Source: Amidon 2009.

The following vegetation community descriptions are summarized from Falanruw et al. (1989) to provide a systematic and consistent vegetation classification for discussing vegetation communities on Tinian.

3.9.4.1.1 Native Limestone Forest

Native limestone forest has been significantly reduced on Tinian due to past activities, including widespread cultivation of non-native species (e.g., sugar cane), activities during World War II, intentional and accidental introduction of non-native plants and animals, and grazing by non-native ungulates. Limestone forests on Tinian are important because they retain the functional ecological components of native forest that provide habitat for the majority of Tinian’s native species, including Endangered Species Act-listed and proposed species, and CNMI-listed species, as well as bird species protected under the Migratory Bird Treaty Act. These forests also help maintain water quality and reduce fire risk. Non-native plant species (e.g., tangantangan) significantly alter the native forest structure, composition, and resilience of the forest to other disturbances and also provide less suitable conditions for native flora and fauna species than a native forest (Morton et al. 2000; Tang et al. 2011; DoN 2013b).

The few areas of native limestone forest remaining on Tinian within the Military Lease Area occur along cliff lines near Mount Lasso, around the northern escarpment of Maga, above and to the south-southeast of Unai Masalok, and in the southwestern section of the International Broadcasting Bureau site ([Figure 3.9-1](#)). This vegetation community harbors native trees such as *Cynometra ramiflora*, *Neisosperma oppositifolia*, *Cerbera dilatata*, *Psychotria* spp., *Eugenia* spp., *Guamia mariannae*, Pandanus (*Pandanus* spp.), coral tree (*Erythrina variegata* var. *orientalis*), banyan tree (*Ficus prolixa*), *Pisonia grandis*, and tropical almond (*Terminalia catappa*).

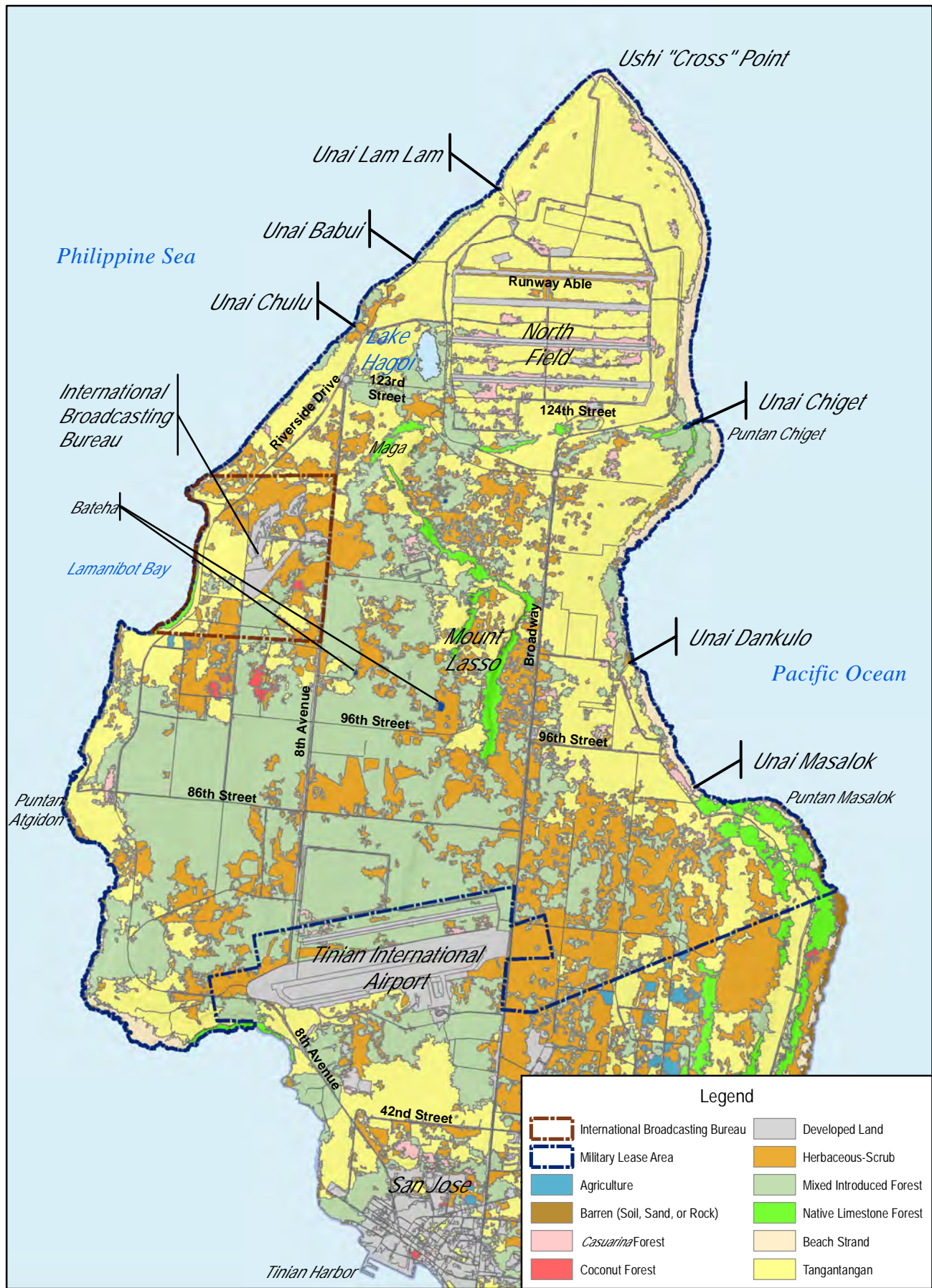


Figure 3.9-1
Vegetation Communities - Tinian Military Lease Area

3.9.4.1.2 Mixed Introduced Forest

Mixed introduced forest, also referred to as secondary forest, contains a mixture of introduced trees, shrubs, and dense herbaceous plants. Dominant trees common in this vegetation community include tangantangan, ironwood (*Casuarina equisetifolia*), siris tree (*Albizia lebbek*), Formosan koa (*Acacia confusa*), flame tree (*Delonix regia*), and Madras thorn (*Pithecellobium dulce*). While not considered a native vegetation community on Tinian, the mixed introduced forest community provides habitat for the federal Endangered Species Act-listed and proposed species and CNMI-listed species as well as for other native bird species, including those protected under the Migratory Bird Treaty Act.

3.9.4.1.3 Tangantangan

This vegetation community typically occurs on limestone and is dominated by the non-native tangantangan tree. Tangantangan forests dominate much of the level and moderately sloping lowland habitat areas on Tinian, especially in the northern portions of the island. While not considered a native vegetation community on Tinian, tangantangan forest provides habitat for native bird species, including those protected under the Migratory Bird Treaty Act.

3.9.4.1.4 Herbaceous-Scrub

This vegetation community occurs on both limestone and volcanic soils, primarily within open fields, and is dominated by grassy and low herbaceous vegetation with small thickets of native and introduced shrubs. Introduced species such as lantana (*Lantana camara*), paper rose (*Operculina ventricosa*), climbing hempweed (*Mikania scandens*), blue buffle grass (*Pennisetum polystachion*), and giant sensitive plant (*Mimosa invisa*) are common, as are small groves of trees including African tulip tree (*Spathodea campanulata*).

3.9.4.1.5 Casuarina Forest

This vegetation community consists of forests of pure ironwood or dominated by ironwood and is referred to as *Casuarina* forest throughout this EIS/OEIS. Commonly called ironwood or Australian pine, this tree species tolerates dry and salty conditions. It often grows in shrub and grass habitat, and in some locations forms sparse woodland with little understory. Ironwood also occurs in exposed areas and in narrow bands along the coast. This species is generally accepted as native to the Mariana Islands and seems to be an early successional species that deters the growth of other species by producing a dense layer of fallen needle-like branches that have compounds inhibiting the growth, survival, and reproduction of other plant species within the immediate vicinity (Pratt 2010).

3.9.4.1.6 Coconut Forest

Coconut forest describes a vegetation community dominated by coconut palms (*Cocos nucifera*). Approximately one third of the island's coconut forests are located in five stands within the Military Lease Area. These stands are found adjacent to and south of the International Broadcasting Bureau (see [Figure 3.9-1](#)).

3.9.4.1.7 Beach Strand

Beach strand vegetation communities are limited to narrow strips in coastal areas and have adapted to excessively drained soils and salt spray from the adjacent coastal waters. Many beach areas are

occasionally inundated with salt water during storm events, which is a controlling influence on all organisms. Strand vegetation includes beach heliotrope (*Tournefortia argentea*), bur-marigold (*Bidens pilosa*), portia tree (*Thespesia populnea*), false verbena (*Stachytarpheta* spp.), morning glory (*Ipomoea triloba*), lantana, and beach naupaka (*Scaevola taccada*). It also includes *Pemphis acidula* in rocky areas.

3.9.4.1.8 Wetland

Wetland vegetation communities are areas of grasses, sedges, herbs, or woody species which are specialized for growing in standing water or soils that are saturated for most of the year. Wetlands are habitats that are subject to permanent or periodic inundation sufficient to support vegetation that is typically adapted for life in saturated soil conditions. These habitats include marshes, swamps, bogs, and similar areas.

Wetland habitats on Tinian are important because of their limited occurrence and the habitat they provide for the federally and CNMI-listed endangered Mariana common moorhen (see [Section 3.9.4.4, Special-status Species](#)) and migratory birds. Lake Hagoi is a 34-acre (14-hectare) area comprising open-water and wetland vegetation that is the only permanent wetland habitat within the Military Lease Area. A 1995 vegetation map of the area (U.S. Fish and Wildlife Service 1996) showed a band of tall reed (*Phragmites karka*) and large patches of bulrush (*Schoenoplectus litoralis*, formerly *Scirpus litoralis*) around the perimeter. There were also patches of giant swampfern (*Acrostichum aureum*) and the grass *Paspalum distichum*. All of these species are native to Tinian (Raulerson 2006). The DoN (2013b) noted that as of 2012, Lake Hagoi vegetation appears to have changed relative to that mapped in 1995, with the occurrence of additional species such as the indigenous hibiscus (*Hibiscus tiliaceus*), a type of tree. In addition, the range of existing plant species had expanded into previously open-water areas of the wetland. The DoN (2013a) report further noted that the lake's vegetation has been changing continually over the past 50 years, with the expansion of bulrush into the wetland, resulting in a reduction of open water. Particularly rapid changes in the range of bulrush have been documented at Lake Hagoi between 2001 and 2013.

Two additional areas within the Military Lease Area contain water during the wet season: Mahalang and Bateha. The Mahalang complex consists of a number of ephemeral ponds located on a plateau within the northern portion of the Military Lease Area, south of Lake Hagoi (see [Figure 3.9-1](#)). At least 24 individual sites form the complex and are located within a matrix of grasslands (herbaceous-scrub), tangantangan, and mixed secondary forest. A subset of these individual sites contains water during the wet season, and all sites are dry during the dry season. Although no specific sizes for these sites were given in previous reports, AECOS and Wil Chee Planning (2009) estimated the two largest features as approximately 1.2 acres (0.5 hectare) each. The majority of the sites are characterized as likely bomb craters from World War II activities (DoN 2013b). Blue buffle grass, an introduced grass, and various species of weedy vines dominate the interiors of the craters. Other sites in the complex consist of shallow depressions with various weedy vines and herbs. One site contains a dense covering of the introduced wetland species *Ipomoea aquatica* that grows in ponded water during the wet season (DoN 2013b). Results of wetland surveys conducted at a sample of the Mahalang sites in December 2014 indicate that only a single Mahalang site supports wetland vegetation (e.g., *Ipomoea aquatica*) and exhibits the characteristics of an isolated wetland. All other surveyed Mahalang sites do not contain wetland soils, suitable hydrology, or wetland vegetation. See Appendix L, *Tinian Wetland Survey Report*, for more details regarding the Mahalang sites.

