

1 **Mammals**

2 ***Mariana fruit bat.*** An islandwide survey for fruit bats was conducted in 1984 and included an
3 observation station on Mount Barrigada near the Communications Site Barrigada. No fruit bats were
4 observed at this location despite potential fruit bat foraging habitat on the south side of Mount Barrigada
5 within the installation boundaries (Wiles 1987b). No fruit bats were observed during surveys of
6 Communications Site Barrigada in 2008 (Brooke 2008). Limited Mariana fruit bat foraging habitat still
7 exists within the installation boundary on the south side of Mount Barrigada.

8 **Invertebrates**

9 **Gastropods**

10 In 1920, Crampton (1925) surveyed a location in Barrigada and found three species of partula tree snails
11 including the humped tree snail, Guam tree snail, and the fragile tree snail. A re-survey of the Baragada
12 site by Hopper and Smith (1992) did not detect any living tree snails. Natural resources surveys
13 conducted at Communications Site Barrigada in 2009 detected Guam tree snails in forested habitats on
14 the installation (DoN 2010).

15 ***Flora***

16 There are no known Federal- or Guam-listed plants at Communications Site Barrigada.

17 **4.5.2.6 Invasive Species**

18 ***Flora***

19 Common introduced species in the forested areas on Communications Site Barrigada include custard
20 apple, limeberry, and tangantangen (NAVFAC Pacific 2010b).

21 ***Fauna***

22 Introduced bird species occurring on Communications Site Barrigada include the island collared dove,
23 black drongo, Eurasian tree sparrow, and black francolin. These species are common, introduced,
24 breeding residents on Guam (NAVFAC Pacific 2010b).

25 Four introduced herpetofauna species were documented on Communications Site Barrigada during 2008–
26 2009 herpetofauna surveys: curious skink, house gecko, greenhouse frog, and Hong Kong whipping frog
27 (NAVFAC Pacific 2010b). The continued widespread presence of curious skink and other introduced
28 amphibian species is of concern because of each species' potential deleterious impacts on Guam's native
29 fauna. Of particular concern is the ability of the introduced species to serve as additional food sources for
30 the brown treesnake (NAVFAC Pacific 2010b).

31 Shells of the introduced giant African snail and both live individuals and shells of the introduced snail
32 *Satsuma mercatoria* were observed on Communications Site Barrigada during the 2008–2010 tree snail
33 surveys. Additionally, live introduced Manokwar flatworms, which are predators of land snails, were
34 observed on the installation (NAVFAC Pacific 2010b).

1 4.6 Andersen Air Force Base

2 4.6.1 General Physical Environment

3 4.6.1.1 Climate

4 The climate at Andersen AFB is the same as the climate for Guam as a whole. See **Section 4.1.1.1** for a
5 description of the climate on Guam.

6 4.6.1.2 Geology and Topography

7 Andersen AFB is situated on the northern plateau, which is underlain by massive limestone formations
8 (see **Figure 4-1**). The limestone plateau's elevation ranges from 295 to 590 feet (90 to 180 meters) above
9 msl. Steep cliffs surround the plateau on the north, east, and west with a narrow coastal lowland terrace at
10 the bottom of the cliffs. This coastal terrace is 300 to 900 feet (90 to 270 meters) wide from the base of
11 the cliff to the ocean (see **Figure 4-2**).

12 Andersen AFB overlies limestone, consisting primarily of younger age rocks (Pliocene to Pleistocene,
13 1.5–5 million years old). The upper few hundred feet of the plateau are composed of basalt and andesite,
14 sedimentary rock, and limestone (U.S. Navy 2009). The area is karst and cavities and sinkholes occur in
15 the porous limestone. A large sinkhole (IRP Site 66), approximately 700 feet by 900 feet (213 meters by
16 274 meters), is located on the northeastern portion of the installation, near the coastline. Rainwater easily
17 percolates through the porous limestone (Gingerich 2003).

18 The coastline is composed of a relatively narrow margin of beach interspersed with basalt or limestone
19 rock formations. Beach deposits consist of beach sand and gravel, beach rock in the intertidal zone, and
20 patches of recently emerged detrital limestone (USGS 1992). A fringing reef extends around the coastline
21 to approximately 200 feet (61 meters) offshore. The reef complex begins near shore as a relatively flat
22 back-channel or moat (from 5 to 10 meters deep) that consists of large areas of flat, hard pavement with
23 encrusting corals (Chirichetti et al. 1993). This deeper channel becomes shallower as it rises to the reef
24 crest on the seaward side, which is formed by terraced algal pools. The reef complex is transected at
25 various points by cracks or fissures (called “spur-and-groove” zones) that create shallow to slightly
26 deeper pools in the back reef. These grooves run roughly parallel to the shoreline and can merge with the
27 reef crest where they create deeper pools that are protected by the reef crest but well-washed with waves.
28 These are the areas of the highest coral diversity on the reef flat. Natural cuts on the reef (e.g., Tarague
29 Cut) are dangerous areas where water constrained by the fringing reef is funneled back out to sea. The
30 ocean bottom drops off abruptly just past the reef (USAF 2009).

31 4.6.1.3 Seismology

32 Tectonic uplift and sea level variations are apparent on Andersen AFB in the exposed limestone plateau
33 and terraced escarpments (USAF 2009). The Mount Santa Rosa Fault Line is located just south of
34 Andersen AFB and smaller fault lines are located throughout the installation. Andersen AFB is
35 susceptible to earthquake events; however, the overall likelihood for the occurrence of landslides on
36 northern Guam is generally low due to the lack of steep areas that contain soil vulnerable to slipping in
37 seismic events. The Guam Hazard Mitigation Plan reports that the northern portion of Andersen AFB has
38 a high risk of liquefaction. The maximum reported tsunami wave height reached on Guam was
39 approximately 12 feet (4 meters) in an 1849 tsunami event (GHS 2008). The Guam Hazard Mitigation
40 Plan reports that areas most prone to large tsunamis are landmasses that are less than 16 feet (5 meters)
41 above msl (GHS 2008). Because most of Andersen AFB is situated on a plateau with elevations ranging
42 from 295 to 590 feet (90 to 180 meters) above msl, most of Andersen AFB would not be susceptible to

1 tsunami inundation. Coastal areas of Andersen AFB below the cliff line could be susceptible to tsunami
2 inundation.

3 4.6.1.4 Soils

4 The majority of Andersen AFB is within limestone uplands. A thin layer of soil (approximately 4 to
5 10 inches [10 to 25 cm]) covers the northern limestone. Eight soil map units are found on Andersen
6 AFB: Guam cobbly clay loam (3 to 7 percent slopes), Guam cobbly clay loam (7 to 15 percent slopes),
7 Guam-Urban Land complex, Guam-Yigo complex, Ritidian-Rock Outcrop complex (3 to 15 percent
8 slopes), Ritidian-Rock Outcrop complex (15 to 60 percent slopes), Rock Outcrop-Ritidian complex, and
9 Shioya loamy sand. There are four soil series composing the mapping units including the Guam, Yigo,
10 Ritidian, and the Shioya series. The Guam series consists of well-drained, very shallow soils with
11 moderately rapid permeability overlying limestone bedrock. They are on uplifted limestone plateaus and
12 formed in sediments that overlie porous coralline limestone. The Yigo series consists of deep and very
13 deep, well-drained soils that have moderate permeability. They are in depressions on limestone plateaus
14 and formed in sediments overlying porous coralline limestone. The Ritidian series consists of very
15 shallow, well-drained soils of moderately rapid permeability occurring on limestone plateaus and
16 escarpments. They formed in slope alluvium, loess, and residuum from sediments overlying coralline
17 limestone. The Shioya series consists of deep and very deep, rapidly permeable, excessively drained
18 soils. They occur on coastal strands and formed in water-deposited coral sand (NRCS 1988).
19 **Figure 4-22** shows the locations of soil map units occurring on Andersen AFB.

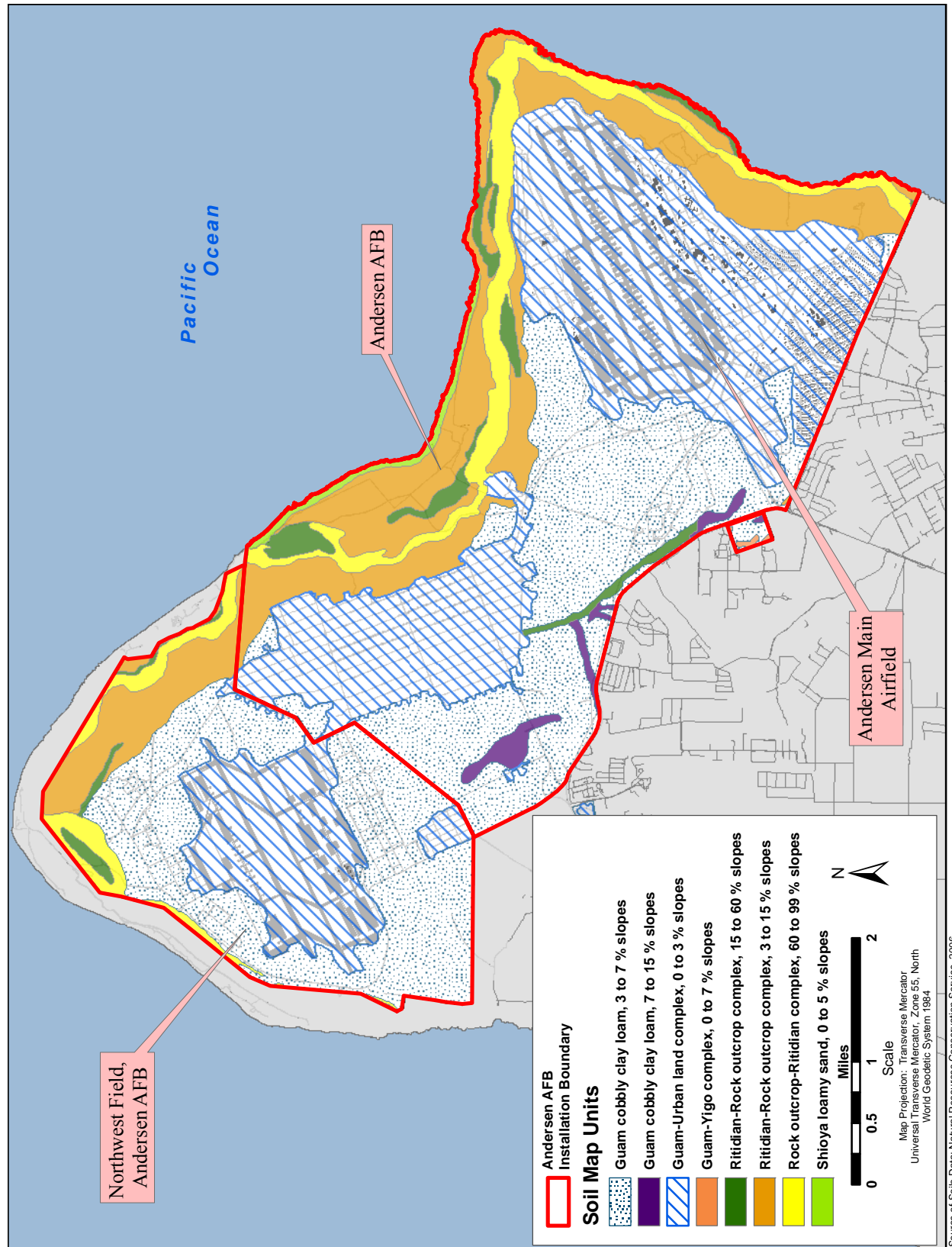
20 Soil formation on northern Guam is the result of intense weathering of the permeable limestone to form
21 the silica-poor soils that are rich in iron oxides and gibbsite clays (NRCS 1988). Soils on Andersen AFB
22 are classified as limestone upland. These soils exhibit moderately rapid permeability and low water
23 capacity (NRCS 1988). A thin layer (from 4 to 10 inches [10 to 25 cm]) of Guam cobbly clay loam
24 overlies the northern limestone substrate, contributing to a shallow vegetation root structure (PACAF
25 2006). Erosion does not present a significant problem on Andersen AFB because it is generally located
26 on a broad limestone reef plateau underlain by volcanic rocks.

27 The South Ramp, North Ramp, and much of Northwest Field and the Munitions Storage Area (MSA) are
28 in areas classified as Guam-Urban Land complex with 0–3 percent slopes. This soil complex is described
29 by the NRCS (1988) as consisting of 55 percent Guam cobbly clay loam and 45 percent Urban Land.
30 Urban land consists of land developed with roads, buildings, parking lots, and airstrips. A small part of
31 the North Ramp and the North Gate Access Road contain Guam cobbly clay loams with 3–7 percent
32 slopes.

33 4.6.1.5 Hydrology

34 **Groundwater.** Groundwater under Andersen AFB is encountered at around sea level, which averages
35 around 450 feet (137 meters) below the ground surface under the limestone plateau in the vicinity of the
36 installation.

37 Andersen AFB overlies the northern portion of three groundwater subbasins: the Finegayan subbasin
38 under the western third of the installation; the Agafa Gumas subbasin under the central portion of the
39 installation, which includes Northwest Field; and the Andersen subbasin under the eastern portion of the
40 installation. Approximately 100 dry wells have been drilled to facilitate the flow of storm water into the
41 underlying basins. While this method of storm water management has the potential to cause groundwater
42 contamination from storm water runoff, proper implementation of the Andersen AFB SWPPP has
43 prevented extensive groundwater contamination (U.S. Navy 2010b). Andersen AFB's water supply
44 comes from groundwater wells on Andersen South.



Source of Soils Data: Natural Resources Conservation Service, 2006

1

2

Figure 4-22. Soils on Andersen AFB

1 **Surface Water.** Because of the high permeability of the limestone substrate, no streams or other natural
2 surface water drainage features occur on Andersen AFB. Rainfall percolates into limestone cavities or is
3 channeled into underground injection control (UIC) wells throughout Andersen AFB. Storm water runoff
4 from impervious surfaces is currently directed via concrete-lined culverts to UIC wells, which are
5 permitted and regulated by GEPA (USAF 2009).

6 4.6.2 General Biotic Environment

7 4.6.2.1 Terrestrial Ecosystems

8 *Flora*

9 Basewide vegetation survey and mapping was conducted on Andersen AFB in 2007 and 2008. This
10 survey included quantitative characterization of 3,211 randomly located plots on 15,371 acres
11 (6,220 hectares) on Andersen AFB proper and the adjacent GNWR on Ritidian Point (e²M 2008).
12 Twenty-two distinct communities (21 vegetative communities and disturbed land) were observed on
13 Andersen AFB within the survey area (e²M 2008). Vegetation community types were named in
14 accordance with the Fosberg (1960) classification, with secondary forest subdivisions based on
15 descriptions of Donnegan et al. 2004. Community types were typically named by the dominant or
16 keystone plant species therein. **Table 4-6** presents the community types identified in the installation wide
17 survey and mapping along with the dominant vegetation species characterizing each community type.
18 **Table 4-7** provides total acreage of each of the community types identified on Andersen AFB within the
19 survey area at the time of the survey. **Figures G7-1a** through **G7-1l** in **Appendix G** provide the maps of
20 vegetative communities occurring on Andersen AFB based on the installation wide vegetation survey and
21 mapping. No wetlands have been identified on Andersen AFB (USAF 2009).

22 Given the change in plant species composition over the past 60 years, more vegetation communities exist
23 and were observed during the installation wide vegetation survey effort, than were reported by Fosberg
24 (1960). **Table 4-8** presents the correlation between the vegetation community categories used by Fosberg
25 (1960) and the 2008 survey. **Table 4-9** presents the correlation between the vegetation community
26 categories used by Donnegan et al. (2004) and the 2008 survey.

27 Because many of the vegetation communities are unique to their geographic location in the landscape of
28 northern Guam, **Figure 4-23** presents the location of the vegetation communities observed by Fosberg
29 (1960) and the 2008 survey (e²M 2008) relative to each other and their location in the landscape.

30 Mixed Limestone Forest

31 The predominant vegetation type in undeveloped areas on Andersen AFB is mixed limestone forest (also
32 called old growth limestone forest or “typhoon forest” due to the unique physiognomy of the forest trees
33 caused by the high winds of typhoons). This vegetative community occurs along portions of the western
34 boundary and the northern and eastern boundaries of the installation, atop the plateau, on the fore slope
35 (cliff face), and at the toe of the cliff slope. Depending on the relative age of the vegetation within the
36 community, mixed limestone forest can be further divided into primary and secondary forests, with
37 primary forests being the historic limestone forest and the secondary being a successional form after
38 primary forests have been impacted by catastrophic forces such as typhoons and intensive military actions
39 (e.g., bombing).