The Bateha sites are located within the Military Lease Area (see [Figure 3.9-1](#)) and consist of two shallow depressions that contain water during the wet season. These areas are approximately 1-2 acres (0.4-0.8 hectare) each. Numerous other small areas, previously identified as potential wetlands, did not have the characteristics of seasonal wetlands as of December 2012 (DoN 2013b). The larger western site at Bateha is dominated by the introduced, sprawling scrub-shrub giant sensitive plant and also contains the introduced shrub *Cassia alata* along with other weedy species. Blue buffle grass occurs along the perimeter. The eastern site is a deeper depression surrounded by ridges dominated by an overstory of the introduced Formosan koa and blue buffle grass. Candle bush (*Cassia alata*) is dispersed throughout the northern and southern portions of the site (DoN 2013b). Wetland surveys conducted at these two Bateha sites in December 2014 indicate that both sites exhibit characteristics of isolated wetlands, including the presence of wetland soils and wetland vegetation. See Appendix L, *Tinian Wetland Survey Report*, for more details regarding the Bateha sites.

3.9.4.1.9 Agriculture

For the purposes of the terrestrial biological resources discussion, the agricultural community is defined as those areas used for the cultivation of food crops. Only 2.5 acres (1.0 hectare) were identified within the Military Lease Area by the U.S. Fish and Wildlife Service (Amidon 2009) (see [Table 3.9-2](#)). These occur near the southwest corner of the International Broadcasting Bureau site (see [Figure 3.9-1](#)). Portions of the herbaceous scrub vegetation community support cattle (*Bos primigenius*) grazing on Tinian. Refer to Section 3.7, *Land Use*, for further discussion of agriculture and cattle grazing.

3.9.4.1.10 Barren (Soil, Sand, or Rock)

Barren, unvegetated areas of soil, sand, or rock primarily occur along Tinian's coastline. Approximately one third of the island's barren areas are located within the Military Lease Area and can be found from Puntan Atgidon to Lamanibot Bay (known locally as Dump Coke) and south of Puntan Masalok (see [Table 3.9-2](#) and [Figure 3.9-1](#)).

3.9.4.1.11 Developed Land

Developed land includes human-occupied or otherwise highly disturbed areas that include lawns, mowed grass fields, and other landscaped areas and impervious surfaces such as buildings, roads, and parking lots. This category includes areas mapped by U.S. Forest Service (2006) as "Urban and Built-up" and "Urban Vegetation."

3.9.4.2 Native Wildlife

3.9.4.2.1 Birds

There are 44 native bird species reported on Tinian, of which 39 are protected under the Migratory Bird Treaty Act. The Marianna common moorhen is a native bird species protected by the Migratory Bird Treaty Act and the federal Endangered Species Act. In addition, another native bird species, Micronesian megapode, is protected only under the federal Endangered Species Act. [Section 3.9.4.4, Special-status Species](#), further addresses bird species protected under the Migratory Bird Treaty Act and the federal Endangered Species Act. The remaining five native bird species that do not have a special status include: (1) Micronesian honeyeater (*Myzomela rubratra*); (2) rufous fantail (*Rhipidura rufifrons uraniae*); (3)

Tinian monarch (*Monarcha takatsukasae*); (4) bridled white-eye (*Zosterops conspicillatus saypani*); and (5) Micronesian starling (*Aplonis opaca guami*) (DoN 2013a, 2013c; U.S. Fish and Wildlife Service 2013).

Of the 44 bird species native to Tinian, 20 have been regularly detected in surveys conducted on Tinian between 1982 and 2013, during monthly monitoring by the DoN, and from periodic observations by the CNMI Division of Fish and Wildlife (Camp et al. 2009, 2012; DoN 2013c, 2014b). Island-wide surveys for native birds were conducted in 1982, 1996, 2008, and 2013 along a set of transects established by the U.S. Fish and Wildlife Service in 1982 (U.S. Fish and Wildlife Service 2009). Surveying of these standardized transects over time has allowed for analyses of population trends for a subset of Tinian native bird species (Camp et al. 2012; DoN 2014a).

Native bird species commonly found in forest habitats on Tinian include bridled white-eye, rufous fantail, Tinian monarch, Mariana fruit dove, white-throated ground-dove (*Gallicolumba xanthonura*), collared kingfisher (*Todiramphus chloris*), Micronesian honeyeater, and Micronesian starling. The yellow bittern (*Ixobrychus sinensis*) is a native bird species that is commonly present in open areas (DoN 2014a). All native shorebirds (e.g., sandpipers, plovers) and waterbirds (e.g., ducks) are protected under the Migratory Bird Treaty Act and are discussed in [Section 3.9.4.4, Special-status Species](#).

Analysis of the 2013 native bird survey data was conducted by the U.S. Geological Survey to allow direct comparison to the data collection and analyses conducted for the 2008 Tinian surveys (Camp et al. 2009), as well as those done for the 1982 and 1996 surveys (Camp et al. 2012; DoN 2014a). Based on the 2013 analysis, the most abundant native bird species on Tinian were bridled white-eye, rufous fantail, and Tinian monarch (DoN 2014a). The collared kingfisher, white-throated ground-dove, and Mariana fruit dove were the least abundant. Analyses of population trends from 1982 to 2013 indicate increases in population densities for the collared kingfisher, Micronesian starling, rufous fantail, Mariana fruit dove, and white-throated ground-dove. Population densities have decreased for the Micronesian honeyeater. Population densities have remained stable for the bridled white-eye and Tinian monarch (DoN 2014a). For more detailed information on the 2013 native forest bird surveys on Tinian, refer to the *Tinian Monarch* section below and to the *Tinian Wetland Survey Report* provided in Appendix L, *Biological Resources Supporting Documentation*.

3.9.4.2.1.1 Tinian Monarch

Although not protected under the Migratory Bird Treaty Act, the Tinian monarch (Photo 3.9-1) was previously listed under the federal Endangered Species Act and by the CNMI government, and is a native bird species found only on Tinian. The monarch nests in native limestone, mixed introduced, and tangantangan forest communities. Native tree species are preferred monarch nesting sites, and native limestone forest appears to provide higher-quality habitat, as evidenced by higher monarch densities, nesting rates, and reproductive success when compared to mixed introduced and tangantangan forest communities (DoN 1997; Camp et al. 2012).

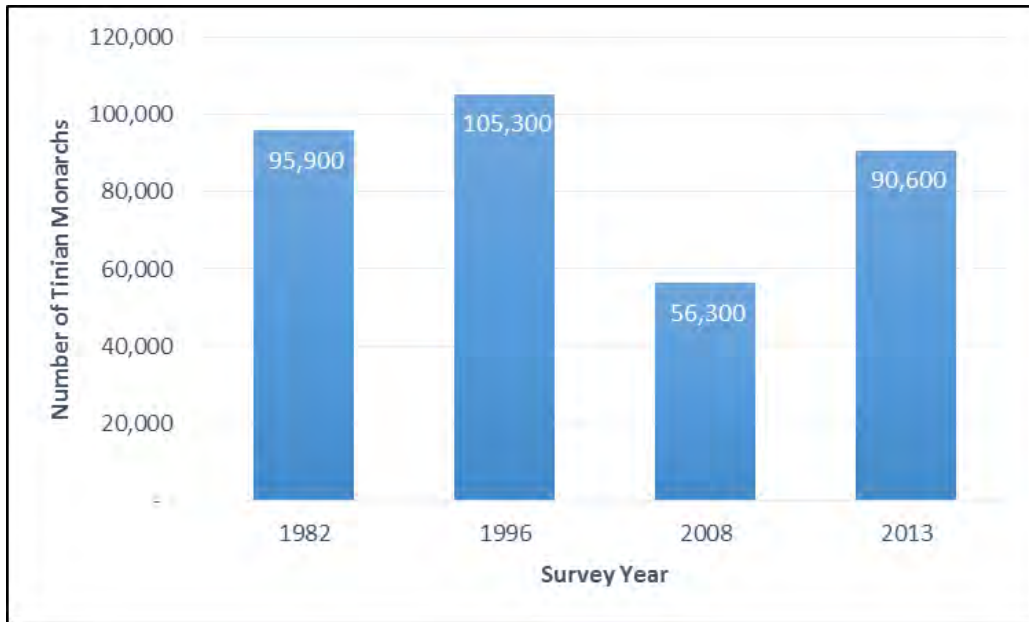


Photo 3.9-1. Tinian Monarch
(Source: S. Vogt)

The Tinian monarch was federally listed as endangered in June 1970 because its population was thought to be critically low due to the destruction of native forests by pre-World War II agricultural practices, and by military activities during and after World War II. Based on forest bird surveys in 1982, which resulted in a population estimate of 39,338 individuals, the Tinian monarch was down-listed to threatened in April 1987. Further population studies in 1994 and 1995 resulted in a population estimate of approximately 52,904 birds. In 1996, surveys conducted along the same routes and using the same methods used in 1982 yielded a population estimate of 55,721 birds (Lusk et al. 2000). The 1996 survey also found a significant increase in forest vegetation density relative to 1982, indicating an improvement in monarch habitat. The U.S. Fish and Wildlife Service proposed delisting the Tinian monarch from the Federal List of Endangered and Threatened Wildlife in February 1999, and the species was federally delisted in 2004 (U.S. Fish and Wildlife Service 2004). The Tinian monarch was also delisted by the CNMI government in 2009 (Commonwealth Register Volume 31, page 29532). As described below, surveys and the associated data analysis conducted in 2008 indicated a significant decrease in the Tinian monarch population compared to the surveys conducted in 1996. Based on these results, the Center for Biological Diversity petitioned the U.S. Fish and Wildlife Service in December 2013 to relist the Tinian monarch as a threatened or endangered species under the Endangered Species Act (Center for Biological Diversity 2013). To date, the species has not been relisted.

The Military Lease Area comprises roughly 66% of the Tinian monarch habitat on the island and supports approximately 52% of the total monarch population (DoN 2014a). After delisting of the Tinian monarch in 2004, the species was monitored for 5 years under the *Post-Delisting Monitoring Plan for the Tinian Monarch* (U.S. Fish and Wildlife Service 2005). In 2008, monitoring resulted in a population estimate of approximately 33,310 Tinian monarchs, a decline of approximately 40% since 1996. In addition, monarch densities in high-quality habitats calculated from the 2008 surveys declined significantly from densities reported by U.S. Fish and Wildlife Service (U.S. Fish and Wildlife Service 2005). It was hypothesized that the overall population decline between 1982 and 2008 was associated with reduced bird density in quality habitats, particularly limestone forest (Camp et al. 2012).

In support of this EIS/OEIS, forest bird surveys, including surveys for the Tinian monarch, were conducted throughout Tinian in 2013. This island-wide survey using the original 10 transects established by the U.S. Fish and Wildlife Service in 1982 resulted in a Tinian monarch population estimate of approximately 90,600 birds. Because analytical methods have changed slightly over time, the 1982, 1996, and 2008 survey data were re-analyzed using the same methods used for the 2013 data. Results of these analyses provided population estimates of approximately 95,900 monarchs in 1982, 105,300 monarchs in 1996, and 56,300 monarchs in 2008 ([Figure 3.9-2](#)). Given these results, the overall population trend for Tinian monarchs from 1982 to 2013 was stable (DoN 2014a).



Source: DoN 2014a

Figure 3.9-2 Estimated Tinian Monarch Population (1982 – 2013)

The Tinian Military Retention Land for Wildlife Conservation was established in 1999 in an agreement between the CNMI Commonwealth Ports Authority, Federal Aviation Administration, and DoN. This conservation area was established for the protection of endangered or threatened wildlife, particularly the Tinian monarch, following Endangered Species Act consultation by the Federal Aviation Administration with the U.S. Fish and Wildlife Service on expansion of the Tinian Airport (U.S. Fish and Wildlife Service 1998). The 936-acre (379-hectare) conservation area is located in the Military Lease Area, northwest of the corner of Broadway and Cross Island Road (see [Figure 3.9-3](#) in [Section 3.9.4.4, Special-status Species](#)).

3.9.4.2.2 Mammals

The only native mammal species on Tinian is the Mariana fruit bat. This bat is listed as threatened under the federal Endangered Species Act and as threatened and endangered by the CNMI government. It is discussed in detail in [Section 3.9.4.4, Special-status Species](#).

3.9.4.2.3 Reptiles

There are eight native terrestrial reptile species reported on Tinian. Of these, the Micronesian gecko (*Perochirus ateles*) is a special-status species and is described separately in [Section 3.9.4.4, Special-status Species](#). There are two native marine reptile species reported to nest on Tinian: the green turtle (*Chelonia mydas*) and hawksbill turtle (*Eretmochelys imbricata*). Both are protected under the federal the Endangered Species Act and the CNMI Endangered Species Act. These marine reptiles are addressed in [Section 3.10, Marine Biology](#), but their beach nesting areas are discussed in [Section 3.9.4.4, Special-status Species](#).

Several native terrestrial reptile species were found during the 2008 surveys on Tinian, including the mourning gecko (*Lepidodactylus lugubrus*), Micronesian gecko, Indo-Pacific house gecko (*Hemidactylus garnotii*), oceanic snake-eyed skink (*Cryptoblepharus poecilopleurus*), littoral skink (*Emoia atrocostata*),

Pacific blue-tailed skink (*Emoia caeruleocauda*), and Brahminy blindsnake (*Ramphotyphlops braminus*). The mourning gecko was the most abundant lizard species in both mixed and limestone forest habitats, while the Indo-Pacific house gecko was the most abundant and conspicuous gecko in tangantangan forests. The oceanic and littoral skinks were found predominantly within the vicinity of coastal areas. The blue-tailed skink was observed only in native forest at Mount Lasso. The blindsnake was found in both mixed and limestone forest (Rodda et al. 2009).

3.9.4.2.4 Amphibians

There are no native amphibians on Tinian.

3.9.4.2.5 Invertebrates

There are four native invertebrate species reported on Tinian—three crab species and one snail species. The humped tree snail (*Partula gibba*), proposed for listing as endangered under the federal Endangered Species Act, is the only terrestrial invertebrate special-status species known to occur on Tinian. This species is discussed in [Section 3.9.4.4, Special-status Species](#).

The coconut crab and two species of land crab (*Discoplax hirtipes* [previously *Cardisoma hirtipes*] and *Cardisoma carnifex*) are regulated as game species by the CNMI Division of Fish and Wildlife. A license is required for harvesting these crabs during regulated hunting seasons. The coconut crab is the largest land invertebrate in the world and can reach over 3 feet (1 meter) in length from leg to leg. In addition to being a highly valued game species in the CNMI, it serves important ecological functions including dispersing seeds and scavenging. Although coconut crabs occur in native forests, females regularly migrate to the ocean to spawn. Coconut crab densities on Tinian have been estimated at 2 crabs/acre (5 crabs/hectare) in native forest and 0.7 crab/acre (1.8 crabs/hectares) in tangantangan (Vogt 2009).

Land crabs are a common terrestrial burrowing crab found throughout the Indo-Pacific and are generally associated with wetland or coastal habitats, although juveniles can be found further inland. Their shells can measure 4-5 inches (10-13 centimeters) across. The two species on Tinian are primarily herbivorous, eating leaves and other vegetation (Carpenter and Niem 1998).

3.9.4.3 Non-native Wildlife

Non-native species are common on Tinian and can negatively impact native wildlife and vegetation. The non-native species on Tinian currently include at least 5 birds, 10 mammals, 6 reptiles, 1 amphibian, and 3 invertebrates (DoN 2010b, 2013a, 2013c).

3.9.4.3.1 Birds

Common non-native bird species include red junglefowl (or feral chicken [*Gallus gallus*]), rock dove (*Columba livia*), island collared-dove (*Streptopelia bitorquata*), Eurasian tree sparrow (*Passer montanus*), and orange-cheeked waxbill (*Estrilda melpoda*) (DoN 2013a, 2013c, 2014c). Red junglefowl are found throughout the island and are no longer exclusively associated with humans. Rock doves can be found in the Military Lease Area and San Jose. The island collared-dove was introduced to the southern Mariana Islands by the Spanish from the Philippines in the 1700s and is considered common to abundant on Tinian. The most abundant non-native bird is the Eurasian tree sparrow, primarily in the vicinity of San Jose. Flocks of 30 or more orange-cheeked waxbills are seen in grasslands and roadsides (Camp et al. 2009; DoN 2013a, 2013c).

3.9.4.3.2 Mammals

Introduced mammals include three rat species, the house mouse (*Mus musculus*), Asian house shrew (*Suncus murinus*), domestic cat (*Felis catus*), dog (*Canis lupus familiaris*), goat (*Capra hircus*), and cattle. High densities of roof rats (*Rattus rattus*) are found in all habitats of the Military Lease Area. Pacific rats (*Rattus exulans*) and brown rats (*Rattus norvegicus*) also occur on Tinian but in lower densities. Rat densities on Tinian are higher than on many other tropical Pacific islands and are likely detrimental to flora and fauna, including Tinian's bird species. Asian house or musk shrew densities are high in native and tangantangan forest. Rodents and shrews are predators of native birds, lizards, insects, and snails. The rat's diet also includes native plants, seeds, and fruit, and high rodent densities are associated with changes in forest composition (Wiewel et al. 2009).

Feral cats are extremely common on Tinian and have been observed hunting in native forest at night (DoN 2013a). Goats have been transported from Aguiguan to Tinian, and a coastal survey in October 2008 confirmed at least 20 goats at Puntan Kastiyu. There is some evidence that feral goats are creating trails, accelerating erosion, and impacting the native vegetation on Tinian (Kessler 2009).

3.9.4.3.3 Reptiles

Introduced reptiles include the oceanic gecko (*Gehyra oceanic*), mutilating gecko (*Gehyra mutilata*), curious skink (*Carlia fusca*), emerald skink (*Lamprolepis smaragdina*), mangrove monitor lizard (*Varanus indicus*), and green anole (*Anolis carolinensis*). Oceanic geckos were reported during the 2008 U.S. Fish and Wildlife surveys and constituted about half of the lizard biomass in limestone forest areas (Rodda et al. 2009). Mangrove monitor lizards were found throughout the island in all habitats (Rodda et al. 2009; DoN 2013a). It should be noted that recent studies indicate that mangrove monitor lizards may be native to some Mariana Islands (Pregill and Steadman 2009).

The brown treesnake (*Boiga irregularis*), while not present on Tinian, has the potential to impact the economy, human health, and island ecology in the CNMI. The brown treesnake's native range is coastal Australia, Papua New Guinea, and a large number of islands in northwestern Melanesia. This species was inadvertently introduced to Guam after World War II (Rodda and Savidge 2007). As a result of this introduction, 17 of 18 native bird species on Guam were severely impacted, and 12 of the 18 species were likely extirpated (i.e., no longer exist on Guam) (Wiles et al. 2003).

Efforts to control the brown treesnake include preventing the snakes from leaving Guam by cargo, ship, or air vessels. The U.S. military has collaborated with other partners and participated in the development of brown treesnake-specific trapping techniques, detection using sniffer dogs, exclusion fence design, development of toxicants, and toxicant delivery methods. While these efforts have had success, individual brown treesnakes originating from Guam have been found in Kwajalein, Pohnpei, Hawaii (Oahu), Diego Garcia, Spain, Alaska, Texas, Oklahoma, California, and neighboring CNMI islands (Rota, Tinian, and Saipan) (Brown Treesnake Technical Working Group 2009; U.S. Department of Agriculture 2014; Kerrigan 2014).

The potential establishment of the brown treesnake on Tinian is of great concern. As of 2008, there have been 76 alleged brown treesnake detections on Saipan considered credible based upon conditions and the observers' familiarity with snakes (N. Hawley, CNMI Division of Fish and Wildlife, unpublished data). Nine unconfirmed brown treesnake sightings have been reported on Tinian (Brown Treesnake Technical Working Group 2009).

3.9.4.3.4 Amphibians

The marine toad (*Bufo marinus*) is the only known amphibian on Tinian and was likely introduced in 1944, when approximately 4,000 individuals were observed in lily ponds and cisterns. By 1974, the toad was common throughout the island in mixed and limestone forest habitats (DoN 2013a). Marine toads currently occur in high densities at Lake Hagoi. The species possesses large parotid glands that excrete poison and kill potential predators. Marine toads are prolific breeders and can lay up to 70,000 eggs per year, and are possibly a threat to native reptiles on Tinian (DoN 2013a).

3.9.4.3.5 Invertebrates

The mangrove crab (*Scylla serrata*), introduced as a potential food source, is the only introduced terrestrial crustacean on Tinian (Commander, U.S. Naval Forces Marianas 2004; DoN 2010b). The predatory manokar flatworm (*Platydemus manokwari*) was introduced to Tinian to help control the introduced giant African snail (*Achatina fulica*). The flatworm poses a serious threat to native tree snails, including the humped tree snail that is proposed for listing under the federal Endangered Species Act (discussed below) (Hopper and Smith 1992; DoN 2014a).

3.9.4.4 Special-status Species

3.9.4.4.1 Federal Endangered Species Act-listed and Proposed Species

The status and occurrence of federal Endangered Species Act-listed and proposed species and CNMI-listed species on Tinian are presented below ([Table 3.9-3](#)). The observed locations of these special-status species within the Military Lease Area are presented in [Figure 3.9-3](#). Further descriptions of these species are presented in the following subsections.

Table 3.9-3. Occurrence of Federally Endangered Species Act-Listed and Proposed Species and CNMI-Listed Species on Tinian

English Name	Status*		Habitat	Occurrence
	ESA	CNMI		
Birds				
Mariana common moorhen	E	E/T	Freshwater wetlands.	Population up to 75 birds at Lake Hagoi, the Mahalang ephemeral ponds, and Bateha sites.
Micronesian megapode	E	E/T	Limestone forest and coconut forest.	Eight reports of individual birds seen within last 28 years, but none were detected during taped-playback surveys in 2008, 2013, and 2014.
Mammals				
Mariana fruit bat	T	E/T	Limestone forest, coastal forest, and coconut forest.	Occasional sightings by residents. During three surveys conducted between 2000 and 2008, five fruit bats were observed in 2005.
Pacific sheath-tailed bat	PE	-	Roosts in caves during the day and forages for insects over forests at night.	The subspecies is currently known only from Aguiguan and does not occur on Tinian.
Reptiles				
Green sea turtle	T	E/T	Suitable beaches for basking and nesting. †	Regular nesting documented.
Hawksbill sea turtle	E	E/T	Suitable beaches for basking or nesting. †	One hawksbill nest observed during monthly surveys from 1999-2012.
Slevin's skink	PE	-	Leaf litter of native forest floors.	Not known to currently occur on Tinian.
Micronesian gecko	-	E/T	Forested areas.	Reported at Mount Lasso and Carolinas Plateau in 2008.
Invertebrates				
Humped tree snail	PE	-	Intact limestone forest.	Observed during 2013 surveys along Lamanibot Bay (Dump Coke) escarpment.
Plants				
<i>Cycas micronesica</i> **	PT	-	Forest and savanna ecosystems.	<i>Cycas micronesica</i> is not known historically from Tinian. In 2008, the DoN cycad conservation project planted 1,000 cycad seedlings in native limestone forest on Tinian.
<i>Heritiera longipetiolata</i>	PE	-	Moist forest on limestone cliffs and in coastal sites with windy conditions.	Within the Military Lease Area at Unai Masalok on the east coast and along the Lamanibot Bay (Dump Coke) escarpment.
<i>Dendrobium guamense</i>	PE	-	Grows on tree trunks and branches in forest habitats.	Within the Military Lease Area near Unai Dankulo on the east coast.
<i>Solanum guamense</i>	PE	-	Native forest.	Not known to currently occur on Tinian; known from just a single individual on Guam.
<i>Tuberolabium guamense</i>	PE	-	Native forest.	Not known to currently occur on Tinian; known only from a single individual on Guam and two occurrences on Rota.