40

1
2**Table 4-6. Vegetation Community Types and Characteristic Species Found on Andersen Air Force Base**

General Vegetation Type	Community Type	Characteristic Species
Mixed Limestone Forest	Mixed Limestone Forest-Plateau/Primary	<i>Ficus, Premna, Neisosperma</i>
	Mixed Limestone Forest-Plateau/Secondary	<i>Vitex, Ficus, Premna, Neisosperma, Guamia, Aglaia</i>
	Mixed Limestone Forest-Fore Slope	<i>Triphasia, Aglaia, Neisosperma, Guamia</i>
	Mixed Limestone Forest-Toe Slope/Primary	<i>Mammea, Aglaia, Cynometra, Hibiscus</i>
	Mixed Limestone Forest-Toe Slope	<i>Guamia, Neisosperma, Hibiscus</i>
Native Strand	Fore Strand/Sand	<i>Scaevola, Tournefortia, Sophora</i>
	Back Strand/Sand	<i>Hernandia, Casuarina, Cocos</i>
	Back Strand/Rock	<i>Callicarpa, Ochrosia</i>
	Strand/Rock	<i>Pemphis</i>
Native Scrub	Hibiscus-Ochrosia Scrub	<i>Hibiscus, Ochrosia, Cestrum, Neisosperma</i>
	Ochrosia Edge	<i>Ochrosia</i>
	Neisosperma Forest	<i>Neisosperma, Aglaia</i>
	Mixed Herbaceous Scrub	<i>Stachytarpheta</i>
	Hibiscus Scrub	<i>Hibiscus</i>
Native Shrub	Mixed Shrub	<i>Triphasia, Cestrum, Hibiscus, Morinda</i>
	Eugenia Forest	<i>Eugenia</i>
Invasive Plants	Coconut Plantation	<i>Cocos</i>
	Casuarina Forest	<i>Casuarina</i>
	Vitex-Closed Canopy	<i>Vitex</i>
	Vitex-Sparse Canopy	<i>Vitex, Guamia, Aglaia</i>
	Hibiscus-Leucaena	<i>Hibiscus, Leucaena</i>
Developed Land	Developed Land	pavement, structures, maintained lawn grasses

Source: e²M 2008

3

1 **Table 4-7. Total Area for Each Vegetation Community Type on Andersen Air Force Base**

Community Type	Total Area (acres)
Mixed Limestone Forest-Plateau/Primary	1,540.67
Mixed Limestone Forest-Plateau/Secondary	4,107.34
Mixed Limestone Forest-Fore Slope	833.88
Mixed Limestone Forest-Toe Slope/Primary	115.88
Mixed Limestone Forest-Toe Slope	26.69
Fore Strand/Sand	34.04
Back Strand/Sand	13.98
Back Strand/Rock	38.20
Strand/Rock	99.92
Hibiscus-Ochrosia Scrub	623.90
Ochrosia Edge	37.74
Neisosperma Forest	285.66
Mixed Herbaceous Scrub	731.81
Hibiscus Scrub	431.46
Mixed Shrub	32.26
Eugenia Forest	39.14
Coconut Plantation	486.96
Casuarina Forest	102.25
Vitex-Closed Canopy	850.77
Vitex-Sparse Canopy	807.01
Hibiscus-Leucaena	109.29
Developed Land	4,501.21

Source: e²M 2008

2 **Mixed Limestone Forest-Plateau/Primary, Mixed Limestone Forest-Fore Slope, Mixed Limestone**
3 **Forest-Toe Slope/Primary.** Vegetation in mixed limestone forest-plateau/primary, -fore slope, and
4 -toe/slope/primary is very dense due to the relatively open canopy structure that allows light to penetrate
5 to the understory and ground levels. Mature limestone forest is of moderate stature and is represented by
6 a number of characteristic subtypes described in Fosberg (1960) and Stone (1970). Common limestone
7 forest plants include breadfruit, strangler fig, *Pisonia grandis*, *Elaeocarpus joga*, *Neisosperma*
8 *oppositifolia*, *Guamia mariannae*, *Aglaiia mariannensis*, *Macaranga thompsonii* (pengua in Chamorro),
9 *Premna obtusifolia*, *Tristiropsis acutangula*, ifil, *Eugenia thompsonii*, *Cycas micronesica* (fadang in
10 Chamorro), *Pandanus fragrans* (kafo in Chamorro), *Ochrosia marianensis* (langiti in Chamorro),
11 *Psychotria hombroniana*, *Psychotria mariana* (aplokating in Chamorro), *Jasminum marianum*, and
12 *Morinda umbellata*. See **Figure 4-24** for photograph of a strangler fig, **Figure 4-25** for a photograph of
13 *Neisosperma oppositifolia*, **Figure 4-26** for a photograph of *Macaranga thompsonii*, and **Figure 4-27** for
14 a photograph of a *Cycas micronesica*. Grasses, ferns, and orchids also occur in limestone forests.
15 Limestone forest subtypes are distinguished on the basis of plant associations and are affected by aspect,
16 substrate, and other factors. Rare plants found in the limestone forests on Andersen AFB include the last
17 wild individuals of the federally endangered *Serianthes nelsonii* tree on Guam, *Tabernaemontana*
18 *rotensis*, and the rare *Heritiera longipetoliata* (listed as endangered by GovGuam endangered species
19 list). Native limestone forest provides high-quality habitat for a number of endangered forest birds and
20 fruit bats, and most of the installation's forested areas are included in the GNWR, Overlay Refuge Unit.
21 See **Figure 4-28** for a view of mixed limestone forest-toe slope/primary on Andersen AFB.

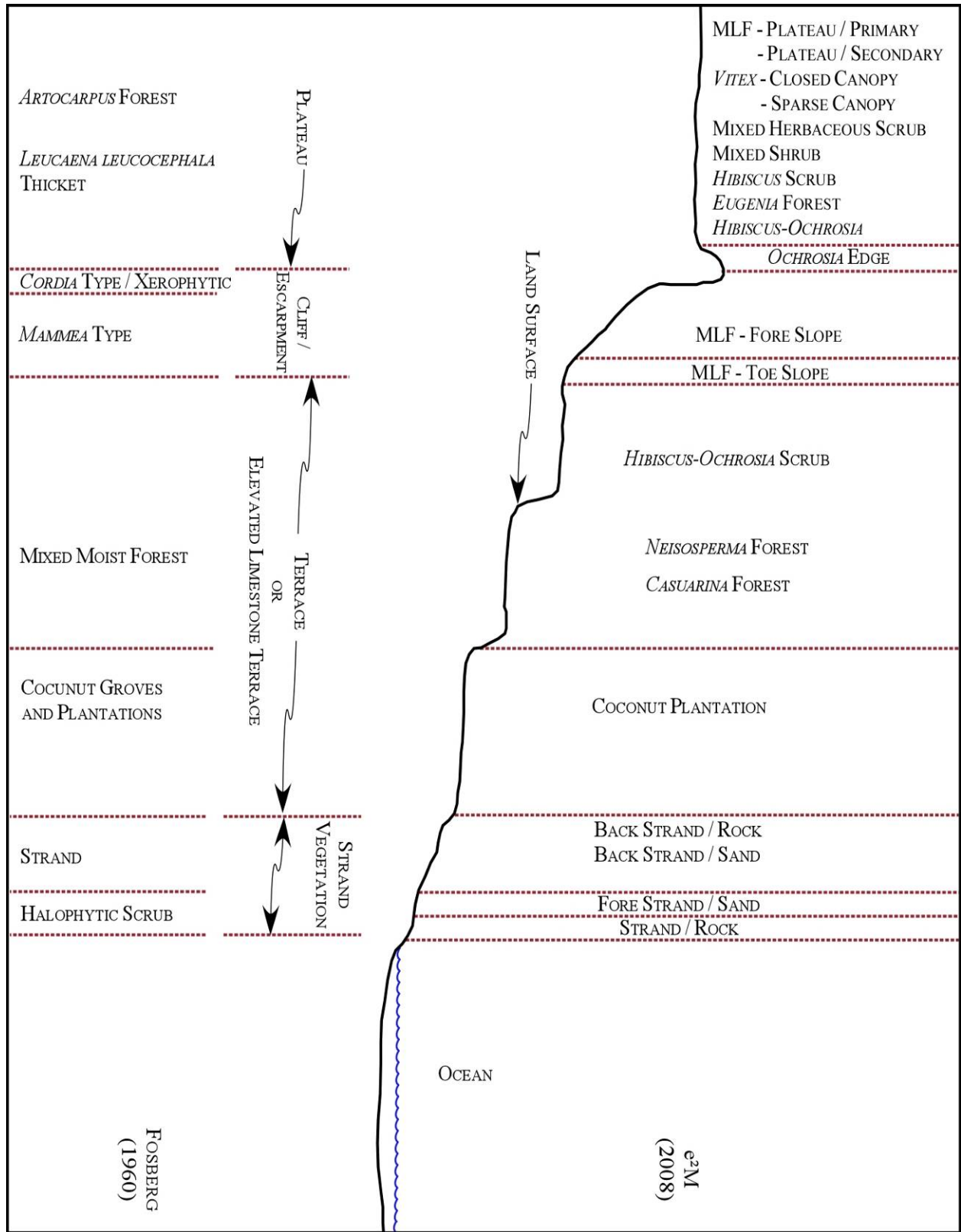
22

1
2**Table 4-8. Vegetation Community Correlation between Fosberg (1960)
and the 2008 Survey on Andersen Air Force Base**

Fosberg (1960)		2008 Survey
Significant Vegetation Type	Variant	Vegetation Community
Forests of Elevated Hard Limestone	<i>Artocarpus</i> Forest	<i>Vitex</i> -Closed Canopy
		<i>Vitex</i> -Sparse Canopy
		Mixed Limestone Forest-Plateau/Primary
		Mixed Limestone Forest-Plateau/Secondary
		<i>Eugenia</i> Forest
	Mixed Moist Forest	<i>Hibiscus</i> - <i>Ochrosia</i> Scrub
	<i>Mammea</i> Type	Mixed Limestone Forest-Toe Slope/Primary
		Mixed Limestone Forest-Toe Slope
		<i>Neisosperma</i> Forest
		<i>Casuarina</i> Forest
	<i>Cordia</i> Type	<i>Ochrosia</i> Edge
	Halophytic and Xerophytic Scrub	Strand/Rock
<i>Hibiscus</i> Scrub		
Mixed Limestone Forest-Fore Slope		
Strand Vegetation		Back Strand/Sand
		Fore Strand/Sand
		Back Strand/Rock
Coconut Groves and Plantations		Coconut Plantation
Weed Communities	Mixed Shrub Community	Mixed Shrub
	<i>Leucaena leucocephala</i> Thicket	<i>Hibiscus</i> - <i>Leucaena</i>
	Mixed Herb Type	Mixed Herbaceous Scrub

3
4**Table 4-9. Vegetation Community Correlation between Donnegan et al. (2004)
and the 2008 Survey on Andersen Air Force Base**

Donnegan et al. (2004)		2008 Survey
Significant Vegetation Type	Variant	Vegetation Community
Limestone Forest Types	<i>Artocarpus</i> Forest	<i>Vitex</i> -Closed Canopy
		<i>Vitex</i> -Sparse Canopy
		Mixed Limestone Forest-Plateau
		<i>Eugenia</i> Forest
	<i>Mammea</i> Type	Mixed Limestone Forest-Toe Slope
		<i>Neisosperma</i> Forest
		<i>Casuarina</i> Forest
<i>Cordia</i> Type	<i>Ochrosia</i> Edge	



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Figure 4-23. Correlation of Vegetation Community Locations Identified by Fosberg (1960) and the 2008 Survey



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Figure 4-24. Strangler Fig on Andersen AFB



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Figure 4-25. *Neisosperma oppositifolia* on Andersen AFB



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Figure 4-26. *Macaranga thompsonii* on Andersen AFB



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Figure 4-27. *Cycas micronesica* on Andersen AFB



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Figure 4-28. Mixed Limestone Forest-Toe Slope/Primary on Andersen AFB

3 It is important to note that the species composition of the mixed limestone forest-fore slope is similar to
 4 the other primary mixed limestone forests (-plateau/primary and -toe slope primary). However, due to the
 5 persistent winds buffeting the northern cliff face of Guam and paucity of soil, the plant community on the
 6 fore slope is far shorter in stature than those same species located on the plateau and the toe slope.

7 **Mixed Limestone Forest-Plateau/Secondary, Mixed Limestone Forest-Toe Slope.** Secondary growth
 8 mixed limestone forest (mixed limestone forest-plateau/secondary and -fore slope) occurs in areas that
 9 were once cleared of mature growth and are presumably returning to the climax successional stage. This
 10 forest type occurs in Northwest Field (far northwestern corner area of Andersen AFB) and in the MSA 1
 11 (in the central area of Andersen AFB) and is typified by an open canopy of low to moderate stature.
 12 Small pockets of secondary growth limestone forest also occur just east of the military family housing
 13 area, near the Main Gate. Dominant flora include ironwood, *Pandanus fragrans*, *Neisosperma*
 14 *oppositifolia*, beach naupaka (*Scaevola sericea*), Indian mulberry, *Hibiscus tiliaceus*, *Eleaocarpus joga*,
 15 *Cycas micronesica*, *Mammea odorata* (chopak in Chamorro), *Artocarpus altilis* (lemia in Chamorro),
 16 screwpine, and *Pandanus dubius* (Pahong in Chamorro) (36 CES/CEVN 2003). See **Figure 4-29** for a
 17 photograph of screwpine and **Figure 4-30** for a photograph of secondary growth limestone forest on
 18 Andersen AFB.

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Figure 4-29. Screwpine (*Pandanus tectorius*) on Andersen AFB



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Figure 4-30. Secondary Limestone Forest on Andersen AFB

1 Native Strand Vegetation

2 **Fore Strand/Sand, Back Strand/Sand, Back Strand Rock, Strand Rock.** Excellent examples of native
 3 strand vegetation are found on coastal areas of Andersen AFB. Strand plants are characteristically
 4 salt-tolerant, thrive in sandy soils or on rocky coasts, and tolerate direct sunlight and hot, dry conditions.
 5 Major components of the coastal strand flora include trees and shrubs such as beach naupaka, tree
 6 heliotrope, *Triumfetta procumbens*, *Guettarda speciosa*, *Hernandia nymphaeifolia*, milo (*Thespesia*
 7 *populnea*), ironwood, *Barringtonia asiatica*, and coconut trees; grasses including bunchgrass, *Paspalum*
 8 *distichum*, *Sporobolus virginicus*, and *Thuarea involuta*; and trailing vines including *Vigna marina*,
 9 beach morning glory (*Ipomoea pres-caprae* ssp. *brasiliensis*), and *Canavalia maritima*. Rocky coasts
 10 typically support stunted, wind-sheared shrubs such as *Hedyotis albido-punctata*, *Suriana maritima*,
 11 *Pemphis acidula*, and *Capparis cordifolia*. See **Figure 4-31** for a photograph of coastal strand vegetation
 12 on Andersen AFB.



13

14

Figure 4-31. Coastal Strand Vegetation on Andersen AFB

15 The fore strand/sand vegetation community is that area immediately landward of the beach face where the
 16 dominant substrate is sand. The back strand/sand vegetation community is immediately landward of the
 17 fore strand zone, and the dominant substrate is also sand. The back strand/rock vegetation community is
 18 in the same location as the back strand/sand community, but the dominant substrate is exposed limestone.
 19 The strand/rock vegetation community is immediately adjacent to the intertidal zone of the beach face,
 20 lies waterward of the fore strand zone, and the dominant substrate is exposed limestone.

21 Native Scrub

22 **Hibiscus-Ochrosia Scrub, Ochrosia Edge, Neisosperma Forest, Mixed Herbaceous Scrub, Hibiscus**
 23 **Scrub.** The native scrub community occurs in historically cleared areas on the plateau in the area of
 24 Northwest Field, along the top of the cliff edge, and along roadsides and previously disturbed areas on the

1 northern limestone plateau and the terrace of Andersen AFB. The scrub community occurs in varying
2 heights and densities that might be a response to extreme salt spray, to dryness resulting from excessive
3 drainage, to excessive transpiration due to exposure to winds, or to any combination of these and other
4 factors (Fosberg 1960). The native shrub community is generally of a lower stature than secondary
5 growth mixed limestone forest. Native scrub can be subdivided into *Hibiscus-Ochrosia* scrub, *Ochrosia*
6 edge, *Neisosperma* forest, mixed herbaceous scrub, or *Hibiscus* scrub depending on species characterizing
7 the community. The *Hibiscus-Ochrosia* scrub is found below the toe of slope of the cliff on the terrace of
8 Andersen AFB. Species characterizing the community include *Hibiscus tiliaceus*, *Ochrosia marianensis*,
9 china inkberry (*Cestrum diurnum*) (tintanchina in Chamorro), and *Neisosperma oppositifolia*. *Ochrosia*
10 edge is only found along the top edge of the cliff on Andersen AFB and is characterized by *Ochrosia*
11 *marianensis*. *Neisosperma* Forest occurs below the fore slope of the cliff on the terrace and is
12 characterized by *Neisosperma oppositifolia*, and *Aglaia mariannensis*. Mixed herbaceous scrub occurs on
13 the plateau and terrace in association with developed land and is typically characterized by a dominance
14 of *Stachytarpheta jamaicensis*. The Hibiscus scrub community occurs on the plateau in the area of
15 Northwest Field and is characterized by a dominance of *Hibiscus tiliaceus*.

16 **Mixed Shrub, Eugenia Forest.** Excellent examples of native shrub vegetation are found in several small
17 patches near the northern tip of the plateau and in association with mixed limestone forest primary on
18 Andersen AFB. Mixed shrub habitat occurs in one area on the plateau just south of Ritidian Point.
19 Vegetation occurring in the mixed shrub habitat is characterized by limeberry, china inkberry, *Hibiscus*
20 *tiliaceus*, and Indian mulberry. Eugenia forest occurs in several small patches within the mixed limestone
21 forest primary near the edge of the plateau to the northeast of Northwest Field. Vegetation in the Eugenia
22 forest is characterized by a dominance of *Eugenia reinwardtiana* (a'abang in Chamorro).

23 Developed Land

24 The main portion of Andersen AFB, including the runway and flightline, administrative areas, and
25 community areas, is disturbed ground. The installation is landscaped according to the Andersen AFB
26 *Architectural Compatibility and Base Design Standards* (Andersen AFB 2006), which promotes a tropical
27 setting using native vegetation while minimizing maintenance costs, and to EO 13148, *Greening the*
28 *Government Through Leadership in Environmental Management*. Palm trees (except coconut-bearing
29 palms) are augmented by a variety of tropical trees, ornamental shrubs, and vines. Turf grasses used at
30 Andersen AFB include low-maintenance varieties such as buffalo grass (*Stenotaphrum secundatum*),
31 common Bermuda grass (*Cynodon dactylon*), centipede grass (*Eremochloa ophiuroides*), and pangola
32 grass (*Digitaria decumbens*). Medium- and high-maintenance varieties of turf grass are also used as
33 appropriate, and include hilo grass (*Paspalum conjugatum*), kikuyu grass (*Pennisetum clandestinum*),
34 mondo grass (*Ophiopogon japonicum*), and daylily (*Heemerocallis* spp.). Native ferns are also used as an
35 attractive, low-growing, ground cover.