Legend: *ESA = Federal Endangered Species Act; E = endangered; E/T = the CNMI Administrative Code does not specify whether a species is threatened or endangered; all species are considered threatened and endangered; PE = proposed endangered; PT = proposed threatened; T = threatened; - = not listed.

†Occurrence of sea turtles in the marine environment is addressed in Section 3.10, *Marine Biology*.

**Population established by DoN on Tinian via translocations is not included in the species' range in U.S. Fish and Wildlife Service (2014).

Sources: Berger et al. 2005; Vogt 2008a, 2008b; Brooke 2009; Kessler and Amidon 2009; Marshall et al. 2009; DoN 2010a, 2010b, 2011, 2012, 2013a; U.S. Fish and Wildlife Service 2012a, 2014; Holland and Sischo 2013.

Note: Species observations are historical sightings over multiple years and multiple surveys and do not represent the current population status or distribution of species within the depicted area.



Figure 3.9-3
 Occurrence of Special-Status Species - Tinian Military Lease Area



3.9.4.4.1.1 Mariana Common Moorhen

The Mariana common moorhen (Photo 3.9-2) is a bird species that relies on emergent vegetation of freshwater marshes, ponds, and placid rivers for breeding, foraging, and shelter (U.S. Fish and Wildlife Service 1991; DoN 2010b). In the Mariana Islands, its preferred habitat includes freshwater lakes, marshes, and swamps. The U.S. Fish and Wildlife Service recovery plan for the Mariana common moorhen identifies Lake Hagoi (estimated at that time at 44 acres [18 hectares] with 2.5 acres [1 hectare] of open water) within the northern portion of the Military Lease Area as primary habitat for the moorhen (U.S. Fish and Wildlife Service 1991) (see [Figure 3.9-3](#)).



Photo 3.9-2. Mariana Common Moorhen
(Source: S. Vogt)

The 1991 recovery plan estimated the moorhen population on Tinian to be between 20 and 125 birds (U.S. Fish and Wildlife Service 1991). Based on previous reports and surveys from 1989, 1994-1995, and 2001, the moorhen population was estimated to be between 41 and 75 birds (Takano and Haig 2004).

The DoN has conducted monthly or quarterly monitoring of moorhens at Lake Hagoi since 1998. Surveys conducted between November 1998 and September 2013 indicate that total moorhen detections have ranged from 0 to 46 birds per survey, with a mean of 15 individuals detected per survey (DoN 2014d). Yearly averages show that 2003 and 2007 were peak years for adult moorhen numbers at Lake Hagoi (16.9 and 17.1 detections, respectively), and that 2010 was an extremely low year (6.8 detections). These numbers are the means for the year and are index surveys, not absolute population estimates. The number of birds observed is negatively correlated with periodic dry conditions at Lake Hagoi, and the lake was completely dry for much of 2010. Survey results for fiscal years 2011, 2012, and 2013 show a rebound from the low of 2010, with an average of 16, 16, and 16.5, respectively, adult moorhens detected per monthly survey (DoN 2011, 2012, 2013a). The 2013 taped-playback surveys resulted in the detection of 20-23 individual moorhens at 3 survey points on Lake Hagoi (DoN 2014a). This is within U.S. Fish and Wildlife Service's range of 21-29 moorhens detected per survey during wet season surveys between July 1994 and August 1995 (DoN 2013b). Depredation by rats and mangrove monitor lizards may impact the moorhen population at Lake Hagoi, especially during peak nesting periods (U.S. Fish and Wildlife Service 1996; Vogt 2008a; DoN 2010b).

Prior to 2013, moorhen use of the Mahalang complex of ephemeral ponds and Bateha wetlands had not been regularly monitored. Based upon surveys at the Mahalang complex and Bateha sites in 1994 and 1995, the U.S. Fish and Wildlife Service estimated that Mahalang and Bateha may have supported a total of approximately 10 moorhens (U.S. Fish and Wildlife Service 1996) ([Figure 3.9-4](#)).

To obtain a more recent inventory of sites used or potentially used by moorhens, surveys were conducted at the Mahalang ephemeral ponds and the Bateha wetlands during the wet seasons of 2012-2014. As of January 2014, surveys conducted within the Mahalang ephemeral ponds resulted in the following individual moorhen detections: one in MC1 in November and December of 2012, one in M10 in November 2013, one in M07 from May through October 2013, and one in M11 from May through October 2013 (see [Figure 3.9-3](#)).

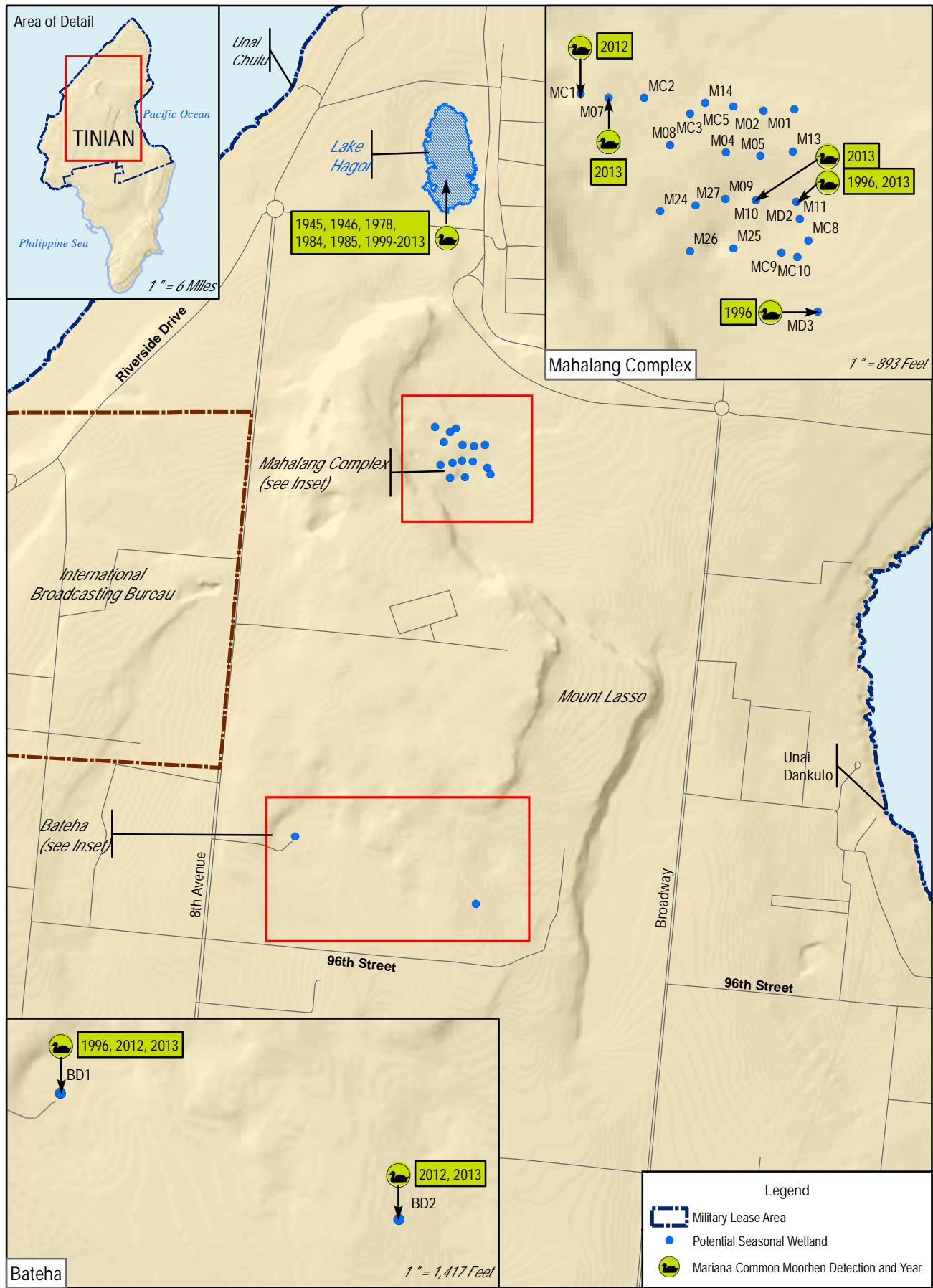
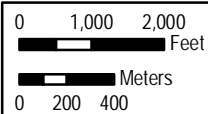


Figure 3.9-4
 Past and Current Occurrences of Mariana Common Moorhen
 within the Military Lease Area

Sources: Hawaiian Agronomics 1985; DoN 2013a, 2013b, 2013c, 2014a



Surveys have also detected moorhens within both Bateha sites BD1 and BD2. Seven surveys between October 2012 and January 2013 resulted in a total of 20 moorhen detections at BD1 (see [Figure 3.9-4](#)). This includes a maximum of three visual observations of adults and four visual observations of juveniles on both October 22 and November 25, 2012. An additional 4 detections, of 2 adult and 2 juvenile moorhens, were made in November 2013 (DoN 2014a). Eight surveys conducted between October 2012 and January 2013 at BD2 resulted in 50 moorhen detections, including 4 visual detections of adults and 3 visual detections of juveniles in November 2012 (DoN 2013b).

Overall, the 2012-2014 surveys indicated that approximately four moorhens used the Mahalang ephemeral ponds and approximately four adult and four juvenile moorhens used each of the Bateha wetlands each year during this period (DoN 2014b).

3.9.4.4.1.2 Micronesian Megapode

The Micronesian megapode (Photo 3.9-3) is a medium-sized, stocky, brownish-black, ground-dwelling bird. In 1902, the Micronesian megapode was noted as common on Tinian. However, by 1949 these birds were difficult to locate (DoN 1997). Surveys conducted prior to 1999, and monthly surveys since 1999, have confirmed that the megapode occurs within the Military Lease Area on Tinian at very low numbers: one to three megapodes were detected, always individually, in 1985, 1995, 2000, 2001, 2004, 2005, 2009, and 2013. No megapodes were detected during surveys in 1999, 2002, 2003, 2006-2008, and 2014 (Krueger and O'Daniel 1999; Witteman 2001; Vogt 2006; DoN 2010b, 2012, 2014b). All megapode detections have been from the Mount Lasso area, the Maga area (south of Lake Hagoi), and a small area of native forest adjacent to Cross Island Road in the southern portion of the Tinian Military Retention Land for Wildlife Conservation (see [Figure 3.9-3](#)). Occasional sightings of megapodes on Tinian may be a result of the movement of transient birds from Aguiguan or Saipan, as there is not a resident breeding population on Tinian at this time (DoN 2013c).



Photo 3.9-3. Micronesian Megapode
(Source: S. Vogt)

3.9.4.4.1.3 Mariana Fruit Bat

Tinian once supported a large number of Mariana fruit bats (Photo 3.9-4). After World War II, however, it was estimated that only 5% of the native forest cover remained on Tinian. Habitat loss and poaching are thought to be the primary reasons for the current near-absence of Mariana fruit bats on the island. No permanent fruit bat colony exists on Tinian. However, bats may fly between islands in the southern Marianas, including Aguiguan (DoN 2013c;



Photo 3.9-4. Mariana Fruit Bat
(Source: U.S. Fish and Wildlife Service)

Mildenstein and Mills 2013). Within the Military Lease Area, fruit bats have been observed associated with the native limestone forest in the cliff-line forest in the Maga region north of Mount Lasso, and at other locations in western Tinian (see [Figure 3.9-3](#)). There have been sightings of two (in 1979), and as many as four fruit bats (in 1983-1984) in the Kastiyu forest, south of the Military Lease Area. No fruit bats were observed during 1994 and 1995 surveys at five observation stations. However, there were two incidental observations during the 1994-1995 study period, one near San Jose village and one near the south end of the island. No fruit bats were observed during surveys in 2000, 2001, or 2008. The highest number of recent sightings from Tinian occurred in 2005 when approximately five individuals were sighted in cliff-line forest in the Maga region. In 2008, fruit bat surveys were conducted at eight separate count stations at seven locations on Tinian but no bats were observed (Brooke 2009; DoN 2010b, 2013c).

3.9.4.4.1.4 Pacific Sheath-tailed Bat

The Pacific sheath-tailed bat (*Emballonura semicaudata rotensis*) is endemic to the Mariana Islands, with populations historically occurring on Guam, Rota, Saipan, Tinian, Aguiguan, and possibly Anatahan and Maug. The subspecies is currently known only from Aguiguan and is proposed for listing as endangered under the Endangered Species Act (U.S. Fish and Wildlife Service 2014). Surveys conducted in 2008 by U.S. Geological Survey biologists, using echolocation stations in native limestone forest, resulted in no detections of sheath-tailed bats on Tinian (U.S. Fish and Wildlife Service 2009). The Pacific sheath-tailed bat is presumed to no longer exist on Tinian and is not discussed further in this EIS/OEIS. This species is being addressed in the Biological Assessment in support of Endangered Species Action section 7 conferencing with the U.S. Fish and Wildlife Service.

3.9.4.4.1.5 Sea Turtles

Both the green and the hawksbill sea turtles are known to nest on Tinian (DoN 2010a, 2011, 2012, 2013c). Beaches within the Military Lease Area are surveyed monthly for sea turtle activity (i.e., crawls, nests, potential nests, and body pits). The occurrence of sea turtle nesting activities on land is covered in this section, and occurrence in the nearshore waters is discussed in Section 3.10, *Marine Biology*.

Green sea turtle abundance and density is highest along the island's relatively uninhabited east coast (Kolinski 2001). For successful nesting, green sea turtles require deep sand beaches with open ocean exposure and minimal disturbance (DoN 2010b, 2012). Of the 13 distinct beaches or beach complexes on Tinian that could support nesting, 10 are within the Military Lease Area, and 6 of these have been surveyed monthly since 1998: Unai Chulu, Unai Lam Lam, Unai Chiget, Unai Dankulo, Unai Masalok, and Unai Babui (see [Figure 3.9-3](#)). Unai Dankulo consists of 13 pocket beaches, separated by rocky outcrops and fronted by a coral reef system (DoN 2014c).

Over 10 years (1998-2007) of monthly nesting beach surveys, data indicate that Unai Dankulo is the beach most used by sea turtles (DoN 2014c). Nearly 50% of all sea turtle activity on the 6 regularly surveyed Military Lease Area beaches was observed on 2 of the 13 pocket beaches at Unai Dankulo. These surveys also indicated that nesting activity is variable, with relatively high levels of activity in 1999 and 2005, and little to no activity in 1998, 2000-2004, 2006, and 2007 (DoN 2014c).

Based on the 1998-2007 surveys, it was believed that green sea turtle nesting activity would occur as early as late January and end in mid-July on most of Tinian's sandy beaches (DoN 1997). Surveys since October 2008, however, have indicated that nesting activity occurs during all months of the year. These

more recent surveys also indicated a substantial increase in overall sea turtle nesting activity (DoN 2014c), with 2010 and 2012 having the greatest nesting activity. In addition, 2012 was the first year in which Unai Dankulo was not an active nesting beach. Conversely, in 2012, Unai Babui was among the most active beaches despite its complete lack of nesting activity during the previous 10 years of surveys (DoN 2014c). On Tinian, the green sea turtle is threatened by increased human presence, coastal construction, algae/seagrass/reef degradation, and illegal harvesting (National Marine Fisheries Service and U.S. Fish and Wildlife Service 1998).

Hawksbill sea turtles use both low- and high-wave energy nesting beaches on insular and mainland sites in tropical oceans of the world. Hawksbills will nest on small pocket beaches and, because of their small body size and great agility, can traverse fringing reefs that limit access to other sea turtle species (National Marine Fisheries Service and U.S. Fish and Wildlife Service 1998b). Hawksbill sea turtles are rare on Tinian beaches, and no hawksbill sea turtles were recorded during a 13-month survey in 1994-95 (DoN 2010b). Only one hawksbill nest, found in 2010 at Unai Dankulo, has been observed during monthly surveys from 1999 through 2012 (DoN 2013c). On Tinian, the hawksbill sea turtle is primarily threatened by direct takes from humans. Historically, hawksbill sea turtles have been taken for trade (e.g., tortoiseshell crafts) and, to a lesser extent, for food. Although hawksbill sea turtle eggs are readily consumed, adults are not valued as highly as green sea turtles for food. This may be due to their poor taste and sporadic fatal poisonings from their occasional toxicity (National Oceanic and Atmospheric Administration 1998).

3.9.4.4.1.6 Slevin's Skink

Slevin's skink (*Emoia slevini*), a lizard species, is endemic to the Mariana Islands and is proposed for listing as endangered under the Endangered Species Act (U.S. Fish and Wildlife Service 2014). The species historically occurred on Guam, Rota, Tinian, and Aguiguan. Surveys over the past three decades have indicated Slevin's skink populations on Guam (Cocos Island), Sarigan, Guguan, Alamagan, Pagan, Asuncion, and Maug (U.S. Fish and Wildlife Service 2014). The species was last observed on Tinian in the 1940s (U.S. Fish and Wildlife Service 2009). Slevin's skink is presumed to no longer exist on Tinian and is not discussed further in this EIS/OEIS. This species is being addressed in the Biological Assessment in support of Endangered Species Action section 7 conferencing with the U.S. Fish and Wildlife Service.

3.9.4.4.1.7 Humped Tree Snail

The humped tree snail is a species proposed for listing as endangered under the federal Endangered Species Act (U.S. Fish and Wildlife Service 2014). It was historically present on Tinian but was thought to no longer occur on the island because of the presence of the predatory manokar flatworm and rosy wolf snail (*Euglandina rosea*), the severe loss of native limestone forest habitat, and because it had not been observed on Tinian since 1970 (Berger et al. 2005; DoN 2010b; U.S. Fish and Wildlife Service 2012b; Holland and Sischo 2013). However, surveys from June 22-27, 2013, performed in support of this EIS/OEIS, documented two discrete populations of the humped tree snail within native limestone forest along Lamanibot Bay, which is known locally as Dump Coke (see [Figure 3.9-3](#)). A total of 92 individuals were counted between the two sites, including adults, subadults, and juveniles (DoN 2014a). Aged humped tree snail shells were also observed on the ground in native limestone forests in the vicinity of Unai Chiget, south of Lake Hagoi in the Maga area, the Mount Lasso area, and Unai Masalok (DoN

2010b; Holland and Sischo 2013). For more detailed information on the 2013 tree snail surveys, refer to Appendix L, *Biological Resources Supporting Documentation*.

3.9.4.4.1.8 Cycas micronesica

Cycas micronesica is a tree currently known to occur in the forest and savanna ecosystems of Guam, Rota, Palau, and Yap (Raulerson 2006; U.S. Fish and Wildlife Service 2014), and was recently reported on Pagan (Pratt 2010). *C. micronesica* is not known historically from Tinian. On Guam *C. micronesica* is severely impacted by Asian cycad scale (*Aulacaspis yasumatsui*), the non-native cycad blue butterfly (*Chilades pandava*), and non-native ungulates (e.g., Philippine deer [*Rusa marianna*], water buffalo [*Bubalus bubalis*], and feral pigs [*Sus scrofa*]) (Marler and Lawrence 2012). As a result, DoN has been collaborating with others on a conservation project for *C. micronesica* on Tinian. Following the cycad scale outbreak on Guam in the mid-2000s, in 2005 Joint Region Marianas collected 3,000 cycad seeds from Guam, cleaned the seeds of scale insects, and germinated and raised seedlings in a nursery on Tinian. In 2008, 1,000 of the cycad seedlings were planted in native limestone forest on Tinian. The outplanted cycads on Tinian have since been monitored monthly. As of April 2012, there has been an 81% survivorship of these seedlings (Brooke 2012). Although a *C. micronesica* population thus now occurs on Tinian, it is considered to be an experimental population and was not included within the species' range in the proposed rule to list *C. micronesica* as a threatened species under the Endangered Species Act (U.S. Fish and Wildlife Service 2014).

3.9.4.4.1.9 Heritiera longipetiolata

Heritiera longipetiolata is a tree species reported from Guam, Saipan, and Tinian (Raulerson 2006) and is known outside the Marianas only from Pohnpei (Costion and Lorence 2012). The species has been proposed for listing as endangered under the federal Endangered Species Act (U.S. Fish and Wildlife Service 2014). Within the Military Lease Area it has been found in coastal forests near Unai Masalok on the east coast and along the Lamanibot Bay (Dump Coke) escarpment (Hawaiian Agronomics International, Inc. 1985). It has also been observed south of the Military Lease Area in native limestone forest along Tinian's southeastern coast, between Puntan Barangka and Puntan Kastiyu (DoN 2014a; U.S. Fish and Wildlife Service 2014).

3.9.4.4.1.10 Dendrobium guamense

Dendrobium guamense is an orchid species that grows on tree trunks and branches in forest habitats and has been proposed as endangered under the Endangered Species Act. *D. guamense* is known historically from Guam, Rota, Saipan, and Tinian. Currently, a single population of *D. guamense* is known within the Military Lease Area on Tinian, near Unai Dankulo on the east coast (U.S. Fish and Wildlife Service 2014; U.S. Fish and Wildlife Service, R. Rounds, personal communication, 2014).

3.9.4.4.1.11 Solanum guamense and Tuberolabium guamense

Solanum guamense, a shrub in the nightshade family, and *Tuberolabium guamense*, an orchid species, are proposed for listing as endangered under the Endangered Species Act. Although *Solanum guamense* is known historically from Guam, Rota, Saipan, Tinian, Asuncion, Guguan, and Maug, the species is currently known from just a single individual on Guam. *Tuberolabium guamense* is known historically from Guam, Rota, Tinian, and Aguiguan, but it is now known only from a single individual on Guam and two occurrences on Rota (U.S. Fish and Wildlife Service 2014). Both plant species are presumed to no

longer exist on Tinian and are not discussed further in this EIS/OEIS. These species are being addressed in the Biological Assessment in support of Endangered Species Action section 7 conferencing with the U.S. Fish and Wildlife Service.

3.9.4.4.2 Species Protected under the Migratory Bird Treaty Act

A total of 39 bird species observed on Tinian, including the Mariana common moorhen discussed above, are protected under the Migratory Bird Treaty Act ([Table 3.9-4](#)).

Table 3.9-4. Bird Species Observed on Tinian and Protected under the Migratory Bird Treaty Act

Barn swallow (<i>Hirundo rustica</i>)	Mariana fruit dove (<i>Ptilinopus roseicapilla</i>)
Black kite (<i>Milvus migrans</i>)	Marsh sandpiper (<i>Tringa stagnatilis</i>)
Black noddy (<i>Anous minutus</i>)	Northern pintail (<i>Anas acuta</i>)
Black-crowned night heron (<i>Nycticorax nycticorax</i>)	Northern shoveler (<i>Anas clypeata</i>)
Black-winged stilt (<i>Himantopus himantopus</i>)	Pacific golden plover (<i>Pluvialis fulva</i>)
Brown booby (<i>Sula leucogaster</i>)	Pacific reef heron (<i>Egretta sacra</i>)
Brown noddy (<i>Anous stolidus</i>)	Ruddy turnstone (<i>Arenaria interpres</i>)
Collared kingfisher (<i>Todiramphus chloris</i>)	Sooty tern (<i>Onychoprion fuscatus</i>)
Common sandpiper (<i>Actitis hypoleucos</i>)	Spectacled tern (<i>Onychoprion lunatus</i>)
Common tern (<i>Sterna hirundo</i>)	Swinhoe's snipe (<i>Gallinago megala</i>)
Eastern cattle egret (<i>Bubulcus coromandus</i>)	Tufted duck (<i>Aythya fuligula</i>)
Eurasian coot (<i>Fulica atra</i>)	Wandering tattler (<i>Tringa incana</i>)
Eurasian wigeon (<i>Anas penelope</i>)	Whimbrel (<i>Numenius phaeopus</i>)
Gadwall (<i>Anas strepera</i>)	White-tailed tropicbird (<i>Phaethon lepturus</i>)
Garganey (<i>Anas querquedula</i>)	White tern (<i>Gygis alba</i>)
Grey-tailed tattler (<i>Tringa brevipes</i>)	White-throated ground-dove (<i>Gallicolumba xanthonura</i>)
Green-winged teal (<i>Anas carolinensis</i>)	White-winged tern (<i>Chlidonias leucopterus</i>)
Intermediate egret (<i>Egretta intermedia</i>)	Wood sandpiper (<i>Tringa glareola</i>)
Lesser sand plover (<i>Charadrius mongolus</i>)	Yellow bittern (<i>Ixobrychus sinensis</i>)
Mariana common moorhen (<i>Gallinula chloropus guami</i>)	

Sources: Reichel and Glass 1991; Vogt and Williams 2004; Camp et al. 2009, 2012; Kessler 2009; DoN 2013a; U.S. Fish and Wildlife Service 2013; Gill and Donsker 2014.