36 Fauna

37 **Birds.** Native terrestrial bird species on Guam are either endangered or extirpated in the wild due to
38 predation by, or competition with introduced species. These bird species are discussed in **Section 4.6.2.5**.
39 Some of the introduced bird species on Guam with potential to occur on Andersen AFB include black
40 francolin, black drongo, Eurasian tree sparrow, and island collared dove. Regulated game species on
41 Guam include black francolin, blue-breasted quail (*Coturnix chinensis*) (known as bengbeng in
42 Chamorro), and island collared dove. Introduced birds are a concern because of their potential to
43 displace, compete with, or transmit diseases to native birds. Black drongos are a conspicuous and
44 aggressive avian species that can contribute to a decline in native bird species (USAF 2009).

45 Sea birds that have the potential to migrate through or reside at Andersen AFB include black noddy,
46 brown noddy, brown booby, red-footed booby (*Sula sula*) (lu'ao talisai in Chamorro), white tern, great

1 frigatebird (*Fregata minor*) (ga'ga' manglo'in Chamorro), sooty tern (*Sterna fuscata*) (giree'girak in
2 Chamorro), and the white-tailed tropicbird (*Phaethon lepturus*) (utag in Chamorro) (GDAWR 2005).
3 Black noddies, brown noddies, white terns, and brown boobies are commonly observed at Andersen AFB
4 (USAF 2009).

5 Shorebirds that have the potential to migrate through or reside in coastal areas of Andersen AFB include
6 the whimbrel and sandpipers and plovers that share the collective Chamorro term “dulili,” including the
7 common sandpiper (*Actitis hypoleucos*), ruddy turnstone, Siberian tattler, wandering tattler (*Heteroseclus*
8 *incanus*), Pacific piping plover, Pacific golden-plover, Mongolian plover, black-bellied plover (*Pluvialis*
9 *squatarola*), the great sandpiper (*Charadrius leschenaultii*), common ringed plover (*Charadrius*
10 *hiaticula*), little ringed plover (*Charadrius dubius*), and snowy plover (*Charadrius alexandrinus*)
11 (GDAWR 2005). Wintering shorebirds such as the Pacific golden-plover, Mongolian plover, wandering
12 tattler, Siberian tattler, whimbrel, and ruddy turnstone are commonly observed on the beaches of
13 Andersen AFB. GDAWR staff members have observed white tern, brown noddy, and Pacific
14 golden-plover.

15 Wading birds that have the potential to migrate through, or reside at Andersen AFB include cattle egret,
16 intermediate egret (*Egretta intermedia*), Pacific reef heron, and yellow bittern (GDAWR 2005). Pacific
17 reef-herons have been observed at Andersen AFB foraging on the exposed reef.

18 The following avian species were identified during the 2008–2010 roadside and forest bird surveys
19 performed at the Northwest Field, North Ramp, and a Proposed Utility Corridor along Route 9 on
20 Andersen AFB: black francolin, island collared dove, yellow bittern, black drongo, Eurasian tree
21 sparrow, and Micronesian starling. The black francolin was the most commonly observed species on this
22 portion of Andersen AFB. The black francolin, island collared dove, black drongo, and Eurasian tree
23 sparrow are common, introduced, breeding residents in Guam (NAVFAC Pacific 2010b). The yellow
24 bittern is a common, native, breeding resident of Guam. The Micronesian starling is a Guam-listed
25 endangered species that is an uncommon, native, breeding resident of Guam (NAVFAC Pacific 2010b).

26 The following avian species were identified during the 2008–2010 avian surveys performed on Andersen
27 AFB Finegayan: black drongo, Eurasian tree sparrow, island collared dove, and chicken (*Gallus gallus*).
28 The island collared dove and chicken are common, introduced, breeding residents in Guam (NAVFAC
29 Pacific 2010b).

30 **Mammals.** The only native terrestrial mammal species with the potential to occur on Andersen AFB is
31 the Mariana fruit bat, which is federally listed as threatened and Guam-listed as endangered, and will be
32 discussed further in the **Section 4.6.2.5**. Forested habitats on Andersen AFB are essential to the
33 long-term conservation of the Mariana fruit bat. Specifically, 11,085 acres (4,486 hectares) of the
34 installation were identified as important to the species in 2004, but were excluded from critical habitat
35 designation under Section 4(a)(3) of the ESA, as amended by Section 318 of the fiscal year 2004 National
36 Defense Authorization Act (P.L. No: 108–136) (69 FR 62944).

37 A number of species of whales and dolphins occur in the waters offshore of Andersen AFB. Marine
38 mammals occurring in waters offshore of the installation are protected under the MMPA (USAF 2009).

39 **Reptiles and Amphibians.** Nine herpetofauna species were documented during the 2008–2009
40 herpetofauna surveys performed in the Northwest Field, North Ramp, and Proposed Utility Corridors on
41 Andersen AFB. Of these, three species are native: Pacific blue-tailed skink, moth skink (a Guam-listed
42 endangered species), and stump-toed gecko; and six species are introduced: curious skink, house gecko,
43 brown treesnake, brahminy blind snake (*Ramphotyphlops braminus*), marine toad, and greenhouse frog
44 (NAVFAC Pacific 2010b). The continued widespread presence of the curious skink, the brown
45 treesnake, and other introduced amphibian species is of concern because of each species' potentially
46 deleterious impacts on Guam's native fauna (NAVFAC Pacific 2010b).

1 The green sea turtle, federally listed as threatened, and the hawksbill sea turtle and leatherback sea turtle,
2 both federally and GovGuam listed as endangered, can be found in the coastal waters off Andersen AFB.
3 The green sea turtle is also documented to bask and nest on beaches on Andersen AFB (USAF 2009).
4 Sea turtles are discussed further in **Section 4.6.2.5**.

5 **Invertebrates.** Endemic and indigenous tree and land snails, once abundant on the island, are in a state of
6 serious decline and are disappearing from their former ranges. Causes of the decline include habitat loss
7 to agriculture and development, pesticides, wildland fires, competition with introduced species, and
8 predation by introduced predatory snails and the predatory Manokwar flatworm (USAF 2009). Shells of
9 the introduced giant African snail and both live individuals and shells of the introduced snail *Satsuma*
10 *mercatoria* were observed during 2009 tree snail surveys. Additionally, live introduced Manokwar
11 flatworms were also observed (NAVFAC Pacific 2010b). A total of 49 live tree snails, 20 Guam tree
12 snails and 29 fragile tree snails were recorded during surveys conducted in 2011 (HDR 2012). Because of
13 the possibility of impacting native tree and land snails, any projects including land clearing should be
14 coordinated with natural resources personnel to ensure that native terrestrial snails are not impacted.

15 Five butterfly species were documented within forested areas on Andersen AFB during 2009–2010
16 butterfly surveys: lemon emigrant (*Catopsilia pomona*), monarch (*Danaus plexippus*), blue-banded king
17 crow, blue moon, and common Mormon (NAVFAC Pacific 2010b). These species are fairly well
18 distributed throughout Guam and portions of the Mariana Islands. Additional butterfly species
19 documented on Andersen AFB in previous surveys include Mariana wandering (*Vagrans egistina*), plains
20 cupid (*Chilades pandava*), three-spot grass yellow (*Eurema blanda*), and tiny grass blue (*Zizula hylax*)
21 (Schreiner and Nafus 1997, USAF 2009).

22 The Mariana eight-spot butterfly and the Mariana wandering butterfly, which are both candidate species
23 for listing by the USFWS under the ESA, were not observed on Andersen AFB during the 2009–2010
24 surveys. However, thirty-eight percent of host plant patches surveyed for the Mariana eight-spot butterfly
25 during surveys conducted at Andersen AFB in 2011 were occupied by the butterfly (HDR 2012).

26 Other terrestrial invertebrates that occur at Andersen AFB include the native land hermit crab and the
27 coconut crab, which both begin their life at sea. After a planktonic larvae stage, small crabs emerge from
28 the ocean to a life on land. Land hermit crabs rely on borrowed shells throughout their lives, often using
29 the shell of the giant African snail. Coconut crabs initially borrow shells, but then develop their own hard
30 shell. Coconut crabs hide in burrows during the day and, like land hermit crabs, forage at night. Both
31 species are omnivorous and feed on coconuts, fruits, plants, rotten wood, dead insects, and carrion. The
32 coconut crab is large with a leg span up to 3 feet (1 meter). Threats to these species include introduced
33 predators including rats, feral pigs, dogs, monitor lizards, and humans. Coconut crabs are a culturally
34 important species and a local delicacy and, because of this, have been overharvested. They are
35 considered a game species and are regulated by GovGuam.

36 4.6.2.2 Freshwater Ecosystems

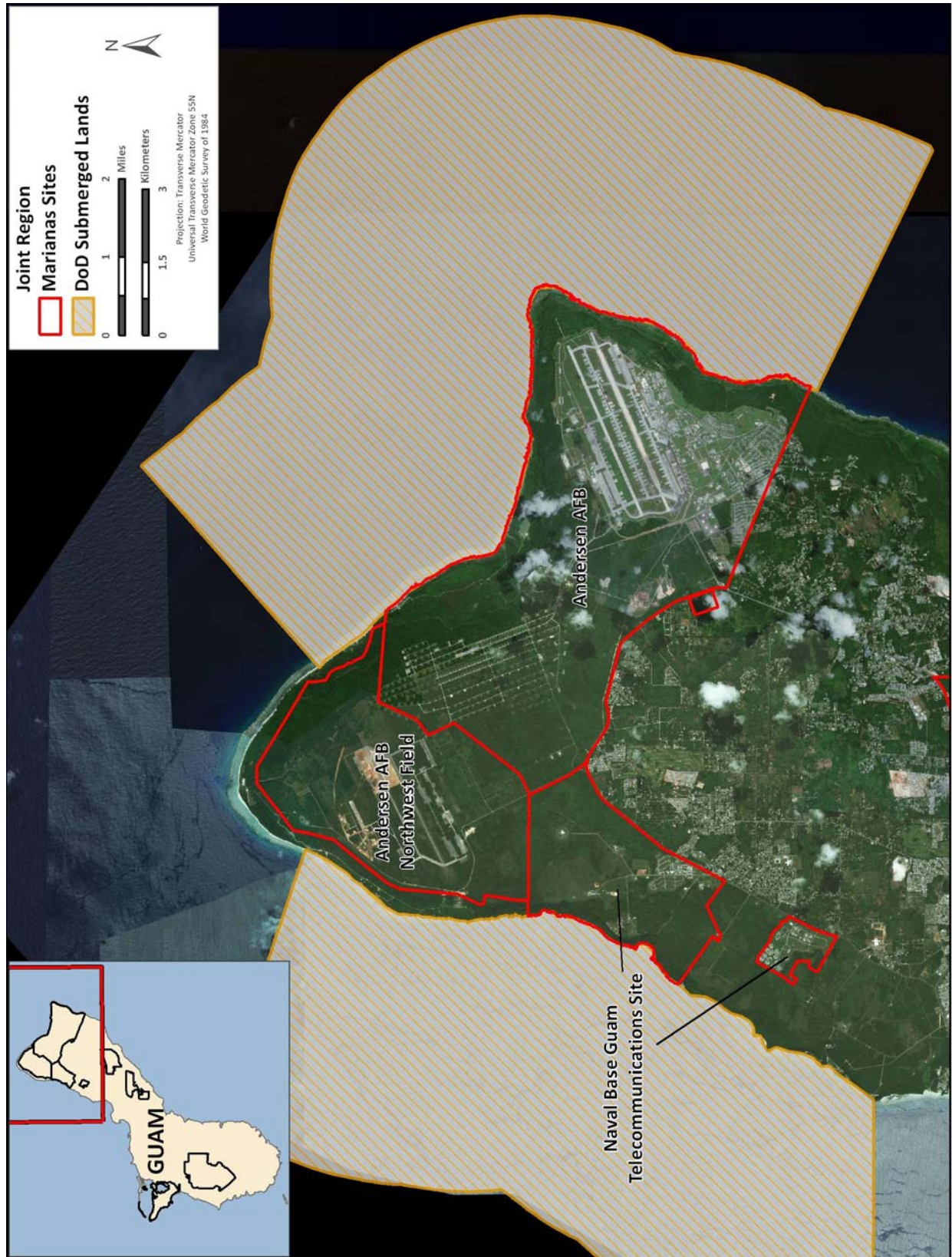
37 There are no freshwater ecosystems on Andersen AFB.

38 4.6.2.3 Estuarine Ecosystems

39 There are no estuarine ecosystems on Andersen AFB.

40 4.6.2.4 Submerged Lands

41 JRM-managed submerged lands that extend 3 nautical miles seaward from the coastline at Andersen AFB
42 include the northern edge of Guam around Ritidian Point and extend eastward along the coastline to Pati
43 Point, as shown in **Figure 4-32**.



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Figure 4-32. JRM Managed Submerged Lands at Andersen AFB

1 In February 1993, the USAF established the Andersen AFB Marine Resources Preserve (MRP) to protect
2 marine habitats and marine species, and to enhance Guam's marine resources. The seaward boundary of
3 the Andersen AFB MRP extends to any distance where spear or net fishing is observed and the inland
4 boundary extends landward 65 feet (20 meters) from the shoreline. The MRP supports a considerable
5 variety of marine plants, fish, corals, and other invertebrates. The ocean currents in northern Guam carry
6 fish, coral, and other invertebrate larvae to seed Guam's central and southern reefs. There is a permanent
7 ban on any form of spearfishing, any form of fishing from land, taking of marine life (dead or alive)
8 except for game fish trolling or spin casting from shore, and possessing spearfishing equipment within the
9 area and adjacent beaches (Andersen AFB undated, Belt Collins Hawaii Ltd. 2002).

10 Two surveys were conducted on the reef flats and reef slopes within the boundaries of the MRP during
11 the Baseline Survey of Marine Resources conducted in 1993 and 1994. Surveys were conducted for each
12 of the major groups of marine organisms (i.e., marine plants, corals, macroinvertebrates, and fish).
13 Sediment sampling was also performed (Andersen AFB 1995). In June 1999, a Legacy Program-funded
14 marine resources survey, including an ocean current assessment, was contracted by the UOG Marine
15 Laboratory to gather baseline data to support a marine resources management plan in the future at
16 Andersen AFB.

17 The Pati Point Preserve was established on May 16, 1997, by Guam Public Law 24-21. The seaward
18 boundary of the preserve extends to the 600-foot (182-meter) contour and the inland boundary of the
19 preserve extends landward 32 feet (10 meters) from the mean high tide mark or to the nearest edge of a
20 public right-of-way, whichever comes first. The Pati Point Preserve and the Andersen AFB MRP overlap
21 in the nearshore area and approximately 32 feet (10 meters) along the onshore area.

22 At Ritidian Point, the JRM-managed submerged lands do not include a designated 100-foot (30-meter)
23 isobath that is part of the Ritidian Point NWR managed by the USFWS.

24 4.6.2.5 Protected Species

25 Four federally endangered species are currently known to occur on Andersen AFB, including the Mariana
26 fruit bat, Mariana crow, green sea turtle, and the fire tree. The Micronesian starling, and the *Heritiera*
27 *longipetiolata* tree, Guam-listed endangered species, are also present. In 2003, two male white-throated
28 ground-doves, a Guam-listed endangered species, were sighted on the installation. Potential habitat is
29 present on the installation for nine other federally endangered, threatened, or candidate species, some of
30 which might already be extinct. Six federally listed cetaceans and one additional federally listed sea turtle
31 have the potential to occur in the JRM-managed submerged lands off of Andersen AFB.

32 ***Fauna***

33 Terrestrial Species

34 **Birds**

35 ***Micronesian starling.*** The Micronesian starling is found in the forests north of the flightline, east of the
36 golf course, in the housing areas, and in an area to the south of Andersen AFB. See **Figure 4-33** for the
37 range of the Micronesian starling on Andersen AFB and adjacent areas. The species is also still present
38 on Cocos Island, parts of Hagåtña and the beach strand areas along the southeastern portion of Guam. In
39 1996, conservation staff at Andersen AFB initiated a volunteer program to protect nesting by Micronesian
40 starling through the installation of nest boxes. By 2001, more than 80 nest boxes were in place.

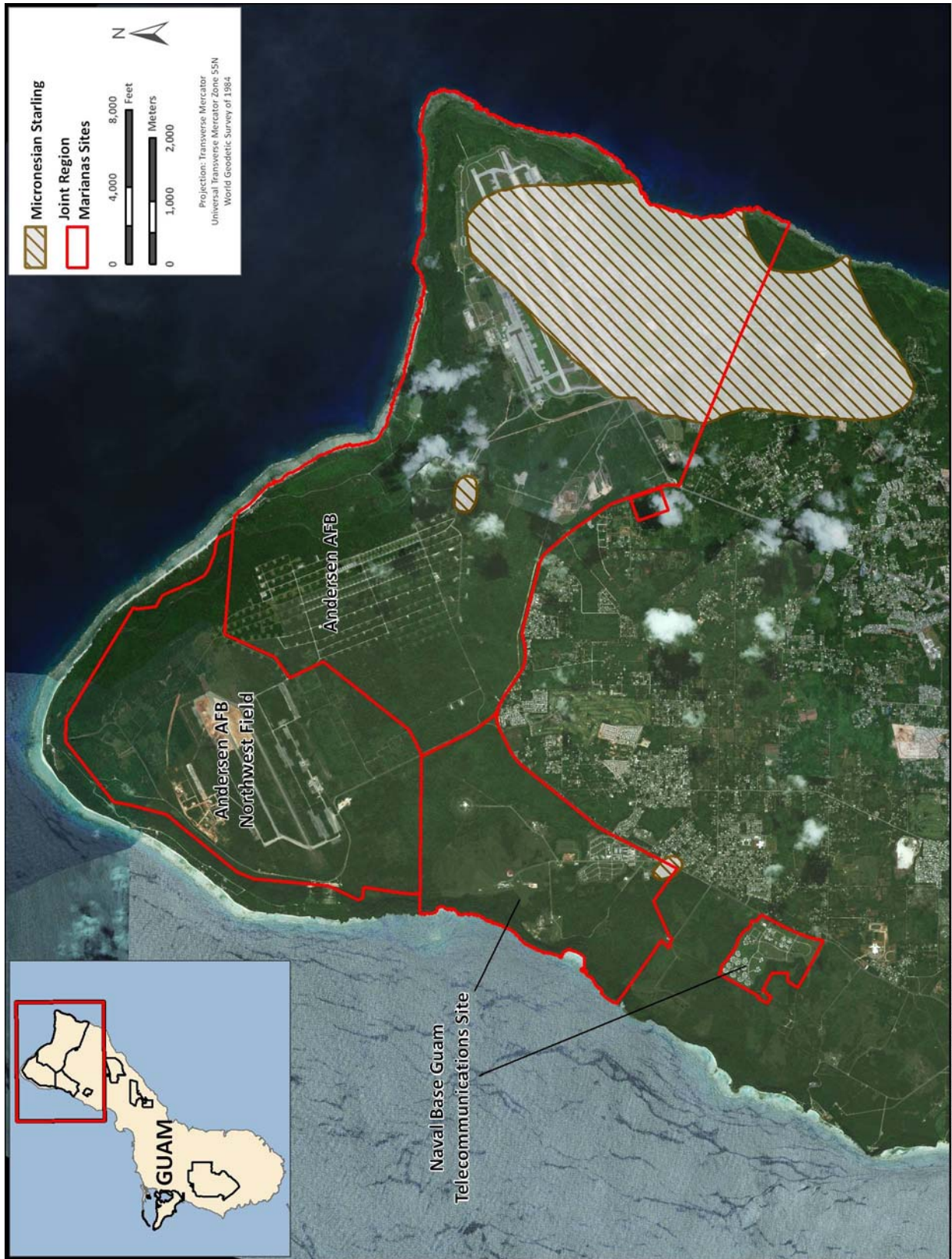


Figure 4-33. Range of the Micronesia Starling on Andersen AFB and Adjacent Areas

1 **Mariana crow.** The last native Mariana crow on Guam likely disappeared between 2002 and 2003
2 (USFWS 2005b). In 2007, 10 crows, most of which were translocated from nearby Rota or mainland
3 zoos, remained on Guam, restricted in distribution to the northern cliff forests on Andersen AFB (USFWS
4 2010a). The most recent Mariana crow survey was conducted between January and October 2011. The
5 only Mariana crow observed during the survey was a banded male named Kahit. Kahit was observed a
6 total of 16 times during the survey in the Vitex-Closed Canopy vegetation community, and in the Mixed
7 Limestone Forest–Plateau/Secondary vegetation community. Despite an intensive and comprehensive
8 survey effort, no additional Mariana crows were detected during the project (SWCA 2012).