Numerous grey-tailed tattlers and wandering tattlers, Pacific reef herons, black noddies, and white terns (including one large colony of more than 30 birds), all protected under the Migratory Bird Treaty Act, were recorded during 2008 shoreline surveys of the Military Lease Area. More shorebirds and seabirds were observed along the western coastline that consists of flat coralline shelves along the water with large boulders in the bays and protection from the prevailing winds (Kessler 2009).

In support of this EIS/OEIS, forest bird surveys were conducted in June 2013 along transects previously surveyed by the U.S. Fish and Wildlife Service in 1982, 1996, and 2008 (Camp et al. 2012; DoN 2014a). Three species protected under the Migratory Bird Treaty Act were detected, including collared kingfisher, Mariana fruit dove, and white-throated ground-dove. Based on these surveys, estimates of species abundance and density on Tinian are available, and detailed discussion is provided below.

3.9.4.4.2.1 Collared Kingfisher

Abundance estimates for collared kingfishers across the four survey efforts (1982, 1996, 2008, and 2013) varied greatly, with a high of approximately 7,300 birds in 2008, and a low of 842 birds in 1982. While the 2013 estimates showed a decrease in kingfisher abundance and density compared to 2008, the 2013 estimates were similar to the 1996 estimates. In terms of abundance and density by habitat type, there were significant decreases in density from 2008 to 2013 in limestone forest, secondary forest, and tangantangan habitats. Although there was a decrease in abundance and density from 2008 to 2013, the overall trend for collared kingfisher abundance and density since 1982 is increasing (DoN 2014a).

3.9.4.4.2.2 Mariana Fruit Dove

Abundance estimates for Mariana fruit doves across the four survey efforts varied from a high of approximately 6,600 birds in 1982, to a low of 2,445 birds in 1996. In terms of abundance and density by habitat type, there were decreases in density from 2008 to 2013 in herbaceous-scrub and tangantangan habitats. The overall trend for Mariana fruit dove abundance and density since 1982, however, is increasing (DoN 2014a).

3.9.4.4.2.3 White-throated Ground-Dove

Abundance estimates for white-throated ground-doves across the four survey efforts varied greatly and showed an increase across all years, with a high of approximately 4,500 birds in 2013, and a low of 535 birds in 1982. In terms of abundance and density by habitat type, there were no significant changes in density from 2008 to 2013. Overall, the trend for white-throated ground-dove abundance and density since 1982 is increasing (DoN 2014a).

3.9.4.4.3 CNMI-Listed Species

The Mariana common moorhen, Micronesian megapode, Mariana fruit bat, and green and hawksbill sea turtles are all CNMI-listed threatened/endangered species. These species are discussed above within the *Federal Endangered Species Act-listed and Proposed Species* section. One other species, the Micronesian gecko, is a CNMI-listed species.

3.9.4.4.3.1 Micronesian Gecko

The Micronesian gecko is native to Micronesia and is the only CNMI-listed threatened/endangered terrestrial reptile in the CNMI. This gecko has never been abundant on Tinian. It was believed to no longer exist on the island after 1946 but was collected in southern Tinian in August 2003, was sighted in 2007 near Mount Lasso, and was collected in limestone forest on Mount Lasso in 2008 (see [Figure 3.9-3](#)) (Rodda et al. 2009; DoN 2010b).

3.9.5 Pagan

3.9.5.1 Vegetation Communities

Pagan consists of two high volcanic cones connected by a wide, low isthmus. A 2010 vegetation survey found that the vegetation communities have been shaped by three primary forces: (1) cultivation and alteration of land cover by humans; (2) grazing and browsing actions of feral domestic animals; and (3) volcanic eruptions that have produced vast quantities of lava and fragmented material (Pratt 2010).

A total of 215 vascular plant species were observed in the 2010 survey. An additional 84 vascular plant species not observed in the 2010 survey were observed in previous vegetation surveys for a total of 299 plant species recorded on Pagan (Pratt 2010).

Non-native plants make up a significant component of the flora of Pagan, with the number of non-native species increasing over the last 50 years. Fosberg (1958, 1960) compiled a list of plant species reported from Pagan based on collections from 1930-1950 and listed 59 non-native plant species and 8 intentional Chamorro introductions. The 2010 vegetation survey documented 102 non-native plant species, an increase of 35 species or 52% since 1950. New non-native plant species recorded in 2010 included ivy gourd (*Coccinia grandis*), which is a serious, rapidly growing pest. Because non-native plant introductions are occurring at a rapid pace and occur over large areas of the island, they are considered a substantial threat to ecosystem health on Pagan (Pratt 2010).

Surveys in 2000 and 2010 found the island’s forests and grasslands “severely overgrazed” due to the abundance of feral cattle, goats, and pigs that have done considerable damage to island vegetation. Overgrazing has resulted in large open areas susceptible to soil erosion. There is a significant lack of native ground cover, deterioration of the forest cover, and a distinct browse line within the vegetation communities where grazing by non-native ungulates (e.g., cattle, goats, pigs) is seen (Cruz et al. 2000; Kessler 2011a).

Supplementing the vegetation survey by Pratt (2010), vegetation communities on Pagan were mapped by Rogers (2010) and are shown in [Figure 3.9-5](#) with the acreages listed in [Table 3.9-5](#).

Table 3.9-5. Vegetation Communities – Pagan

<i>Vegetation Community</i>	<i>Acres</i>	<i>Percent</i>
Casuarina Forest	3,197	27.8
Barren (lava or cinder)	2,531	22.0
Grassland	1,706	14.8
Herbaceous-Scrub	1,362	11.8
Barren (bare ground)	937	8.1
Coconut Forest	858	7.5
Native Forest	418	3.6
Mixed Native-Introduced Forest	398	3.5
Water (Lake)	67	<1
Sand	28	<1
Total	11,502	100

Source: Rogers 2010.

Current Pagan vegetation communities described below are based on Rogers (2010) and Pratt (2010).

3.9.5.1.1 Casuarina Forest

This vegetation community consists of forests of pure ironwood or dominated by ironwood. This species is generally accepted as native to the Mariana Islands and seems to be an early successional species that then deters the growth of other species due to a dense layer of fallen needle-like branches that have compounds inhibiting the growth, survival, and reproduction of other plant species within the immediate vicinity (Pratt 2010).

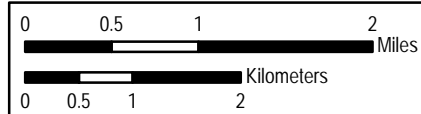
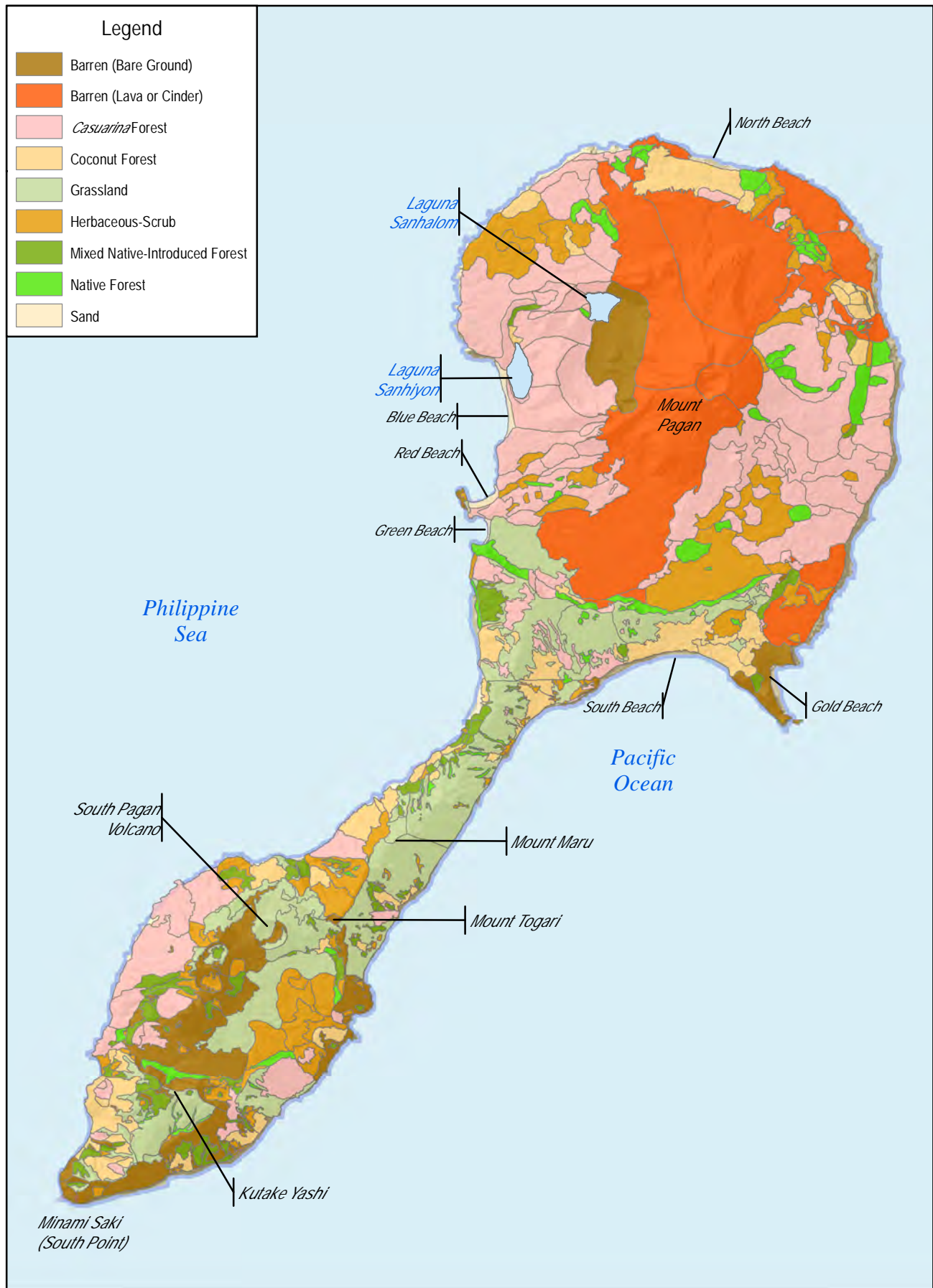


Figure 3.9-5
Vegetation Communities - Pagan

3.9.5.1.2 Barren (Lava, Cinder, or Ground)

Barren areas of lava or cinder are found on the northern half of Pagan and consist of land completely covered by volcanic material. Areas of barren ground not covered by lava do not support any vegetation and are found island-wide.

3.9.5.1.3 Grassland

This vegetation community consists of either swordgrass (*Miscanthus floridulus*) or golden false beardgrass (*Chrysopogon aciculatus*), sometimes mixed with Siam weed (*Chromolaena odorata*) (Rogers 2010). Pratt (2010) noted that swordgrass appears to be the dominant grass in the isthmus connecting the northern and southern parts of the island, but other grass species are dominant in northern Pagan.

3.9.5.1.4 Herbaceous-scrub

This vegetation community is open or lava-covered land with a discontinuous canopy cover of grass, shrubs, and/or trees. Rogers (2010) mapped this community in northern Pagan as “lava scrub” or “scrub.” Scrublands on northern Pagan occur on relatively young substrates and primarily are composed of native species such as hopseed bush (*Dodonaea viscosa*).

3.9.5.1.5 Coconut Forest

Coconut forest vegetation communities are prominent on both northern and southern Pagan. Groves of coconut palm are generally in areas formerly used as coconut plantations, and some areas may have been developed during initial habitation by Chamorro people (Pratt 2010). Coconut forests, typically composed of three to eight native tree species in the canopy (Pratt 2010), were estimated to cover 19% of the island in 2000 (Cruz et al. 2000). Rogers (2010) identified a reduced cover of only 7.5%.

3.9.5.1.6 Native Forest

Native forest has been significantly reduced on Pagan by World War II, widespread planting of non-native species, non-native ungulate grazing, periodic development, deforestation, and volcanic eruptions. Native forests on Pagan are important as this habitat provides for the majority of Pagan’s native species, including special-status species, as well as maintaining water quality and reducing fire risk (Morton et al. 2000; Tang et al. 2011; DoN 2014a).

Native forests on northern Pagan, other than those dominated by ironwood, are observed at the base of the old caldera wall north of the isthmus, and growing on rocky substrates of the northeastern slopes. Species include *Aglaia mariannensis*, *Psychotria mariana*, *Neisosperma oppositifolia*, and *Ochrosia mariannensis* (Pratt 2010).

Prior to the 1981 eruption of Mount Pagan and the release and increase in feral animals, native broad-leaf forests were more widespread. Fosberg (1960) reported these forests in the vicinity of Sanhalom Lake (i.e., Upper Lake), and from the north and south slopes of Mount Pagan. In 2010, Sanhalom Lake was surrounded by ironwood forest, with only scattered individuals of other plant species. The release and increase in feral animals also impacted native forests in other areas on Pagan (Pratt 2010).

Common tree species of native forests on southern Pagan include ironwood and the small trees *Aglaia mariannensis* and *Psychotria mariana*. Several uncommon or rare species, some of which were new records for Pagan during the 2010 surveys, were noted in an area referred to as “cycad ravine” in

southern Pagan. This includes *Cycas micronesica*, *Chamaesyce serrulata*, *Cordia subcordata*, *Cynometra ramiflora*, *Pisonia grandis*, and *Melochia villosissima*. The rugged nature of the southern forests, the lack of grazing cattle, and the lack of recent cultivation of land have likely been the reason for the presence of a greater native woody plant diversity and abundance in the south versus the north (Pratt 2010).

3.9.5.1.7 Mixed Native-introduced Forest

The mixed native-introduced forest vegetation community is a general category for forests that do not fall within another category (Rogers 2010). These forests are often dominated by one or more of the native trees *Aglaia mariannensis*, *Psychotria mariana*, ironwood, *Neisosperma oppositifolia*, or *Ochrosia mariannensis*, and the introduced tangantangan or physic nut (*Jatropha curcas*).

3.9.5.1.8 Water (Lake)

This community consists of two lakes: Lagunas Sanhalom and Sanhiyon (Upper Lake and Lower Lake, respectively).

3.9.5.1.9 Sand

Sand occurs on the beach areas.

3.9.5.1.10 Rare Plants

Several species were noted as rare in the 2010 survey.

Chamaesyce serrulata, a small shrub, was present in southern Pagan. The description in Pratt (2010) noted that this species was previously known only from the southern Marianas (Fosberg et al. 1979). Synonym names for the species were listed as present on Pagan in Raulerson's (2006) checklist of the Mariana Islands. Based on this information, the taxonomy of this species is unclear. *Chamaesyce serrulata* is not on the Costion and Lorence (2012) Micronesia endemics list. No other definitive information about the species, including its current status on other Mariana Islands, is known.

Hedyotis scabridifolia, a shrub, was listed in Pratt (2010) but was not documented during the 2010 survey. This species is listed as present on Pagan and Saipan by Raulerson (2006), and is listed as being an endemic species to the Mariana Islands (Costion and Lorence 2012). Wagner et al. (2012) specifies two varieties, var. *stonei* (present on Guam and Rota) and var. *scabridifolia* (present on Saipan). The omission of Pagan as a location for the variety *scabridifolia* on the Wagner et al. (2012) list may be in error because its presence on Pagan was reported by Fosberg et al. (1975) and Raulerson (2006). The eruptions in 1981 and 1986 would have eliminated the species from Mount Pagan because lava flows destroyed the area where this species was formerly reported to have occurred.

Ischaemum longisetum var. *raulersoniae* is a grass reported by Pratt (2010) as rare but present near the peaks of southern Pagan. This species is reported as native to the Mariana Islands (Costion and Lorence 2012), with the variety found on Pagan reported on four other northern Mariana islands (Raulerson 2006).

Lagenophora lanata is a small herb in the composite family occurring widely on southwestern Pacific islands. Prior to its reported occurrence near the southern peaks on Pagan by Pratt (2010), this species had been previously reported only from the Mariana Islands on Alamagan (Raulerson 2006). The current status of the species on other Mariana Islands is unknown.

3.9.5.2 Native Wildlife

Based on previous island-wide wildlife surveys that were conducted between 2000 and 2010, the following native terrestrial wildlife species have been observed on Pagan: 15 birds, 1 mammal, 7 reptiles, and over 400 invertebrate species (Cruz et al. 2000; Commander, U.S. Naval Forces Marianas 2004; Berger et al. 2005; Marshall and Amidon 2010; Reed et al. 2010; Vogt 2010a, 2010b; Kessler 2011b). Special-status species are addressed separately under [Section 3.9.5.4, Special-status Species](#).

3.9.5.2.1 Birds

Within the last decade, 15 landbird, seabird, and wetland bird species were observed during surveys on Pagan. All are protected under the Migratory Bird Treaty Act except for the Micronesian starling, Micronesian honeyeater, and Micronesian megapode (U.S. Fish and Wildlife Service 2013) (see [Section 3.9.5.4, Special-status Species](#) for a list of those protected under the Migratory Bird Treaty Act). The most commonly observed birds during the 2010 survey were the Micronesian starling, Micronesian honeyeater, white tern, and collared kingfisher (Marshall and Amidon 2010; Kessler 2011b). The Endangered Species Act-listed Micronesian megapode is discussed below in [Section 3.9.5.4, Special-status Species](#).

3.9.5.2.2 Mammals

Only one native terrestrial mammal species is currently known to occur on Pagan, the endangered Mariana fruit bat. This species is discussed in [Section 3.9.5.4, Special-status Species](#).

3.9.5.2.3 Reptiles

Native reptile species found during the 2010 surveys include mourning gecko, Indo-Pacific house gecko, Pacific slender-toed gecko (*Nactus pelagicus*), Pacific blue-tailed skink, oceanic snake-eyed skink, and Brahminy blindsnake. Slevin's skink is proposed for listing under the Endangered Species Act and is discussed in more detail in [Section 3.9.5.4, Special-status Species](#).

The occurrence of the federal Endangered Species Act-listed green and hawksbill turtles in the marine environment is addressed in Section 3.10, *Marine Biology*, and potential beach nesting areas are discussed in [Section 3.9.5.4, Special-status Species](#).

3.9.5.2.4 Amphibians

There are no native amphibians on Pagan.

3.9.5.2.5 Invertebrates

A terrestrial arthropod survey conducted in 2010 identified 288 species, bringing the total number of known arthropod species on Pagan to 416. Eight of these species are endemic to Pagan (Evenhuis et al. 2010). Coconut crab populations have declined on Pagan within the last few decades, and only one crab was captured on Pagan during a recent 2010 survey. However, coconut crabs were common in the past on the southeast side of the island, which was not sampled in this study. The decline in the coconut crab population may be a result of feral pig depredation as well as direct mortality and degradation of habitat from the 1981 volcanic eruption. In addition to being a highly valued game species in the CNMI, coconut crabs serve important ecological functions as scavengers and seed dispersers (Vogt 2010a).

The humped tree snail is proposed for listing under the federal Endangered Species Act and is discussed in [Section 3.9.5.4, Special-status Species](#).

3.9.5.3 Non-native Wildlife

3.9.5.3.1 Birds

The only non-native bird species on Pagan is the red junglefowl (feral chicken).

3.9.5.3.2 Mammals

Non-native mammals found on Pagan include the Oriental house rat (*Rattus tanezumi*), dogs, cats, pigs, goats, and cattle. It is unknown when these domesticated animals were first brought to Pagan, but it is assumed that the pigs and goats were first introduced in the 1600s with the Spanish and after that during attempts to colonize Pagan in the 1800s. Cattle were brought to the island during the German and Japanese administration (early 1900s) when the island was developed for copra production. All livestock were abandoned in 1981 following the volcanic eruption. Surveys of feral ungulates in 2010 resulted in island-wide estimates of approximately 260 cattle, 1,180 pigs, and 3,160 goats. Cattle were found only in northern Pagan, while pigs and goats were observed throughout the island. As a result of the feral ungulate populations, the island vegetation has a long history of being severely overgrazed, particularly in the north (Adams et al. 2010; Amidon et al. 2011; Kessler 2011a).

3.9.5.3.3 Reptiles

Three non-native reptiles were observed during the 2010 survey: mutilating gecko, oceanic gecko, and mangrove monitor lizard. The mutilating gecko was the most common of the three, with densities of 202-364 per acre (500-900 per hectare). The oceanic gecko is currently rare on Pagan, with only two individuals found during the 2010 survey. These non-native geckos could pose a threat to native geckos. Only five observations of the mangrove monitor lizard were made during the 2010 survey. While the population size of the mangrove monitor lizard is unknown, there are thought to be scattered patches of higher densities, with it being more common on the southern peninsula. The mangrove monitor lizard may be a threat to megapodes as they are known to eat megapode eggs (Reed et al. 2010; Vogt 2010b).

3.9.5.3.4 Amphibians

There are no non-native amphibians on Pagan.

3.9.5.3.5 Invertebrates

The highly invasive, non-native crazy ant (*Anoplolepis gracilipes*) is abundant on Pagan. This species can form super colonies, and when they occur in high densities, can devastate plant and invertebrate organisms, thereby posing a potential threat to food resources of the Mariana fruit bat and Micronesian megapode. No super colonies were observed during 2010 surveys, and it is believed that they currently pose no direct threats to megapode or fruit bat populations (Evenhuis et al. 2010).

Evidence of three non-native snail species was found during the 2010 surveys. One single living giant African snail was found along with shells of the land snail *Subulina octona* and the predatory snail *Gonaxis kibweziensis*. These species were observed during surveys on Pagan in 1949 and 1994 and at that time were widely dispersed. The giant African snail was likely introduced for food, while *G.*

kibweziensis was introduced to control the giant African snail, and *S. octona* was most likely introduced by accident on food plants from human migrations (Hadfield 2010).

3.9.5.4 Special-status Species

3.9.5.4.1 Federal Endangered Species Act-listed and Proposed Species

Eight federal Endangered Species Act-listed threatened, endangered, or proposed species have been observed on Pagan (Table 3.9-6 and Figure 3.9-6). These species are discussed below. Two other federally listed species, the nightingale reed-warbler (*Acrocephalus luscinia*) and Mariana common moorhen, are presumed to no longer exist on Pagan (Marshall and Amidon 2010) and are not discussed further.