9 **White-throated ground-dove.** This species was extirpated from Guam along with other forest bird
10 species in the mid-1980s. However, one male white-throated ground-dove was heard, observed, and
11 photographed on Andersen AFB during surveys conducted in June 2011 (SWCA 2012). During the
12 survey, the ground-dove was initially observed 33 feet (10 meters) up in a *Ficus prolixa* tree, after which
13 it flew and perched in *Vitex parviflora* and *Hibiscus tiliaceus* trees.

14 Mammals

15 **Mariana fruit bat.** In 1972, 500 to 600 fruit bats on Andersen AFB made up the majority of the island
16 population. The Pati Point area was declared a protected area in 1973. By 1978, the number of fruit bats
17 on Guam had been reduced to 50 (Wheeler and Aguon 1978). Between 1980 and 1981 the fruit bat
18 population grew to almost 1,000 bats, likely the result of immigration from Rota (Wiles 1987a, 1987b).
19 The increased population was concentrated on Andersen AFB in one or two colonies at Pati Point.
20 Between 1981 and 1987, fruit bats roosted in at least 19 locations along the northern coast of Guam, on
21 Andersen AFB (see **Figure 4-34**) between Lafac Point and Ritidian Point (Wiles 1987c). The Mariana
22 fruit bat colony on Andersen AFB has used the same roost location at Pati Point since 1994 (see
23 **Figure 4-35**) (Wiles 1998). Except for the punctuated increase in the early 1980s, the overall population
24 trend of this species has been declining (see **Figure 4-36**). In 2006, Janeke (2006) estimated fewer than
25 100 fruit bats at Pati Point. A survey conducted by SWCA on Andersen AFB from June 2007 until April
26 2008 indicated counts from 31 to 54 individuals with an average count of 40 bats (SWCA 2008). A
27 recent count in May 2010 recorded only 10 bats at the Pati Point colony (Anne Brooke, U.S. Navy,
28 personal communication). Surveys in 2011 by SWCA found 2 to 3 bats below Pati Point, but the colony
29 is no longer present and surveys have not found that the colony has relocated (SWCA 2012).

30 Sightings of fruit bats observed during surveys in 2012 by SWCA on Andersen AFB are illustrated in
31 **Figure 4-37**.

32 Additional information on the Mariana fruit bat on Andersen AFB, including management
33 recommendations, can be found in the Fanihi (*Pteropus mariannus mariannus*) Management Plan for
34 Andersen Air Force Base, Guam, in **Appendix J**.

35 Reptiles

36 **Moth skink.** Moth skinks have an unknown distribution on Guam and are not frequently encountered.
37 One moth skink was recorded during herpetofauna surveys on Andersen AFB in 2008 (DoN 2010). The
38 moth skink was captured in a glue-board trap on a transect paralleling Route 9 near the solid waste
39 landfill. The moth skink is not a federally listed species, but GovGuam lists the species as endangered.

Figures detailing sensitive resources are withheld to protect those resources.

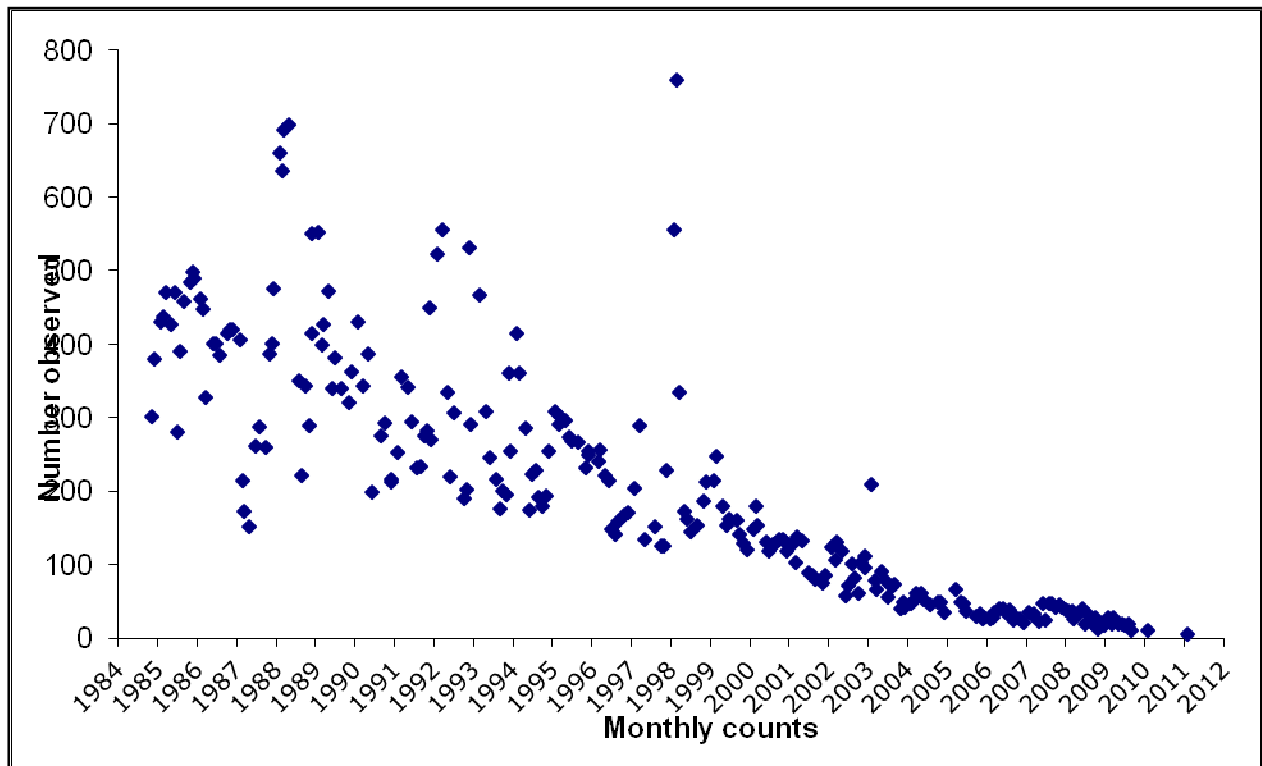
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Figure 4-34. Historic Mariana Fruit Bat Roost Locations on Andersen AFB

Figures detailing sensitive resources are withheld to protect those resources.

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**Figure 4-35. Mariana Fruit Bat Colony at Pati Point.
Fruit Bats Pictured Roosting in *Mammea odorata* Trees**



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Figure 4-36. Mariana Fruit Bat Counts at the Pati Point Colony from FY 1984 to FY 2012

Figures detailing sensitive resources are withheld
to protect those resources.

1
2 **Figure 4-37. Observations of Mariana Fruit Bats on Andersen AFB (SWCA 2012).**

3 **Invertebrates**

4 **Insects**

5 ***Mariana eight-spot butterfly.*** During surveys conducted in 2011 on Andersen AFB, 73 host plant
6 patches were located and assessed between detailed and reconnaissance and meander searches.
7 Thirty-eight percent of host plant patches were occupied by Mariana eight-spot butterflies. Seven adult
8 butterflies, 96 larvae, and 35 eggs were observed during surveys. Thirty of the 35 Mariana eight-spot
9 eggs showed indications of parasitism (HDR 2011).

10 **Marine Species**

11 **Marine Mammals**

12 In 2007, SRS-Parsons et al. (2007) conducted a marine mammal and sea turtle survey covering
13 170,500 square nautical miles around Guam and the CNMI. The survey area was bounded by 10°–18° N
14 Latitude and 142°–148° E longitude. Nine unique marine mammal species were identified, including the
15 federally endangered sei, sperm, and humpback whales. Sperm whales were the most commonly
16 observed whale during the study. Marine mammals have the potential to occur in JRM-managed
17 submerged lands which extend 3 nautical miles seaward from the coastline at Andersen AFB.

18 **Sea Turtles**

19 Historically, the EOD beach at Andersen AFB and Cocos Island have had the highest incident of sea
20 turtle nesting. The *Green Sea Turtle Management Plan* in **Appendix J** summarizes in detail nests
21 recorded at Andersen AFB from June 1984 until June 2006. Data were not available from 1985 through
22 1990, 1992, 1994, and 2002 through 2004 (Andersen AFB 2008).

23 Considering the available data provided by GDAWR, nesting activity was only documented at the EOD
24 beach from 1991 until 1997 and again in 1999, 2000, and 2005. The highest distribution of recorded sea

1 turtle activity was in 1993 when 17 occurrences were observed at the EOD beach. Most of these,
 2 however, were recorded as false crawls. In 2000, 16 crawls were counted on Andersen AFB beaches. In
 3 FYs 2001 and 2002, funding was provided by Andersen AFB to GDAWR to track turtle activity on and
 4 near Andersen AFB. No turtle activity was reported on Andersen AFB beaches during 2001. Data were
 5 not available for turtle activity on nesting beaches at Andersen AFB in 2002, 2003, and 2004. In 2005,
 6 11 occurrences of crawls, body pits, nesting, or hatchlings were documented at the EOD beach. The 2006
 7 season recorded 5 occurrences of turtles at Tarague Beach (as of August 2006). No activity was recorded
 8 at the EOD beach during the 2006 nesting season. No turtle activity was documented on Andersen AFB
 9 during the 2007 nesting season. In 2011 25 nests were observed on Andersen AFB, and 17 nests were
 10 observed in 2012 (see **Table 4-10**). See **Figure 4-38** for a map of green sea turtle nesting areas on
 11 northern Guam and Andersen AFB.

12 **Table 4-10. Green Sea Turtle Nesting on Andersen AFB from 2005 to 2010**
 13 **(Data provided by Shawn Wusstig, GDAWR)**

Year	Total Nests	Month
2005	11	July –October
2006	5	February –June
2007	0	----
2008	6	July
2009	11	April–June
2010	16	January–(no end date provided)
2011	25	----
2012	17	----

14 **Green sea turtle.** During the nesting season, which is generally from April through August, female green
 15 sea turtles emerge from the sea to lay approximately 100 eggs in large sand-pit nests near vegetation
 16 above the high water line. After incubating for 50 to 60 days, 2-inch turtle hatchlings emerge from the
 17 nest and return to the ocean. An individual turtle can lay as many as 7 clutches of eggs in successive
 18 14-day intervals over a several-month season (Davis 1991). However, green sea turtles will skip long
 19 periods of time between egg-laying seasons (estimated at 4 to 7 years). Green sea turtles will return to the
 20 same beach, if possible. A total of 49 green sea turtle nests have been recorded by GDWAR biologists on
 21 Andersen AFB beaches between 2005 and 2010 (see **Table 4-10**). Green sea turtles nest on the beach
 22 between Mergagan and Tagua Point (see **Figure 4-38**), with most activity occurring on the EOD beach to
 23 the east.

24 **Hawksbill sea turtle.** Hawksbill sea turtles have nested on beaches in northern and central Guam. The
 25 last sighting of a hawksbill sea turtle on the beach at Andersen AFB was a desiccated specimen found on
 26 the EOD beach in 1997. The cause of death was unknown. The last recorded nestings in the area were
 27 three unconfirmed sightings in 1984 between Urunao and Tarague (Green Sea Turtle Management Plan,
 28 **Appendix J**).

Figures detailing sensitive resources are withheld to protect those resources.

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Figure 4-38. Green Sea Turtle Nesting Areas on Andersen AFB

1 **Flora**

2 ***Heritiera longipetiolata*.** *Heritiera longipetiolata* is an uncommon species in forested areas of Andersen
3 AFB. No surveys have been conducted to document the distribution, population numbers, or population
4 trend of this Guam endangered species on the installation.

5 **Fire tree.** As many as five fire trees currently survive on Andersen AFB, one mature seed-bearing adult
6 and four saplings between 12 and 20 years old (see **Figure 4-39**). The adult tree is located in limestone
7 forest in the Ritidian Point area and was evaluated on May 21, 2010. The ungulate exclusion fence
8 established in 1996 to protect seedlings around the adult tree from ungulate damage was in terrible
9 disrepair. There were several breaches in the fence and much of the fence was lacking sufficient support
10 structures. The adult tree itself was in good condition, approximately 23 to 30 feet (7–9 meters) tall with
11 a diameter of 20.9 inches (53 cm). Termite activity was noticed on the tree and has been present for many
12 years. No obvious termite damage was observed. Two seedlings and one sapling were observed within
13 the damaged enclosure, and the sapling had signs of ungulate browsing. The understory within the
14 enclosure was clear, also indicating that ungulates were able to get inside the fence and browse on
15 vegetation.

16 In 1999, 20 fire trees seedlings from Rota were planted as a joint effort by USFWS, UOG, and Andersen
17 AFB in limestone forest along a utility access road in Tarague Basin. Each seedling was protected from
18 ungulate browsing with a wire enclosure. As of 2010, four of the original 20 seedlings survive,
19 surrounded by a wire enclosure fence. The remaining fire trees from the Rota seedling stock in Tarague
20 were visited on May 7, 2010. The enclosure fencing was in good condition, but with two possible
21 breaches. Two trees were observed from outside the enclosure fencing and appeared to be in good health,
22 but no attempt was made to enter and check the remaining two.

23 The third location in Area 53 was not visited and the status of that tree remains unknown. Two saplings
24 were found under an adult fire tree at this location in 1991. The adult tree was killed in 1992 during
25 Typhoon Omar. As of 1999, both saplings were still surviving, but by 2001, only a single sapling
26 survived. In 2002, this sapling was partially uprooted by super typhoon Pongsona and it is regularly
27 impacted by larval butterfly damage. The tree has since died.

28 **Invertebrates**

29 No Federal-listed invertebrate species have been recorded at Andersen AFB; however the Guam
30 endangered humped tree snail, Guam tree snail, and fragile tree snail have all been observed at the
31 installation. All three of these snails are candidate species for federal listing.

32 **Flora**

33 The federally and Guam-listed endangered fire tree, and the Guam endangered tree fern and
34 Ufa-halomtano' occur on Andersen AFB.

35 **4.6.2.6 Invasive Species**

36 **Flora**

37 Several large areas within the Tarague Basin between Mergagan Point and Tagua Point are locations of
38 historic coconut plantations. These areas are now characterized by near pure stands of coconut palms in
39 the overstory. In addition, numerous smaller areas dominated by coconut palms occur on flat ground
40



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Figure 4-39. Locations of Fire Trees on Andersen Air Force Base

1 across the plateau on Andersen AFB. Many of the coconut palm groves have thick undergrowths
2 composed of various shrubs and young trees with an abundance of self-sown coconut palms. **Figure 4-40**
3 provides a photograph of a former coconut plantation on Andersen AFB. Near pure stands of ironwood
4 forests occur on Andersen AFB on the terrace bordering the native strand community and within the
5 strand, and in numerous smaller areas on the plateau. Ironwood is one of the most successful colonizers
6 of denuded areas and will rapidly develop dense tall forests. *Vitex*-closed canopy and *Vitex*-sparse canopy
7 occurs in large stands in the southwest section of MSA 1 and the area to the west of MSA 1, and in
8 several smaller stands on the plateau. *Vitex*-closed canopy is characterized by a dense overstory of *Vitex*.
9 *Vitex*-sparse canopy typically occurs in association with the *Vitex*-closed canopy, but is more open and is
10 characterized primarily by *Vitex*, *Guamia mariannae*, and *Aglaiia mariannensis*. *Hibiscus-Leucaena*
11 occurs in several stands on the plateau primarily in the western section of the installation and in
12 association with the clear zone at the western end of the airfield. Tangantangan, an introduced legume
13 used for restoration after World War II, is one of the most common types of vegetation in recently cleared
14 or disturbed areas on Guam and often forms dense pure stands. Tangantangan is one of the most
15 conspicuous exotic invasive plants on Andersen AFB. This prolific tree forms extensive thickets in
16 limestone soils that prevent recolonization by native species. For the most part, stands of tangantangan on
17 the installation occur in association with *Hibiscus*.



18

19

Figure 4-40. Former Coconut Plantation on Andersen AFB

20 *Chromolaena*, a native to Central America, is a fast-growing, highly invasive shrub that is a prolific seed
21 producer. The shrub occurs on Andersen AFB and is abundant in the Tarague Basin. **Figure 4-41**
22 provides a photograph of *Chromolaena* on Andersen AFB. *Stachytarpheta indica*, an erect exotic
23 invasive herb, occurs in association with developed land on the installation and is prolific along many
24 roadsides and the edges of clearings. Disturbed areas that are not landscaped on Andersen AFB are
25 commonly colonized by exotic and invasive plant species, such as tangantangan, wild passion flower, and
26 masiksik (36 CES/CEVN 2003).



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Figure 4-41. Chromolaena on Andersen AFB

3 ***Fauna***

4 Introduced bird species occurring on Andersen AFB include the island collared dove, black drongo,
5 Eurasian tree sparrow, and black francolin. These species are common, introduced, breeding residents in
6 Guam (NAVFAC Pacific 2010b). Introduced avian species occurring in the southwest section of
7 Andersen AFB (Andersen AFB Finegayan) include black drongo, Eurasian tree sparrow, island collared
8 dove, and chicken, all of which are common, introduced, breeding residents in Guam (NAVFAC Pacific
9 2010b).

10 Several introduced mammalian species that threaten native flora and fauna occur on Andersen AFB,
11 including feral cats, ungulates, and rats. Feral cats were primarily responsible for the eradication of a
12 population of 16 captive-bred Guam rails released in an enclosure on Andersen AFB in 1999 (USAF
13 2009). A second release of 44 captive-bred rails occurred in the MSA 1 on Andersen AFB in 2003, with
14 21 of 26 transmitters succumbing to cat predation. All Guam rails from the 2003 release are
15 presumed deceased (Paul Wenniger, unpublished report). Management efforts need to be focused on
16 removing these nonnative predators.

17 Browsing and rooting by feral ungulates hastens the decline of native forests by directly killing native
18 vegetation, preventing regeneration, spreading invasive alien plants, and altering soils. Other common
19 introduced species on Andersen AFB include brown rat, black rat, Polynesian rat, and house mouse,
20 which are collectively known as “cha’ka” in Chamorro (USAF 2009). In addition to preying on native
21 birds and their eggs, rats eat rare plants and their roots. The musk shrew is another introduced
22 mammalian species that might exist on Andersen AFB (USAF 2009).

1 Philippine deer populations on Guam are thought to be highest on Andersen AFB (Wiles et al. 1999).
2 Surveys conducted in 2000–2001 estimated 468.5 deer per square mile (183 deer/square kilometer), or
3 920 deer in the 1.94-square-mile (5.03-square-kilometer) MSA 1 area, one of the highest deer densities in
4 the world. The Pati and Tagua Point areas of Andersen AFB are thought to have the highest deer
5 densities on Andersen AFB as they are regularly patrolled by Security Forces and not open to recreational
6 hunting (Wiles et al. 1999). Recreational hunting in the MSA 1 area is limited to archery hunting by
7 Munitions Squadron (MUNS) personnel only, limiting the number of population-control measures.
8 Lower deer densities are expected in Northwest Field where regular recreational hunting activities are
9 conducted; but a survey conducted in 2006 (Parsons 2006) indicated a density of 315.9 deer per square
10 mile (122 deer/square kilometer). Hunting data indicate that deer populations are increasing in this area
11 with the number of deer taken per year increasing while the effort per take has remained stable
12 (JRM 2011).

13 Feral pig density in Northwest field was estimated at 55.4 pigs per square mile (21.4 pigs/square
14 kilometer) in 2006 (Parsons 2006). At this density, the 4,400-acre (17.8-square kilometer) Northwest
15 Field is estimated to hold approximately 381 feral pigs. The feral pig density in MSA 1 was determined
16 to be 98 pigs per square mile (38 pigs/square kilometer) in 2000–2001 (Knutson and Vogt 2002) for a
17 total of 186 pigs estimated in the 1.94-square-mile (5.03-square-kilometer) MSA 1. Feral pig density is
18 highest in MSA 1 and thought to be lowest in the Pati Point area (Wiles et al. 1999). Results of a recent
19 vegetation survey on Andersen AFB, indicated that 82 percent of 50 vegetation plots were found to have
20 signs of ungulate presence (Philippine deer and feral pigs) (U.S. Navy 2009).

21 Past management of feral ungulates at Andersen AFB has been primarily through a hunting program,
22 augmented with controlled hunts using VCOs. The VCO program is an Andersen AFB organized and
23 managed program and does not extend to other JRM sites outside of Andersen AFB and Northwest Field.
24 Existing hunting limits on Andersen AFB are two pigs per day, and 40 for the year. Deer limits on
25 Andersen AFB are three (any sex) per day and three per season (October 1–March 31). In addition, there
26 are special hunts authorized at the discretion of the Director of the Department of Agriculture, GDAWR,
27 upon request from the installation CO. Special hunts can include unlimited, either-sex take. This
28 “special” season is opened at the discretion of the installation CO and GDAWR acting together (GDAWR
29 2008b). Ungulates are also controlled through depredation permits that allow snares, traps, and firearms
30 to control these species. Protection of extremely rare plants and other special ecological areas calls for
31 construction of exclusion fences and total eradication of feral ungulates within the enclosures.
32 Management efforts have not been sufficient to control the ungulate population at Andersen AFB. New
33 management practices, such as coordinating with GDAWR to extend the hunting season and bag limits,
34 using drone/thermal imaging to monitor ungulates, baiting, and hunting with dogs should be considered
35 (USAF 2009). However, hunting with dogs should only be used in enclosures (i.e., habitat management
36 units [HMUs]) in order to retrieve the dogs once loose to extract ungulates. An Ungulate Management
37 Plan has been developed for Andersen AFB, and is included in **Appendix O** of this INRMP. The
38 Ungulate Management Plan provides implementation strategies for controlling ungulates on Andersen
39 AFB.

40 Six introduced herpetofauna species were documented on Andersen AFB during the 2008–2009
41 herpetofauna surveys: curious skink, house gecko, brown treesnake, brahminy blind snake, marine toad,
42 and greenhouse frog (NAVFAC Pacific 2010b). Four introduced herpetofauna species were documented
43 on the southwest section of Andersen AFB (Andersen AFB Finegayan): curious skink, house gecko,
44 brown treesnake, and marine toad (NAVFAC Pacific 2010b). The continued widespread presence of the
45 curious skink, brown treesnake, and other introduced amphibian species is of concern because of each
46 species’ potentially deleterious impacts on Guam’s native fauna (NAVFAC Pacific 2010b).

47 Cycad aulacaspis scale or Asian cycad scale has infested native and landscape cycads on Andersen AFB.
48 The cycad is an important component of the native forest on Guam and is rapidly being lost. There has

1 been 90 percent mortality of this species since 1994 as a result of cycad scale (USAF 2009). A
2 predacious lady beetle, *Rhyzobius lophanthae* has been released on Andersen AFB in an effort to help
3 control the scale. In addition to Cycad aulacaspis scale, the cycad blue butterfly (*Chilades pandava*)
4 larvae represent one of the greatest threats to Cycas species over a very wide range. The Cycas species
5 like *C. micronesica* that evolved without any lepidoptera herbivory pressure are particularly susceptible to
6 damage, possibly due to a lack of chemical defense. So when the cycad blue butterfly invades an insular
7 population of any Cycas species, including *C. micronesica*, it represents an extreme threat to the cycad
8 plants. The presence of ornamental plants throughout the urban landscape provides the butterfly with
9 substrate for the larval stage that aids the butterfly population. This exaggerates the damage to native
10 cycads in the forest.

11 Shells of the introduced giant African snail and both live individuals and shells of the introduced snail
12 *Satsuma mercatoria* were observed on Andersen AFB during the 2009 tree snail surveys. Additionally,
13 live introduced Manokwar flatworms, the coconut rhinoceros beetle, and little fire ant were also observed
14 (NAVFAC Pacific 2010b).

15 4.7 Andersen South

16 4.7.1 General Physical Environment

17 4.7.1.1 Climate

18 The climate at Andersen South is the same as the climate for Guam as a whole. See **Section 4.1.1.1** for a
19 description of the climate on Guam.

20 4.7.1.2 Geology and Topography

21 The geology of Andersen South is characterized by a broad limestone reef plateau underlain by volcanic
22 rocks (see **Figure 4-1**). The southern portion of the site consists of young limestone rock (Pliocene to
23 Pleistocene, 1.5–5 million years old) and the northern portion is older limestone rock (Miocene to
24 Pliocene, 5–25 million years old). Numerous caves are present on Andersen South.

25 The elevation of Andersen South gently rises from approximately 300 feet (91 meters) above msl in the
26 northwestern portion to 500 feet (152 meters) above msl at the southeastern corner of the installation (see
27 **Figure 4-2**).

28 4.7.1.3 Seismology

29 Andersen South overlies both a major and minor fault line and is susceptible to earthquake events. The
30 overall likelihood for landslides to occur on northern Guam is generally low due to the lack of steep areas
31 that contain soils vulnerable to slipping in seismic events. Andersen South is not an area of high risk for
32 liquefaction or tsunami inundation (GHS 2008).

33 4.7.1.4 Soils

34 The following soil types occur on Andersen South: (1) Guam cobbly clay loam, covering the majority of
35 the area, (2) Guam-Urban Land complex and Pulantat clay in the western portion of the installation,
36 (3) Pulantat-Kagman clay in a small section in the center of the western border of the installation; and
37 (4) Ritidian-Rock Outcrop complex in the southeastern corner of Andersen South. In general, erosion
38 risks at Andersen South are slight to moderate, but do not present a major problem because the area is
39 located on a broad limestone reef plateau.

1 4.7.1.5 Hydrology

2 **Groundwater.** Andersen South is underlain primarily by very permeable limestone of the Yigo Subbasin
3 within the larger NGLA (see **Section 4.1.1.5**). Water levels in Andersen South wells indicate the
4 presence of parabasal water at higher elevations than other areas of the NGLA due to the occurrence of a
5 basement of less-permeable volcanic rock.

6 Andersen South has nine groundwater production wells that draw water from the Yigo Subbasin of the
7 NGLA. Water is currently supplied to Andersen AFB from seven of the nine off-installation water
8 production wells. Of the approximately 37 MGD (140 million liters per day [MLD]) of water withdrawn
9 from the NGLA, 2.5 MGD (9.5 MLD) is pumped to Andersen AFB. Water is currently supplied from
10 wells located in the MARBO Annex; stored, disinfected, and fluoridated; and then pumped to Andersen
11 AFB. Two wells, Marbo Well No. 2 and Tumon Maui Well, are currently not operational due to the
12 detection of volatile organic compounds (VOCs) in the groundwater at concentrations that exceed
13 USEPA maximum contaminant levels (MCLs) for drinking water. Other active drinking water wells are
14 either upgradient of, or a sufficient distance away from, contaminated areas and are not at risk of
15 contamination. An analysis of chloride concentrations in Andersen AFB water supply wells at Andersen
16 South indicates that chloride is increasing in approximately half of the wells and concentrations in several
17 wells exceed the Secondary MCL (McDonald and Jenson 2003, NAVFAC Pacific 2008).

18 The Agency for Toxic Substances and Disease Registry (ATSDR) evaluated past exposure to
19 contaminants in the affected production wells and determined that drinking this water would not harm
20 individuals or increase their likelihood of developing adverse health effects. ATSDR also concluded that
21 it does not expect any public health effects, now or in the future, as a result of individuals drinking water
22 from the Andersen AFB water supply or any other wells on Guam. Several reasons for this include
23 (1) the military's remediation actions are further reducing contamination at the installation, (2) dispersion
24 (i.e., natural mixing of contaminated with uncontaminated water dilutes chemical contaminants to
25 concentrations well below levels of public health concern), and (3) the mixing of drinking water in the
26 installation's distribution system further dilutes the levels of any contaminants in the water before the
27 water reaches the taps. On the basis of its evaluation of available environmental information, ATSDR
28 concluded that exposures to contaminants in groundwater, surface soil, and local plants and animals
29 harvested for consumption are below levels that would cause adverse health effects. ATSDR has
30 categorized the installation as "no apparent public health hazard" because of the education efforts, access
31 restrictions, and monitoring programs at Andersen AFB (NAVFAC Pacific 2008).

32 **Surface Water.** Because of the high permeability of the limestone substrate, no streams or other natural
33 surface water drainage features occur on Andersen South.

34 4.7.2 General Biotic Environment

35 4.7.2.1 Terrestrial Ecosystems

36 **Flora**

37 Twenty-five tree species were identified on the transects quantified during 2008 vegetation surveys
38 performed on Andersen South, 17 of which are native to Guam (see **Table 4-11**).

39 Native Guam tree species had a higher collective relative density than introduced species on the Andersen
40 South transects. The most common native tree species on Andersen South include the following:
41 *Hibiscus tiliaceus*, *Guamia mariannae*, Indian mulberry, *Neisosperma oppositifolia*, and *Premna*
42 *obtusifolia*. The most common introduced tree species on Andersen South include the following:
43

1

Table 4-11. Native Tree Species on Andersen South

Chamorro/ Common Name	Scientific Name
Mapun Yao	<i>Aglaia mariannensis</i>
Sumak	<i>Aidia cochinchinensis</i>
Dugdug	<i>Artocarpus mariannensis</i>
Fadang	<i>Cycas micronesica</i>
A'abang	<i>Eugenia reinwardtiana</i>
Hodda	<i>Ficus tinctoria</i>
—	<i>Glochidion marianum</i>
Paipai	<i>Guamia mariannae</i>
Pago	<i>Hibiscus tiliaceus</i>
Ixora	<i>Ixora triantha</i>
Pengua	<i>Macaranga thompsonii</i>
Luluhut	<i>Maytenus thompsonii</i>
Ladda	<i>Morinda citrifolia</i>
Fagot	<i>Neisosperma oppositifolia</i>
Kafu (screwpine)	<i>Pandanus tectorius</i>
Ahgao	<i>Premna obtusifolia</i>
Nanaso	<i>Scaevola taccada</i>

2 tangantangan and pickle tree (*Averrhoa bilimbi*). Aside from pickle tree, other nonnative species in the
 3 survey, such as papaya and custard apple, produce edible fruits that are likely dispersed by ungulate
 4 activity (NAVFAC Pacific 2010b).

5 A vegetative survey was performed for the host plants (*Procris pedunculata* and *Elatostema calcareum*)
 6 for the Mariana eight-spot butterfly and the host plant (*Maytenus thompsonii*) for the Mariana Wandering
 7 Butterfly. Only individuals of *Maytenus thompsonii* were observed on Andersen South (NAVFAC
 8 Pacific 2010b).

9 Geologic conditions needed to support wetland areas (i.e., hydric soils) are not found in highly permeable
 10 limestone plateau of northern and central Guam (NRCS 1988, Wiles and Ritter 1993). The absence of
 11 NWI-mapped wetlands (USFWS 2009a) and NRCS-mapped hydric soils (NRCS 2010) on the Andersen
 12 South support the conclusion that no wetlands are expected to occur on this complex.

13 **Fauna**

14 **Birds.** The following avian species were identified during the 2008–2010 roadside and forest bird
 15 surveys performed on Andersen South: Eurasian tree sparrow, black francolin, Pacific golden-plover,
 16 island collared dove, and yellow bittern. The Eurasian tree sparrow and black francolin were the most
 17 commonly observed species on Andersen South. The Eurasian tree sparrow, black francolin, and island
 18 collared dove are common, introduced, breeding residents in Guam (NAVFAC Pacific 2010b). The

1 Pacific golden-plover is a common, nonbreeding visitor to Guam and the yellow bittern is a common,
2 native, breeding resident of Guam (NAVFAC Pacific 2010b).

3 **Mammals.** During the 2009 habitat quality survey at Andersen South, ungulate activity (feral pig and
4 Philippine deer) on the installation was evidenced most commonly by rooting and rubbings
5 (NAVFAC Pacific 2010b).

6 **Reptiles and Amphibians.** Nine herpetofauna species were documented on Andersen South during the
7 2008–2009 herpetofauna surveys. Of these, three species are native to Guam: Pacific blue-tailed skink,
8 stump-toed gecko, and monitor lizard; and seven species are introduced to Guam: curious skink, house
9 gecko, brown treesnake, brahminy blind snake, marine toad, and greenhouse frog (NAVFAC Pacific
10 2010b). The continued widespread presence of the brown treesnake, curious skink, and other introduced
11 amphibian species is of concern because of each species' potential deleterious impacts on Guam's native
12 fauna (NAVFAC Pacific 2010b).

13 **Invertebrates.** Three butterfly species were documented within forested areas on Andersen South during
14 2009–2010 butterfly surveys: lemon emigrant, blue-banded king crow, and common Mormon
15 (NAVFAC Pacific 2010b). All of these species are widely distributed in the Mariana Islands (NAVFAC
16 Pacific 2010b).

17 During the 2009 tree snail survey performed on Andersen South, no living partulid tree snails or their
18 shells were observed on the transect performed. However, since there were several known host plant
19 species present throughout the survey area, the possibility that tree snails, including candidate species
20 such as humped, fragile, or Guam tree snails, are present on Andersen South cannot be dismissed. Shells
21 of the introduced giant African snail and both live individuals and shells of the introduced snail *Satsuma*
22 *mercatoria* were seen along the transect (NAVFAC Pacific 2010b).

23 4.7.2.2 Freshwater Ecosystems

24 There are no freshwater ecosystems on Andersen South.

25 4.7.2.3 Estuarine Ecosystems

26 There are no estuarine ecosystems on the Andersen South.

27 4.7.2.4 Submerged Lands

28 No JRM-managed submerged lands are associated with the Andersen South.

29 4.7.2.5 Protected Species

30 Terrestrial Species

31 Birds

32 No Federal- or Guam-listed bird species have been recorded at Andersen South.

33 Mammals

34 No Federal- or Guam-listed mammals have been recorded at Andersen South. However, historical data
35 might indicate the occurrence of the Mariana fruit bat on Andersen South. The vegetation study of the
36 area provides evidence that the fruit bat used the site.