Table 3.9-6. Occurrence of Federally Endangered Species Act-Listed and Proposed Species and CNMI-Listed Species on Pagan

English Name	Status*		Habitat	Occurrence
	ESA	CNMI		
Birds				
Micronesian megapode	E	E/T	Limestone forest, mixed native-introduced forest, and coconut forest.	In 2010, approximately 147 birds were estimated to occur on Pagan.
Mammals				
Mariana fruit bat	T	E/T	Limestone forest, coastal forest, and coconut forest.	Two colonies in the southeast and one in the northeast portions of Pagan, consisting of an estimated 1,017 individuals.
Reptiles				
Green sea turtle	T	E/T	Suitable beaches for basking and nesting. †	No known nesting records.
Hawksbill sea turtle	E	E/T		
Slevin’s skink	PE	-	Mid-elevation closed humid forest and montane forest ecosystems	Although Slevin’s skink was not observed during the 2010 surveys on Pagan, it was collected during a survey in 1999 on the southern part of the island.
Invertebrates				
Humped tree snail	PE	-	Intact native forest.	Found within the ancient caldera rim of South Pagan volcano.
Plants				
<i>Cycas micronesica</i>	PT	-	Forest and savanna ecosystems.	Recently reported on Pagan in ravines of the southern part of the island.
<i>Bulbophyllum guamense</i>	PE	-	Forest ecosystems.	Historically this species occurred on Pagan, but has not been observed since 1984.

Legend: *E = endangered; ESA = federal Endangered Species Act; PE = proposed endangered; PT = proposed threatened; T = threatened; E/T = the CNMI Administrative Code does not specify whether a species is threatened or endangered: all species are considered threatened *and* endangered; - = not listed.

†Occurrence of sea turtles in the marine environment is addressed in Section 3.10, *Marine Biology*.

Sources: Hadfield 2010; Marshall and Amidon 2010; Valdez 2010; Amidon et al. 2011; U.S. Fish and Wildlife Service 2012a, 2014.

Note: Species observations are historical sightings over multiple years and multiple surveys and do not represent the current population status or distribution of species within the depicted area.

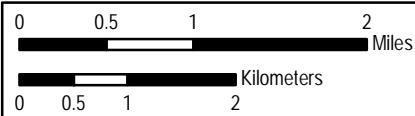
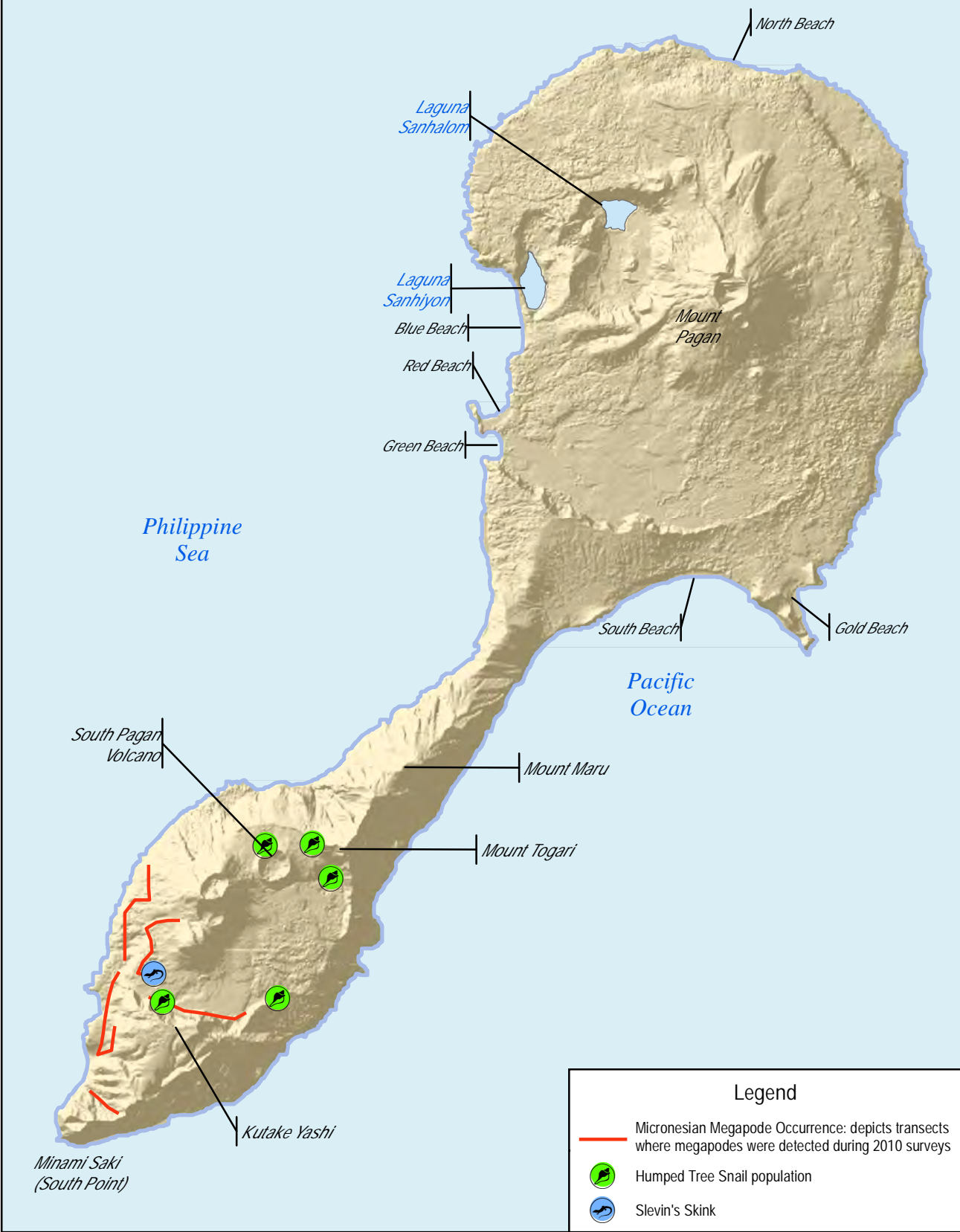


Figure 3.9-6
Occurrence of Special-Status
Species - Pagan

Sources: Reed et al. 2010; Amidon et al. 2011



3.9.5.4.1.1 Micronesian Megapode

The Micronesian megapode has been extirpated (i.e., no longer exists) on Guam and Rota, two of the largest southern Mariana Islands, and large populations are only found on three uninhabited northern islands: Sarigan, Guguan, and Asuncion. Megapodes were reported common on Pagan in the 1950s and 1960s; however, populations have been reported low since Mount Pagan's 1981 eruption that buried at least one nesting area. During surveys in 2010, megapodes were observed only within the southern portion of Pagan within *Casuarina*, coconut, and mixed native-introduced forests (see [Figure 3.9-6](#)).

Based upon the 2010 surveys, it was estimated that there were approximately 147 Micronesian megapodes on Pagan. This estimate was slightly higher than the 1990s and 2000 surveys that estimated 50-100 and 134 birds, respectively. The main threats affecting this species are habitat loss and degradation mainly due to forest clearing and browsing by feral goats, pigs, and cattle, and depredation by introduced species, including mangrove monitor lizards, pigs, dogs, and cats. Heavy grazing by feral livestock also prevents megapode occurrence on the northern half of the island (Amidon et al. 2011).

3.9.5.4.1.2 Mariana Fruit Bat

During surveys in 2010, two fruit bat colonies were observed on southern Pagan (Valdez 2010). One colony was estimated to have 347 bats, while the other colony was estimated to have 670 bats. The survey team also attempted to find a colony of an estimated 200 bats on northern Pagan that was reported by a field technician assisting with other biological surveys on Pagan in June 2010. However, this colony was not found during the July 2010 fruit bat surveys. The survey team suspected that fruit bats from the colony on the northern end may have moved to one or both of the two colonies on the southern end of the island.

During a helicopter flight over Pagan, the survey team noticed that the majority of food sources for the fruit bat were isolated in small patches on the northern end of the island and scattered along the ravines of the southern end of the island. It is thought that the Mariana fruit bat population on Pagan continues to be impacted by habitat degradation or loss from feral animals, as well as from illegal hunting (Valdez 2010).

3.9.5.4.1.3 Sea Turtles

No sea turtle nesting crawls were observed on Pagan's eastern and western beaches during weekly beach surveys conducted by the CNMI Division of Fish and Wildlife sea turtle tagging team during the June 2010 surveys (Kessler 2011b). Sea turtle nesting on Pagan may be impacted by the high densities of feral pigs and cows using and degrading beach habitat. One juvenile green sea turtle was observed resting on Red Beach during the 2010 surveys (Kessler 2011b). In addition, seven beaches on Pagan were surveyed in July of 2013. No active or past nesting activity was observed on any of these beaches (DoN 2014c). The occurrence of sea turtles in the nearshore waters of Pagan is discussed in Section 3.10, *Marine Biology*.

3.9.5.4.1.4 Slevin's Skink

Slevin's skink is known to inhabit mid-elevation closed humid forest and montane forest ecosystems, with most individuals observed on the forest floor using leaf litter as cover. Occasionally, individuals have been observed in low hollows of tree trunks (U.S. Fish and Wildlife Service 2014). Surveys for terrestrial reptiles were conducted by U.S. Geological Survey biologists on Pagan in 2010 (Reed et al.

2010). Although Slevin’s skink was not observed during these surveys, the species was collected in the southern part of Pagan during a CNMI Division of Fish and Wildlife survey in 1999 (see [Figure 3.9-6](#)). Slevin’s skink may still be present on Pagan, but if so, it occurs in small numbers (Reed et al. 2010).

3.9.5.4.1.5 Humped Tree Snail

The distribution of the humped tree snail currently extends from Guam, north to Pagan and includes, or once included, populations on nine islands. During the 2010 surveys on Pagan, 345 humped tree snails were found within five survey transects located in the old caldera of the southern volcano (see [Figure 3.9-6](#)). The snails were found only in forests of mixed native vegetation with relatively dense understory and ground cover. The humped tree snail was not found in forests around Mount Pagan where the snail had been collected in 1949. Their absence in the north is most likely due to the impacts from the 1981 eruption and the intense grazing from feral cattle. Non-native snail species could also be a potential threat to the humped tree snail. Evidence of non-native predatory snail species *Gonaxis kibweziensis* was found on Pagan during the 2010 surveys (Hadfield 2010).

3.9.5.4.1.6 *Cycas micronesica*

Cycas micronesica is a tree currently known to occur in the forest and savanna ecosystems of Guam, Rota, Palau, and Yap (Raulerson 2006; U.S. Fish and Wildlife Service 2014), and was recently reported on Pagan in ravines of the southern part of the island (Pratt 2010).

3.9.5.4.1.7 *Bulbophyllum guamense*

Bulbophyllum guamense is an epiphytic orchid that occurs in mat-like formations on tree branches of forest ecosystems. Currently it is known from widely distributed occurrences on the southern Mariana Islands of Guam and Rota. Historically this species occurred on Pagan, but has not been observed since 1984 (U.S. Fish and Wildlife Service 2014).

3.9.5.4.2 Species Protected under the Migratory Bird Treaty Act

Twelve species that are protected under the Migratory Bird Treaty Act have been observed on Pagan ([Table 3.9-7](#)). The majority (nine species) are seabirds.

Table 3.9-7. Bird Species Occurring on Pagan and Protected under the Migratory Bird Treaty Act

Black noddy (<i>Anous minutus</i>)	Red-footed booby (<i>Sula sula</i>)
Brown booby (<i>Sula leucogaster</i>)	Red-tailed tropicbird (<i>Phaeton rubricauda</i>)
Brown noddy (<i>Anous stolidus</i>)	Sooty tern (<i>Onychoprion fuscatus</i>)
Collared kingfisher (<i>Todiramphus chloris</i>)	White-tailed tropicbird (<i>Phaeton lepturus</i>)
Masked booby (<i>Sula dactylatra</i>)	White tern (<i>Gygis alba</i>)
Pacific reef heron (<i>Egretta sacra</i>)	White-throated ground-dove (<i>Gallicolumba xanthonura</i>)

Sources: Reichel and Glass 1991; Vogt and Williams 2004; Camp et al. 2009; Kessler 2009; Camp et al. 2012; DoN 2013a; Gill and Donsker 2014.

3.9.5.4.3 CNMI-Listed Species

The federally listed Micronesian megapode, Mariana fruit bat, and green and hawksbill sea turtles are also listed as threatened/endangered by the CNMI. These species are discussed in detail above within the *Federal Endangered Species Act-listed and Candidate Species* section.