1 **Invertebrates**

2 No Federal- or Guam-listed invertebrate species have been recorded at Andersen South.

3 **Flora**

4 No Federal- or Guam-listed plant species have been recorded at Andersen South.

5 **4.7.2.6 Invasive Species**

6 **Flora**

7 The most common introduced tree species on Andersen South include tangantangan and pickle tree.
8 Other nonnative species occur, such as papaya and custard apple, which produce edible fruits that are
9 likely dispersed by ungulate activity (NAVFAC Pacific 2010b). In addition, fruit bats and birds have also
10 dispersed seeds from fruiting trees.

11 **Fauna**

12 Introduced bird species occurring on Andersen South include the island collared dove, Eurasian tree
13 sparrow, and black francolin. These species are common, introduced, breeding residents in Guam
14 (NAVFAC Pacific 2010b).

15 During the 2009 habitat quality survey at Andersen South, ungulate activity on the installation was
16 evidenced most commonly by rooting and rubbings (NAVFAC Pacific 2010b).

17 Six introduced herpetofauna species were documented on Andersen South during the 2008–2009
18 herpetofauna surveys: curious skink, house gecko, brown treesnake, Brahminy blind snake, marine toad,
19 and greenhouse frog (NAVFAC Pacific 2010b). The continued widespread presence of the brown
20 treesnake, curious skink, and other introduced amphibian species is of concern because of each species'
21 potential deleterious impacts on Guam's native fauna (NAVFAC Pacific 2010b). One native
22 herpetofauna species was documented during the surveys, the monitor lizard (NAVFAC Pacific 2010b).

23 Shells of the introduced giant African snail and both live individuals and shells of the introduced snail
24 *Satsuma mercatoria* were observed on Andersen South during the 2009 tree snail surveys (NAVFAC
25 Pacific 2010b). The coconut rhinoceros beetle was also observed on Andersen South during surveys
26 conducted by UOG in 2010.

5. Management Concerns, Goals, Objectives, and Strategies

JRM currently manages natural resources based on an ecosystem management approach through the implementation of several ongoing projects and management strategies. Examples of ongoing management strategies include soil and water conservation efforts to address erosion sites on the NMS; threatened and endangered species monitoring at NBG; endangered species mitigation on FDM, Anatahan, and Sarigan through the removal of feral goats and pigs; development of alternate survey protocols to more accurately survey Mariana swiftlets at the NMS; invasive species monitoring for the coconut rhinoceros beetle; and long-term vegetation surveys on NBG and Tinian leased lands. These projects, which are further described in the following sections, provide examples of JRMs current efforts to manage and enhance natural resources on their managed lands through an ecosystem approach in a manner consistent with implementation of the military mission. The following sections present management goals, objectives, and strategies to continue implementation of these projects along with additional current and new goals, objectives, and strategies for ongoing management of natural resources on JRM lands.

5.1 Purpose, Approach, and Rationale

Ecosystem management must be based on clearly stated objectives and strategies. The purpose of the INRMP is to identify goals and objectives and present the means to accomplish them. The Navy 2006 guidance defines goals as “broad guiding principles for the [installation natural resources] program” and objectives as “measurable targets for achieving the goals” (U.S. Navy 2006). In addition, the guidance states that the INRMP will provide parameters to determine “the effectiveness of the natural resources program outlined in the INRMP through ensuring that the plan includes quantifiable, scientifically valid parameters that will demonstrate achievement of objectives,” or INRMP strategies and projects (U.S. Navy 2006). This INRMP is the mechanism to ensure that JRM facilities can successfully meet ecosystem and natural resources goals without compromising the mission.

Natural resources management at JRM strives to integrate biodiversity conservation and an ecosystem-based approach into an adaptive management framework compatible with the military mission. As a result, the natural resources program consists of multiple resource disciplines that are frequently interconnected and share similar objectives. Management projects and plans often consist of multiple program elements with several different resource experts collaborating together. This section describes the various natural resources program elements (i.e., Fish and Wildlife Resources Management) along with their primary goals and objectives.

In addition, an Adaptive Management Team (AMT) consisting of representatives from JRM sites, USFWS, and GDAWR has been established in response to Biological Opinion (BO) requirements for management of natural resources at JRM. According to the 2001 Adaptive Management Plan, AMT members are to meet at least quarterly to discuss resources management issues, concerns, and successes at JRM sites.

5.2 Natural Resources Management Goals

The purpose of this section is to identify specific resource area goals, objectives, strategies, and projects for JRM and to obtain workable and useful solutions for natural resources management. In accordance with OPNAVINST 5090.1C CH-1 and the principles of adaptive ecosystem management, natural resources management goals, objectives, and strategies were developed for JRM by an interdisciplinary team of ecologists, biologists, geologists, planners, and environmental scientists. The natural resources management program at JRM encompasses various disciplines and activities, and a set of general goals for JRM has been identified to direct natural resources management activities (see **Table 5-1**).

1

Table 5-1. Summary of INRMP Goals

Long-term Ecosystem Management
<ul style="list-style-type: none"> • Manage all natural resources on JRM lands with a long-term goal of restoring and enhancing habitats for native species including listed species over the next 30 to 50 years.
Threatened and Endangered Species and Other Candidate, Locally Rare or GovGuam-Listed Species Management Goals
<ul style="list-style-type: none"> • Manage JRM on a regional ecosystem-based approach that manages sensitive species and their associated ecosystems while supporting the operational functionality of JRM site missions. Sensitive species include species that rely on specific habitat conditions that are limited in abundance, restricted in distribution or are particularly sensitive to changes in environmental conditions. • Ensure that JRM sites remain in compliance with ESA, mitigation measures contained within biological opinions, Federal consistency determinations affecting listed species, and appropriate territorial regulations. • Protect and enhance habitats for threatened, endangered, and species of concern on JRM. Species of concern include species that are declining or appear to be in need of concentrated conservation actions. • Implement programs and projects that will benefit the species in terms of population recovery towards the goal of delisting the species.
Wetlands and Floodplain Management Goals
<ul style="list-style-type: none"> • Remain in compliance with USACE and GovGuam wetlands regulations. • Minimize the operational impact of JRM missions on wetlands and coastal waters. • Maximize native floral and faunal diversity of wetland communities in the ecosystem. • Manage for no net loss of wetland functions and values. • Ensure that mapping of wetlands and other waters of the United States is conducted based on the 1987 USACE Wetlands Delineation Manual and the 2010 Draft Interim Regional Supplement to the U.S. Army Corps of Engineers Wetland Delineation Manual: Hawaii and Pacific Islands Region, and is accurate and consistent across JRM sites.
Fish and Wildlife Resources Management Goals
<ul style="list-style-type: none"> • Manage based on an ecosystem management approach, rather than from a single-species paradigm. • Employ a systematic approach to managing fish and wildlife resources, using a process that includes inventory, monitoring, modeling, management, and assessment. • Minimize fish and wildlife-related health risks, safety risks, and environmental damage. • Restore and maintain a diversity of fish and wildlife in areas on JRM sites where there will be no conflict with the military mission. • Continue to remain in compliance with Federal, territorial, and local laws and regulations governing fish and wildlife. • Maintain and develop partnerships with agencies and groups involved in fish and wildlife management.

Vegetation and Habitat Management Goals

- Protect native habitat diversity.
- Maximize use of regionally native plant species and avoid introduction of invasive, exotic species in revegetation activities.
- Enhance habitat for native species by removing invasive vegetation and replacing with native vegetation.
- Maintain and enhance vegetation community structure, functionality, and species diversity.
- Lessen or avoid adverse effects from activities on the overall ecosystem and its sensitive resources.

Coastal, Marine and Submerged Lands Management Goals

- Conserve and restore coastal, marine, and submerged lands that provide habitat for a variety of native marine plants and animals, especially coral reef systems.
- Employ a systematic approach to managing coastal, marine and submerged lands resources, using a process that includes inventory, monitoring, modeling, management, and assessment.
- Complete an assessment and establish a monitoring program for coral reef health.
- Develop best management practices for accommodating military training needs and recreation while conserving coral habitat.
- Ensure JRM sites remain in compliance with Magnuson-Stevens Fishery Conservation and Management Act and other appropriate Federal regulations.

Exotic and Invasive Species Management Goals

- Employ a systematic approach for early detection and rapid response to control or remove invasive species that are having an adverse effect on native ecosystems.
- Continually monitor and reduce the effects invasive species have upon the native ecosystems of Guam, such as habitat alteration, competition for resources, and predation.
- Minimize invasive species-related health risks, safety risks, and environmental damage.
- Continue to remain in compliance with Federal, territorial, and local laws and regulations governing invasive species.
- Maintain and involve partnerships with agencies and groups involved in invasive species control and removal.
- Develop BMPs to ensure that invasives species from Guam are not spread to other locations on and off the Island of Guam.

Watershed Management Goals

- Develop an understanding of ecosystem dynamics within the watershed in an effort to prevent and respond to threats to its integrity.
- Maintain healthy and stable soils; rehabilitate damaged areas to reduce soil and sediment inputs into the watershed that degrade water quality.
- Minimize nonpoint source pollution of both surface and groundwater in the watershed through the implementation of BMPs.
- Manage watersheds to maintain natural hydrology.

Developed Land Management Goals

- Minimize or avoid adverse effects from grounds maintenance activities on the overall ecosystem and its sensitive resources.
- Make maximum use of regionally native plant species and avoid introduction of invasive, exotic species in revegetation activities.
- Reduce chemical usage, and maintenance inputs in terms of energy, water, manpower, equipment, and chemicals.
- Ensure compliance with environmental legislation, regulations, and guidelines.
- Control pest and invasive species.
- Ensure the orderly and scientific management of the urban trees on JRM to the extent compatible and consistent with the mission.

Coastal Zone Management Goals

- Collaborate with Federal agencies, GovGuam, and local interests in preserving the marine environment through unifying policies, criteria, standards, methods, and processes for dealing with land and water use decisions of more than local significance.
- Ensure that the future maintenance of JRM's coastal zone resources is performed in a manner that supports shoreline stabilization and the reduction of erosion and sedimentation into marine environments without compromising the military mission.
- Ensure that future maintenance of JRM's coastal zone resources is performed in a manner that supports the diverse biological and hydrological functions unique and significant to coastal zones.

Wildland Fire Management Goals

- Support a Wildland Fire Management Program to protect high-value natural resources areas and operational facilities from catastrophic wildfire while conserving resources and military operational flexibility.

Urban Forestry Management Goals

- Ensure the orderly and scientific management of the urban trees on JRM sites to the extent compatible and consistent with the mission.
- Promote use of native plants in landscaping where applicable. Replace any trees removed from landscaped areas with native trees.

Law Enforcement Goals

- Ensure compliance with state and Federal natural resources laws and regulations.
- Provide training to personnel responsible for enforcement of applicable laws and regulations.
- Secure and sustain dedicated conservation law enforcement personnel.
- Ensure community is aware of Guam and Federal natural resources laws and regulations, and responsibility of law enforcement personnel.

Outdoor Recreation Management Goals

- Provide quality outdoor recreation experiences while sustaining ecosystem integrity.
- Ensure that outdoor recreation activities are not in conflict with mission priorities or natural resources management objectives.
- Ensure recreational activities comply with Federal and local laws and installation instructions.

Surrounding Lands Management Goals

- Encourage cooperative efforts on adjacent lands that are complementary to the INRMP.

Geographic Information Systems Management Goals

- Collect, store, and maintain data about historical conditions, trends, and current status of natural resources.
- Use GIS information as benchmarks for developing future natural resources management goals and objectives.

1 Management objectives and strategies were developed based on evaluation of the natural resources
 2 present on the JRM sites, and discussions with natural resources personnel at JRM, and discussions with
 3 resource agencies USFWS, CNMI DLNR and GDAWR. This section is divided into 18 subsections, one
 4 for each subject area. Each subject area has been abbreviated, as shown in **Table 5-2**. For example, the
 5 first management issue in **Section 5.3**, long-term ecosystem-management Goals, is identified as EM-1. In
 6 addition, a series of strategies for implementation are presented following goals and objectives for each
 7 item. These strategies are consecutively numbered for each resource, and strategies that were previously
 8 identified by a Biological Opinions are identified. **Table 5-3** includes a list of compensatory mitigations
 9 associated with Biological Opinions that are currently programmed, or in progress. Biological Opinions
 10 associated with mitigation are also identified within the table. Projects, mitigation and maintenance work
 11 associated with a Biological Opinion that have already been completed are not included in **Table 5-3**.
 12 Actions identified in **Table 5-3** are included as strategies in the appropriate subject area. Additional
 13 actions not identified in **Table 5-3** are also included as strategies in the appropriate subject area.
 14 Following the management strategies are the evaluation criteria, which are used to track the status of the
 15 resolution of the management issue. A summary of the management strategies and the estimated
 16 timeframe for completion is presented in the **INRMP Project Schedules and Implementation Table**
 17 included as **Appendix C**.

18

Table 5-2. INRMP Subject Area Abbreviations

Section	INRMP Subject Area	Abbreviation
5.3	Long-term Ecosystem Management	EM
5.4	Threatened and Endangered Species and Other Candidate, Locally Rare or GovGuam-Listed Species Management	TE
5.5	Wetlands and Floodplain Management	WT
5.6	Fish and Wildlife Resources Management	FWM
5.7	Vegetation and Habitat Management	VHM
5.8	Coastal, Marine, and Submerged Lands Management	SLM
5.9	Exotic and Invasive Species Management	ISM
5.10	Watershed Management	WP
5.11	Developed Land Management	LM
5.12	Coastal Zone Management	CZM
5.13	Wildland Fire Management	WFM
5.14	Urban Forestry Management	FOR
5.15	Law Enforcement	LE
5.16	Outdoor Recreation Management	OR
5.17	Surrounding Lands Management	SR
5.18	Geographic Information Systems Management	GIS

1 **Table 5-3. Compensatory Mitigations Associated with Biological Opinions that are Currently**
 2 **Programmed or in Progress**

Biological Opinion / Consultation	Compensatory Mitigation / Projects
<i>Mitigation Plan for MILCON P-502, Kilo Wharf Extension (ACOE 2008)</i>	Expansion of the Orote Ecological Reserve by 112.6 acres: 80.6 acres of submerged lands from Orote Point to Adotgan Point, and 32 acres including the beaches, small islets in the cove between Orote Island and the main peninsula, and the limestone forest area inland of the Unit, including the 8.2 acre (3.3 hectares) Orote Island and the 24 acre (9.7 hectares) of cliff line at the north tip of Orote Peninsula. The management plan for the Orote Ecological Reserve Area would be modified to restrict fishing and other types of consumptive activities that could adversely affect the essential fish habitat.
<i>Mariana Islands Range Complex Biological Opinion (DoN 2010)</i>	Tinian: Development of a management plan specific to Hagoi and other wetlands within the Tinian Military Lease Area. The management plan will benefit the Mariana common moorhen and provide additional protection for these unique wetland areas.
	Tinian: Continued monitoring of Mariana moorhen at Hagoi to evaluate population trends and determine success of avoidance and minimization measures.
	Tinian: Continued monthly monitoring of all sandy areas within the MLA to note turtle activity, beach erosion and compaction.
	FDM: Megapode surveys on Farallon de Medinilla will be conducted only after removal of UXO by EOD personnel during operational range clearance.
	FDM: Quarterly population monitoring of seabirds, turtles, and marine mammals conducted using aerial observations.
	Continued trapping of brown treesnakes in areas surrounding Mariana swiftlet caves to reduce or prevent brown treesnake predation on the swiftlets and continue monitoring swiftlet population trends on Guam to evaluate success of avoidance, minimization, and conservation measures.
	Monitor Mariana fruit bats at the Pati Point colony and other locations above and below the cliffline to determine if the colony is shifting from its historical location. These data will be used to assess the current population size at the colony and determine if additional adaptive management actions are needed to minimize impacts associated with ISR Strike and MIRC.
<i>Section 7 consultation Northwest Field Beddown (2006)</i>	Eradication of ungulates, and feral cats in the HMU.
	Fenced ungulate enclosure of 113 acres (54 hectares) and eradication of ungulates within the enclosure.
	500 square feet (50 square meters) fenced plots within ungulate enclosure for outplanting of native trees for forage used by fruit bats and crows.

Biological Opinion / Consultation	Compensatory Mitigation / Projects
<i>Intelligence, Surveillance, Reconnaissance, and Strike Capability Biological Opinion (2006)</i>	Fenced ungulate enclosure of 494 acres (200 hectares) and eradication of ungulates within the enclosure.
	Development of a plan to reduce ungulate numbers in non-fenced areas. [Ungulate Management Plans for NBG and Andersen AFB]
	Base-wide ungulate control to levels that allow for forest regeneration and self-sustaining populations of native animals. [Ungulate Management Plans for NBG and Andersen AFB]
	500 square feet (50 square meters) fenced plots within ungulate enclosure for outplanting of native trees for forage used by fruit bats and crows.
	Out plant trees used by fruit bats and crows within the enclosures.
	Telemetry studies of ungulate movements. [Ungulate Management Plans for NBG and Andersen AFB]
	Transplant <i>Tabernaemontana rotensis</i> saplings from areas that will be developed.
	Funding USDA research on brown treesnake control.
<i>Section 7 consultation, Habitat Management Units wells and fence (USFWS 2009)</i>	Eradication of ungulates, brown treesnakes and other predators within the HMU.
<i>Guam and Commonwealth of the Northern Mariana Islands Military Relocation Biological Opinion (2010)</i>	Ungulate control to levels that allow for forest regeneration and self-sustaining populations of native animals. [Ungulate Management Plans for NBG and Andersen AFB]
	Lighting will be designed to meet minimum safety, anti-terrorism, and force protection requirements.
	Ungulate Management Plans will be finalized by the DOD for DOD lands on Guam to include specific management and control of ungulates.
	DOD will develop a restoration plan for the Camp Covington wetlands in an effort to increase suitable habitat for the Mariana common moorhen.
	DOD will enter into an MOU with USFWS and NMFS outlining the details of a joint investigation on sea turtle population abundance estimates, demographic information, near shore habitat use, baseline populations, and long-term population parameters. This will be a 3 to 5 year joint DOD-USFWS-NMFS capture-mark-recapture laparoscopy program for green sea turtles occurring in near shore waters surrounding Guam, Saipan, Tinian and Rota.
	Conduct additional surveys for the moth skink and Pacific slender-toed gecko on DOD lands.

- 1 Some of the projects described in this section will be accomplished through interactive partnerships with
- 2 other Federal, territorial, and local organizations. JRM natural resources management staff will initiate
- 3 partnerships based on the benefits to the regional ecosystem and the local environment. Required
- 4 projects, which are part of the continued management of JRM, will be internally funded through the JRM.

1 5.3 Long-term Ecosystem Management

2 The intent of this INRMP is to take an ecosystem approach to managing the natural resources present on
3 JRM. The interdisciplinary approach taken by this INRMP follows an ecosystem model, in which all
4 appropriate components are integrated by their function. Ecosystem management is emphasized because
5 it is recognized that the mission of the JRM is inextricably linked to local, regional, and global ecological
6 integrity. Sustaining ecosystem integrity is also the best way to protect biodiversity, ensure sustainable
7 use, and minimize the effort and cost of management. Native and natural communities, and the processes
8 that sustain them, are essential to sustaining system function and resilience over the long term.

9 Native habitats occurring on JRM lands have been impacted by historical activities, introduction and
10 spread of invasive and nonnative species, and the resulting loss of functions necessary to support healthy
11 native habitats. The occurrence of healthy native habitats on JRM is necessary to support sustainability of
12 native species including listed species on Guam and the CNMI. JRM recognizes that restoration and
13 enhancement of native habitats on lands that they manage is an ongoing long-term process. JRM also
14 recognizes that ongoing projects and management efforts need to be coordinated with future management
15 efforts, and that they need to be directed towards a goal of restoring and enhancing habitats for native
16 species including listed species over the long term (30 to 50 years out).

17 JRM is currently implementing several projects and has projects planned with the goals of restoring and
18 enhancing habitats for native species and maximizing availability of important habitat for listed species
19 on terrestrial and submerged lands that they manage. Some of these projects include the following:

- 20 1. Conducting marine monitoring at the Pati Point Marine Preserve to determine the location and
21 status of corals in the preserve, to assess the feasibility of monitoring within the preserve, and to
22 establish permanent transects viable for continued monitoring.
- 23 2. Conducting surveys and studies on threatened and endangered species, populations, and their
24 habitat to prevent further decline of listed species and to contribute to USFWS, GDAWR, and
25 CNMI DLNR goals to recover listed species.
- 26 3. Continuing to develop and implement projects to manage, control, and eradicate exotic and
27 invasive species including ungulates, feral cats and dogs, and the brown treesnake.
- 28 4. Ongoing management by JRM to stabilize and restore erosion scars caused by wildland fires and
29 destruction of vegetation and disturbance of soil by ungulates in the savannah areas of the NMS
30 and at other locations on JRM sites.

31 These example projects along with other ongoing and planned projects need to be linked to the long-term
32 management goal. It is the intent of this INRMP to link ongoing projects and develop future projects
33 from an ecosystem-based management approach that takes into consideration the overriding goal of
34 enhancing habitats for native species including listed species over the long-term. It is understood that
35 many projects and management actions are necessary to address needed management on a daily or
36 short-term basis. It is also understood that many projects developed in this INRMP are necessary for
37 ongoing management of natural resources. The daily and short-term management of resources is
38 important towards reaching the long-term goals.

39 To ensure that JRM continues to meet the overriding goal of restoring and enhancing habitats for native
40 species, including listed species, over the next 30 to 50 years, coordination between JRM site land
41 managers, and resource agencies should continue. In addition, long-term ecosystem based management
42 plans will be developed for JRM submerged lands in Apra Harbor, marine units of the OPERA and
43 HERA, and the overlay units on NBG and Andersen AFB. These plans will direct management on JRM

1 through the development of studies and projects that are based on, or have as primary components, goals
 2 and objectives that are consistent and supplemental to long-term management goals developed in the
 3 Plans.

4 The goal for long-term ecosystem management for JRM is summarized in **Table 5-4**.

5 **Table 5-4. Summary of Long-term Ecosystem Management Goals**

Long-term Ecosystem Management	
	<ul style="list-style-type: none"> • Manage all natural resources on JRM lands with a long-term goal of restoring and enhancing habitats for native species including listed species over the next 30 to 50 years.

6 To meet the long-term ecosystem management goal identified in **Table 5-4**, the following management
 7 concerns have been identified with the indicated objectives, strategies, and monitoring criteria to address
 8 them.

9 5.3.1 EM-1 Long-term Ecosystem Management on JRM

10 **Concerns:** Natural resources management in the overlay units and submerged lands on JRM has a
 11 primary goal of maintaining the health of habitats associated with these areas and where needed working
 12 towards restoring and enhancing these habitats for native species, including listed species, in a manner
 13 consistent with the requirements of JRM's mission. Management of these areas is based on an ecosystem
 14 approach that considers the goals of management over the long term. There currently are no management
 15 plans specific to the overlay units or JRM submerged lands that consider past, ongoing and future projects
 16 and their coordination towards the goal of management objectives for the long term (30 to 50 years).
 17 There is a need to develop long-term management plans that will combine and use the results and
 18 achievements of past management along with ongoing and future projects in the overlay units and in
 19 submerged lands on JRM. These long-term management plans will have the overriding goal of restoring
 20 and enhancing habitat for native species including listed species and their habitats over the next 30 to
 21 50 years.

22 **Objective:** Develop two detailed watershed and forest management plans for the overlay units on NBG
 23 and Andersen AFB that use past and ongoing efforts and prescribe new and future specific actions and
 24 projects designed at achieving the long-term goals. The management plans will develop a chronology of
 25 actions necessary to achieve the long-term goals (i.e., need to address ungulates first).

26 Develop a management plan for submerged lands in Apra Harbor, and marine units of the OPERA and
 27 HERA that evaluates current impacts on the submerged ecosystems, identifies sources of impacts and
 28 recommends management directed at addressing impacts with the long-term goal of restoring and
 29 enhancing submerged ecosystems for native species and corals in these habitats over the next 30 to 50
 30 years.

31 **Strategies:**

32 1. Develop a Long-Term Watershed and Forest Management Plan for terrestrial ecosystems on JRM
 33 lands for the overlay units on NBG, and a Long-Term Watershed and Forest Management Plan
 34 for terrestrial ecosystems on JRM lands for the overlay units on Andersen AFB. The detailed
 35 management plan for the overlay units will address past and ongoing efforts and prescribe new
 36 and future specific actions and projects that, in coordination with past and ongoing activities, are

1 directed at achieving the long-term goal of restoring and enhancing habitats for native species
2 including listed species over the next 30 to 50 years. The plan will be developed as a living
3 document that can be updated over time to address changing management needs necessary to
4 achieve the long-term goal.

- 5 2. Develop a Long-Term Submerged Lands Management Plan for JRM submerged lands associated
6 with Apra Harbor, and marine units of the OPERA and HERA. The plan will identify sources of
7 impacts and recommend management directed at addressing impacts with the long-term goal of
8 restoring and enhancing submerged ecosystems for native species and corals in these habitats
9 over the next 30 to 50 years. The plan will be developed as a living document that can be
10 updated over time to address changing management needs necessary to achieve long-term goals.

11 **Monitoring Criteria:** Development of three long-term management plans directed at management of
12 natural resources in the overlay units and the submerged lands of Apra Harbor and Sumay Cove over the
13 long term. Development and implementation of all natural resources management projects and actions
14 taking into consideration the overriding management goal of restoring and enhancing habitat for native
15 species including listed species and their habitats over the next 30 to 50 years.

16 5.4 Threatened and Endangered Species and Other Candidate, Locally Rare or 17 GovGuam-Listed Species Management

18 Management of threatened and endangered species at JRM includes implementing programs to protect
19 species, and coordinating efforts with the appropriate agencies. Several of the endangered species listed
20 in **Table 4-4** (e.g., little Mariana fruit bat, Guam broadbill) have already become extinct due to the key
21 threats which still exist today. These key threats to threatened and endangered species are as follows:

- 22 • Predation by brown treesnakes on native forest birds, lizards, and bats
- 23 • Overgrazing, rooting, and trampling of plants and wildlife habitat by feral ungulates
- 24 • Predation by feral cats and ungulates on birds, bats, and sea turtles
- 25 • Human disturbance of threatened and endangered species and poaching of sea turtles and Mariana
26 fruit bats
- 27 • Mortality or injury to native plants and wildlife due to natural stochastic events (e.g., typhoons)
- 28 • Low reproductive success due to small population numbers
- 29 • Habitat loss and fragmentation associated with military operations.

30 To address these key threats to listed species, efforts are underway to reduce or control brown treesnake
31 population numbers from habitat areas on JRM sites and to prevent their spread to other Pacific Islands.
32 Captive breeding programs conducted by GDAWR are keeping the Guam rail and Guam Micronesian
33 kingfisher alive and are adding to the information needed for successful recovery of these species.
34 Additional ecological research and monitoring of populations is also being conducted by various agencies
35 on Guam, including DOD, that will support research and management efforts for these species. Some of
36 these projects include the surveys conducted by DOD on NBG TS in 2007 to determine status of
37 populations of candidate snails on JRM sites, and removal of feral goats and pigs populations from
38 Anatahan by the USFWS. Since 2001, USFWS has removed approximately 3,700 goats and 208 pigs
39 from Anatahan. In addition, it is estimated that less than 3 pigs were left and all goats were removed or
40 died after the May 2010 eruption of the Anatahan and Sarigan volcano.

1 Any Federal action that could affect federally listed species must be coordinated with the USFWS or
2 NMFS under Section 7 of the ESA. For federal actions that might affect Guam-listed species, the
3 GDAWR should be consulted. For actions that might affect listed species on Tinian and FDM, CNMI
4 Division of Fish and Wildlife should be consulted. In addition, according to the Cooperative Agreements
5 between the USFWS, Navy and Air Force, the Navy and Air Force must consult if it proposes projects
6 within the Guam National Wildlife Refuge that could impact habitat of endangered or threatened species.

7 Species habitat on JRM sites is identified in published recovery plans for endangered native forest birds
8 (USFWS 1990a, USFWS 1994a) and endangered fruit bats (USFWS 1990b). On JRM, areas with
9 wildlife habitat are included in the OPERA, HERA, and JRM-managed portions of the GNWR. These
10 habitats include primary and secondary native limestone forest, coastal strand and beaches, and coastal
11 plain communities. Habitat for endangered species also supports a diversity of other native plants and
12 animal species.

13 This INRMP qualifies as a “legally operative plan that provides adequate special management and
14 addresses the maintenance and improvement of the primary constituent elements important to the species,
15 and manages for the long-term conservation of the species” (67 FR 63738). An INRMP is considered
16 acceptable in place of the designation of critical habitat if it meets the following criteria:

- 17 1. **The plan provides a benefit to the species.** Cumulative benefits of the management activities
18 identified in a management plan, for the length of the plan, must maintain or provide for an
19 increase in a species’ population or the enhancement or restoration of its habitat within the area
20 covered by the plan (e.g., those areas deemed essential to the protection of the species) A benefit
21 could result from reducing fragmentation of habitat, maintaining or increasing populations,
22 ensuring against catastrophic events, enhancing and restoring habitats, buffering protected areas,
23 or testing and implementing new strategies.
- 24 2. **The plan provides certainty that the management plan will be implemented.** Persons
25 charged with plan implementation are capable of accomplishing objectives of the management
26 plan and there is adequate funding for the management plan. They have the authority to
27 implement the plan and have obtained all necessary authorizations or approvals. An
28 implementation schedule (including completion dates) for the management effort is provided in
29 the plan.
- 30 3. **The plan provides certainty that the management effort will be effective.** The following
31 criteria will be considered when determining the effectiveness of the management effort. The
32 plan includes (1) biological goals (broad guiding principles for the program) and objectives
33 (measurable targets for achieving the goals); (2) quantifiable, scientifically valid parameters that
34 will demonstrate achievement of objectives and standards for these parameters by which progress
35 will be measured are identified; (3) provisions for monitoring and, where appropriate, adaptive
36 management; (4) provisions for reporting progress on implementation (based on compliance with
37 the implementation schedule) and effectiveness (based on evaluation of quantifiable parameters)
38 of the management effort are provided; and (5) a duration sufficient to implement the plan and
39 achieve benefits of its goals and objectives.

40 The JRM INRMP prescribes the following actions to meet these criteria:

- 41 • The INRMP specifies management strategies for the Mariana fruit bat, Mariana crow, Guam
42 Micronesian kingfisher, Guam rail, Mariana swiftlet, Mariana common moorhen, Micronesian
43 megapode, marine mammals, green and hawksbill turtles, and *Serianthes nelsonii* to reduce
44 adverse impacts on the species

- 1 • There is a timely schedule in the INRMP for implementation of the management strategies for
2 these species
- 3 • There is a high probability that the funding sources or other resource(s) necessary to implement
4 the strategies will be available
- 5 • JRM has the authority, legal requirement, and long-term commitment to implement the
6 management strategies in the INRMP due to the SAIA and other DOD and DoN policies and
7 instructions.

8 The goals for this section are to manage JRM lands on a regional ecosystem-based approach that manages
9 sensitive species and their associated ecosystems while protecting the operational functionality of the
10 missions of the installation. Also, natural resources personnel from JRM sites will work to promote
11 ecosystem-based management in the local region.

12 As a general guide, **Figure 5-1** presents a threatened and endangered species coordination decision chart
13 that will be followed as part of the planning process for projects that could impact known or potential
14 future populations of threatened or endangered species on the installation, or nearby critical habitat. The
15 threatened and endangered species management goals are summarized in **Table 5-5**. Sensitive species at
16 JRM will continue to be managed by implementing specific management strategies that enhance habitat
17 for these species and by initiating specific strategies that address immediate needs of threatened and
18 endangered, and other sensitive species on the installation. In addition, adherence to the goals set for
19 threatened and endangered species management will ensure that the installation remains in compliance
20 with ESA and applicable territory regulations.

21 **Table 5-5. Summary of Threatened and Endangered Species Management Goals**

Threatened and Endangered Species Management Goals
<ul style="list-style-type: none"> • Manage JRM on a regional ecosystem-based approach that manages threatened and endangered species and their associated ecosystems while supporting the operational functionality of JRM site missions. • Ensure that JRM sites remain in compliance with ESA, mitigation measures contained within biological opinions, Federal consistency determinations affecting listed species, and appropriate territorial regulations. • Protect and enhance habitats for threatened, endangered, and species of concern on JRM. • Implement programs and projects that will benefit the species in terms of population recovery towards the goal of delisting the species.

22 To meet the threatened and endangered species management goals identified in **Table 5-5**, the following
23 management concerns have been identified with the indicated objectives, strategies, and monitoring
24 criteria to address them.

25 **5.4.1 TE-1: Protection and Recovery of the Mariana Fruit Bat**

26 **Concern:** The Mariana fruit bat or fanihi is federally endangered. In addition, the fruit bat is listed as
27 critically endangered on Guam.

28 **Objective:** With respect to mission requirements, continue to assist the USFWS and GDAWR in
29 achieving Mariana fruit bat recovery goals: (1) restoring two colonies on JRM with a population of at
30 least 500 individuals per colony, (2) recovering the species and delisting as soon as possible, and
31 (3) sustaining recovery of the species in perpetuity.

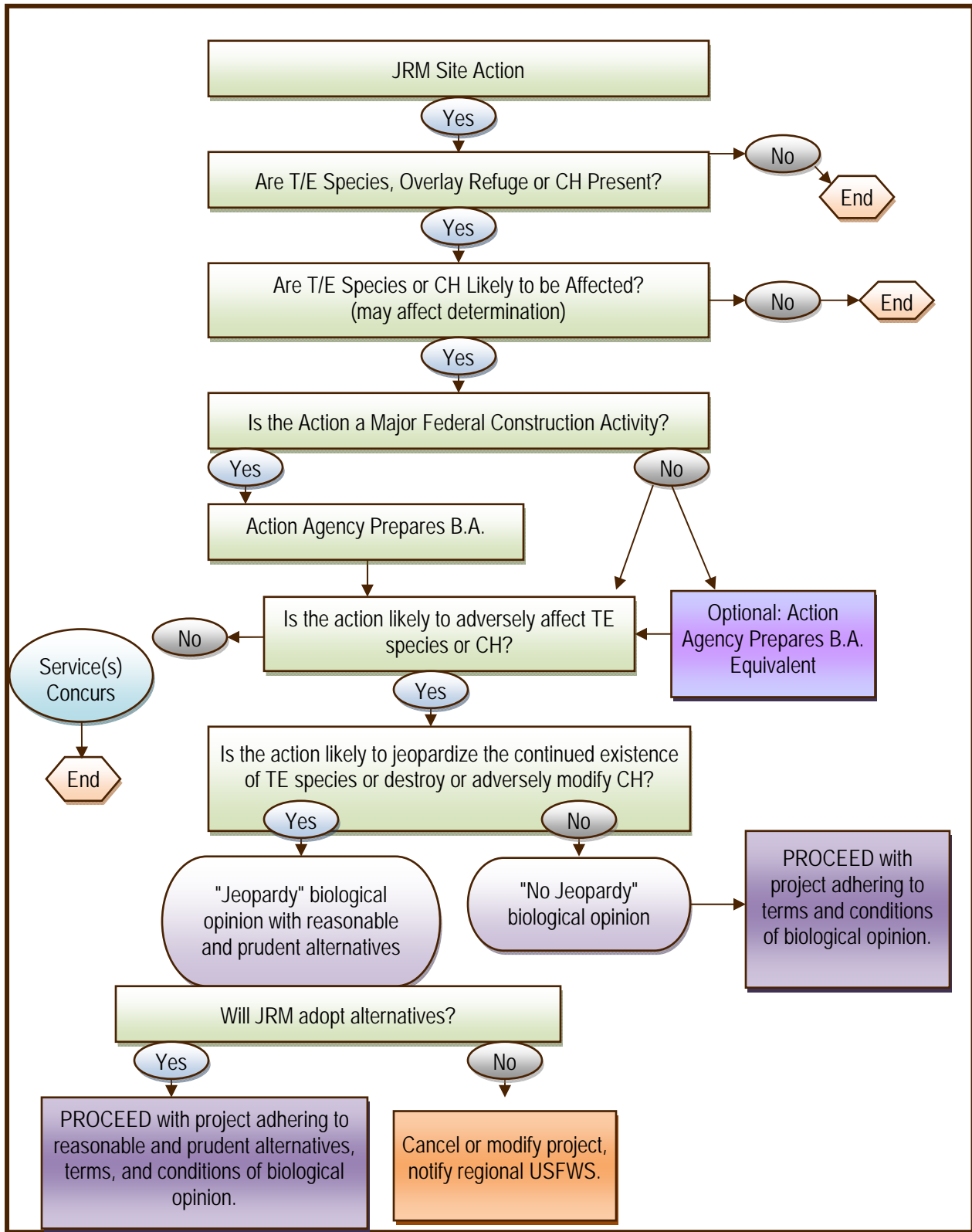


Figure 5-1. Threatened and Endangered Species Coordination Chart

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2
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1 The resident Mariana fruit bat colony has historically been located in an off-limits area on JRM. Recent
2 surveys of fruit bat populations at the JRM colony have indicated very low (less than 5 bats in 2011
3 [SWCA 2012]) attendance, indicating this colony site has been abandoned. As of 2011, no new fruit bat
4 colonies have been recorded anywhere on Guam (GDAWR 2011 and SWCA 2012).

5 The *Mariana Fruit Bat Management Plan* will be updated and management recommendations within the
6 plan will be implemented once the update is complete.

7 With the continued decline of fruit bat populations on Guam, management of this species on JRM lands
8 will focus on the restoration of fruit bat habitat, including the elimination, significant reduction or
9 confining of feral ungulates, and vegetation restoration in areas where ungulates have been controlled or
10 excluded. In addition, management actions will be revised based on population health, including influx of
11 bats from Rota. Elimination or reduction of feral ungulates together with continued patrols on JRM lands
12 will also help reduce illegal hunting. Management will also focus on area-wide control methods for
13 brown treesnakes and regular monitoring of fruit bat habitat condition and existing fruit bat populations.

14 All strategies described as follows for JRM will be developed and implemented in coordination with the
15 AMT.

16 **Strategies:**

- 17 1. Create ten vegetation plots where trees important to Mariana fruit bat and Mariana crow ecology
18 (foraging and nesting) occur in the Ritidian Point East and West Units and the NWF ungulate
19 exclosure (Part of the Ritidian Point ERA) as required by the Intelligence, Surveillance,
20 Reconnaissance, and Strike Capability (ISR/Strike) BO. Supplemental fencing within the
21 ungulate exclosures will be provided around the vegetation plots. Additional actions within the
22 vegetation plots include herbaceous plant management, fence line maintenance and quarterly
23 monitoring of outplanting success. [Requirement from BO]
- 24 2. Continue to maintain a standardized, up-to-date inventory and GIS map of Mariana fruit bats
25 including historic distribution, current distribution, numbers of individuals; nesting sites or
26 breeding locations; maps of important habitat; and other status information useful for long-term
27 management.
- 28 3. Conduct a survey at least annually of all JRM lands for Mariana fruit bat colonies and solitary
29 individuals using the JRM standard operating procedure (SOP), including the limestone forest
30 and cliff line areas of Andersen AFB, NBG TS and NBG to detect new Mariana fruit bat colonies
31 and solitary individuals. [Requirement from BO]
- 32 4. Limit nighttime activity in areas of fruit bat foraging habitat. [Requirement from BO]
- 33 5. Collaborate with USGS and USDA-National Wildlife Research Center (USDA-NWRC), to
34 determine the most effective and least disruptive methods to control brown treesnakes, feral cats
35 and monitor lizards in Mariana fruit bat roosting and foraging habitat. Control methods should
36 focus on area-wide suppression of fruit bat predators and the establishment of low-snake-density
37 areas with a minimum of disturbance. Control methods will consider using multi-species barriers
38 as a tool for management.
- 39 6. Prevent clearing of land for development in areas of colony roosting habitat.
- 40 7. Hire two DoN law enforcement officers to assist the USFWS in limiting illegal hunting on Guam.
- 41 8. Facilitate native forest revegetation by constructing an ungulate exclosure in the area collectively
42 referred to as the Ritidian Point ERA.

- 1 9. Remove ungulates from the overlay refuge lands and restore habitat with appropriate native forest
2 plants. [Requirement from BO]
- 3 10. Implement the JRM NBG Ungulate Management Plan and the JRM Andersen AFB Ungulate
4 Management Plan to reduce and control ungulates on all JRM lands to enhance Mariana fruit bat
5 habitat.
- 6 11. Plant native Mariana fruit bat forage tree species in ungulate excluded areas, where possible.
7 [Requirement from BO]
- 8 12. Support research on effects of introduced insects on Mariana fruit bat forage and roost tree
9 species.
- 10 13. Support research for ecosystem-wide control of brown treesnakes.
- 11 14. Develop a public education and awareness program to educate installation personnel, dependents,
12 and the public about natural and cultural resources on JRM sites.
- 13 15. Revise the *Mariana Fruit Bat Management Plan* to address fruit bat management on all JRM
14 lands and to address the extremely low numbers of remaining bats.
- 15 16. Review the status of actions prescribed under TE-1 at the annual INRMP review meeting. Initiate
16 actions based on the review to ensure that actions are, or will be, implemented as prescribed
17 pending available funding.

18 **Monitoring Criteria:** Monitor to ensure that Mariana fruit bat habitat continues to be protected from
19 illegal hunting and other human disturbance. Ensure that regular patrols by conservation officers are
20 being conducted on JRM lands where fruit bats have been observed. Continue to support new research on
21 Mariana fruit bat ecology in the Mariana Archipelago. Continue to regularly monitor all JRM lands for
22 new Mariana fruit bat colonies, solitary individuals, and areas where suitable foraging habitat occurs.
23 Monitor for the effectiveness of brown treesnake, feral cat and monitor lizard controls in Mariana fruit bat
24 roosting and foraging habitat. Monitor for the effectiveness of the control and removal of ungulates in the
25 enhancement of Mariana fruit bat habitat.

26 5.4.2 TE-2: Protection and Recovery of the Mariana Crow

27 **Concern:** The Mariana crow is federally endangered throughout its range in the Mariana Islands.

28 **Objective:** With respect to mission requirements, continue to assist the USFWS and GDAWR in
29 achieving Mariana crow recovery goals.

30 The Mariana crow population is presumed extirpated on Guam. There are no plans to translocate
31 additional Mariana crows from Rota to Guam. The focus of Mariana crow management on JRM lands
32 now centers on recovering Mariana crow habitat and supporting Mariana crow conservation on Rota.

33 All strategies described as follows for JRM will be developed and implemented in coordination with the
34 AMT.

35 **Strategies:**

- 36 1. Continue to manage existing Mariana crow habitat in limestone, ravine and coastal forest areas
37 on JRM lands using strategies such as preventing forest clearing and preventing wildland fire.
38 To avoid unnecessary clearing of forested areas on JRM lands, all proposed projects are
39 coordinated with natural resources personnel to ensure that native species habitat is not
40 adversely impacted. In addition, several vegetation plots have been established in limestone

- 1 forested areas to encourage regeneration of native forested habitats. Prevention of wildland fire
2 will be accomplished by using strategies identified in the Wildland Fire Management Plan for
3 JRM once developed.
- 4 2. Continue to maintain a standardized, up-to-date inventory and GIS map of Mariana crow
5 including historic distribution, current distribution, numbers of individuals; nesting sites or
6 breeding locations; maps of important habitat; and other status information useful for long-term
7 management.
- 8 3. Create ten vegetation plots where trees important to Mariana crow and Mariana fruit bat
9 ecology (foraging and nesting) occur in the Ritidian Point East and West Units and the NWF
10 ungulate enclosure (Part of the Ritidian Point ERA) as required by the Intelligence,
11 Surveillance, Reconnaissance, and Strike Capability (ISR/Strike) BO. Supplemental fencing
12 within the ungulate enclosures will be provided around the vegetation plots. Additional actions
13 within the vegetation plots include herbaceous plant management, fence line maintenance and
14 quarterly monitoring of outplanting success. [Requirement from BO]
- 15 4. Collaborate with USGS and USDA-NWRC to determine the most effective and least disruptive
16 methods to control brown treesnakes, feral cats and monitor lizards in Mariana crow habitat.
17 Control methods should focus on area-wide suppression of crow predators and the
18 establishment of low-snake-density areas following guidelines in the Brown Treesnake Control
19 Plan developed by the signatories of the MOA on Brown Treesnake Control, which included
20 DOD. Control methods will consider using snake-free barriers as a tool for management.
- 21 5. Facilitate native forest revegetation by constructing ungulate enclosures in the area collectively
22 referred to as the Ritidian Point ERA. Ungulate enclosure areas should be developed following
23 guidelines contained within the JRM Ungulate Management Plans. [Requirement from BO]
- 24 6. Implement the NBG and Andersen AFB Ungulate Management Plans to reduce and control
25 ungulates on all JRM lands and to enhance Mariana crow habitat.
- 26 7. Plant native forest species used by Mariana crows in ungulate excluded areas. [Requirement
27 from BO]
- 28 8. Continue to support research conducted by GDAWR and UOG on the Mariana crow, including
29 research on identification of potential habitat for the species on Guam and JRM lands.
- 30 9. Develop a public education and awareness program to educate installation personnel,
31 dependents, and the public about natural and cultural resources on JRM sites.
- 32 10. Review the status of actions prescribed under TE-2 at the annual INRMP review meeting.
33 Initiate actions based on the review to ensure that actions are, or will be, implemented as
34 prescribed pending available funding.

35 **Monitoring Criteria:** Ensure that Mariana crow habitat continues to be protected from disturbance.
36 Support new research on Mariana crow ecology. Monitor enclosures for success in enhancing Mariana
37 crow habitat. Monitor for success of control of brown treesnake, feral cat, and monitor lizard in Mariana
38 crow habitat. Monitor for success of Ungulate Management Plan implementation and the control of
39 ungulate populations in Mariana crow habitat. Evaluate success of prescribed strategies during annual
40 INRMP review.

1 5.4.3 TE-3: Protection and Recovery of the Guam Micronesian Kingfisher

2 **Concern:** The Guam Micronesian kingfisher is presumed extirpated in the wild on Guam, but a captive
3 population of approximately 100 birds exists in captive propagation institutions on the mainland United
4 States and Guam. Suitable habitat for the Guam Micronesian kingfisher exists on JRM lands.

5 **Objective:** With respect to mission requirements, continue to assist the USFWS and GDAWR in
6 achieving Guam Micronesian kingfisher recovery goals by (1) preventing extinction, (2) restoring a
7 population of 500 individuals on northern Guam (including Andersen AFB) and 500 individuals in
8 southern Guam (including NBG), and (3) achieving full recovery of the species in perpetuity.

9 All strategies described as follows for JRM will be developed and implemented in coordination with the
10 AMT.

11 **Strategies:**

- 12 1. Continue to manage existing Guam Micronesian kingfisher habitat in limestone, ravine and
13 coastal forest areas on JRM lands using strategies such as preventing forest clearing and
14 preventing wildland fire. To avoid unnecessary clearing of forested areas on JRM lands, all
15 proposed projects are coordinated with natural resources personnel to ensure that native species
16 habitat is not adversely impacted. In addition, several vegetation plots have been established in
17 limestone forested areas to encourage regeneration of forested areas. Prevention of wildland fire
18 will be accomplished by using strategies identified in the Wildland Fire Management Plan for
19 JRM, once it is developed.
- 20 2. Facilitate native forest revegetation by constructing ungulate exclosures in the area collectively
21 referred to as the Ritidian Point ERA.
- 22 3. Develop a public education and awareness program to educate installation personnel, dependents,
23 and the public about natural and cultural resources on JRM sites.
- 24 4. Collaborate with USGS and USDA-NWRC to determine the most effective and least disruptive
25 methods to control brown treesnakes, feral cats and monitor lizards in potential Guam
26 Micronesian kingfisher habitat. Control methods should focus on areawide suppression of
27 predators and the establishment of low-snake-density areas following guidelines in the Brown
28 Treesnake Control Plan developed by the signatories of the MOA on Brown Treesnake Control,
29 which included DOD. Control methods will consider using snake-free barriers as a tool for
30 management.
- 31 5. Continue to support control of nonnative competitors or predators, preventing the release of
32 additional noxious exotic species, and the reduction of pesticide use where feasible.
- 33 6. Continue to support ungulate control and the development of habitat restoration techniques.
- 34 7. Continue to support research conducted by GDAWR and UOG on the Guam Micronesian
35 kingfisher, including identification of potential habitat suitable for the species on Guam and JRM
36 lands.
- 37 8. Review the status of actions prescribed under TE-3 at the annual INRMP review meeting. Initiate
38 actions based on the review to ensure that actions are, or will be, implemented as prescribed
39 pending available funding.

40 **Monitoring Criteria:** Continue to coordinate with the USFWS and GDAWR in meeting Guam
41 Micronesian kingfisher recovery objectives without compromising the mission.

1 5.4.4 TE-4: Protection and Recovery of the Guam Rail

2 **Concern:** The Guam rail is extirpated on Guam. The Guam rail was recently released on Cocos Island,
3 and an experimental population has been released on Rota. Live individuals area also maintained at
4 breeding facilities at GDAWR.

5 A management unit was constructed on Andersen AFB by GDAWR and USFWS for future rail release.
6 The perimeter fence surrounding the area is a snake barrier. JRM is responsible to maintaining the snake
7 barrier and for eradicating the brown treesnake, feral cats, and ungulates from inside the unit. JRM is also
8 responsible for controlling other invasive species, plants and animals in the unit.

9 **Objective:** With respect to mission requirements, continue to assist the USFWS and GDAWR in
10 achieving Guam rail recovery goals by (1) preventing extinction, (2) restoring a population of
11 1,000 individuals on JRM, and (3) achieving full recovery of the species in perpetuity.

12 All strategies described as follows for JRM will be developed and implemented in coordination with the
13 AMT.

14 **Strategies:**

- 15 1. Manage habitats on JRM lands to maintain habitats favorable to the Guam rail.
- 16 2. Continue to manage the primary threats to the species by supporting brown treesnake and feral
17 cat control undertaken by other agencies at potential release sites. Collaborate with USGS and
18 USDA-NWRC to determine the most effective and least disruptive methods to control brown
19 treesnakes, feral cats, and monitor lizards in potential Guam rail habitat. Control methods should
20 focus on area-wide suppression of Guam rail predators and the establishment of low-snake-
21 density areas following guidelines in the Brown Treesnake Control Plan developed by the
22 signatories of the MOA on Brown Treesnake Control, which included DOD. Control methods
23 will consider using snake-free barriers as a tool for management.
- 24 3. Implement the NBG and Andersen AFB Ungulate Management Plans to reduce and control
25 ungulates on all JRM lands and to enhance Guam rail habitat.
- 26 4. Develop a public education and awareness program to educate installation personnel, dependents,
27 and the public about natural and cultural resources on JRM sites.
- 28 5. Support monitoring of new wild populations once they are established.
- 29 6. Continue to support ungulate control and the development of habitat restoration techniques based
30 on guidelines provided in the JRM Ungulate Management Plans.
- 31 7. Continue to support research conducted by GDAWR and UOG on the Guam rail, including the
32 identification of potential habitat for the species on Guam and JRM lands, and assessment of the
33 impacts of feral cats on the species.
- 34 8. Support the reintroduction of Guam rails where feral cats, ungulates, monitor lizards, and brown
35 treesnakes have been reduced or eradicated.
- 36 9. Review the status of actions prescribed under TE-4 at the annual INRMP review meeting. Initiate
37 actions based on the review to ensure that actions are, or will be, implemented as prescribed
38 pending available funding.

1 **Monitoring Criteria:** Continue to coordinate with the USFWS and GDAWR in meeting Guam rail
2 recovery objectives and to ensure that recovery efforts are focused on the strategies listed for the
3 protection and recovery of the species without compromising the mission.

4 5.4.5 TE-5: Protection and Recovery of the Mariana Swiftlet

5 **Concern:** The Mariana swiftlet is federally endangered throughout its range in the Mariana Islands.
6 JRM is currently developing alternate survey methods for detecting endangered Mariana swiftlets
7 (e.g., thermal imagery, infrared). Current methods to survey swiftlets on JRM lands are sensitive to
8 observer bias and may be inaccurate at estimating population size.

9 **Objective:** With respect to mission requirements, continue to assist the USFWS and GDAWR in
10 achieving Mariana swiftlet recovery goals to increase the species population by 50 percent (or
11 approximately 2,000 birds) through (1) complete protection of roosting and nesting caves,
12 (2) development of a complete understanding of limiting factors, and (3) reestablishment of Mariana
13 swiftlets to suitable habitat (e.g., historically used caves) within the historical range of the species.

14 All strategies described below for JRM will be developed and implemented in coordination with the
15 AMT.

16 **Strategies:**

- 17 1. Conduct quarterly surveys for Mariana swiftlet at JRM per guidelines contained within the JRM
18 species management SOP.
- 19 2. Conduct a study to examine habitat use by Mariana swiftlets on NMS. Data will be collected to
20 identify and examine forage habitat and prey base, nesting habitat, and roosting site selection of
21 unpaired individuals of Mariana swiftlets.
- 22 3. Continue to maintain a standardized, up-to-date inventory and GIS map of Mariana swiftlet
23 including historic distribution, current distribution, numbers of individuals; nesting sites or
24 breeding locations; maps of important habitat; and other status information useful for long-term
25 management.
- 26 4. Conduct a study to support development of effective approaches for the management of habitat
27 for Mariana swiftlets, including the control of predation by brown treesnakes, and to identify
28 long-term management objectives for the bird.
- 29 5. Implement recommendations included in the JRM Wildland Fire Management Plan, once it is
30 developed, to reduce potential for the occurrence of wildland fires in, or near foraging or nesting
31 habitats.
- 32 6. Continue to support surveys for, securing of, and management of potentially suitable caves for the
33 Mariana swiftlet and immediately surrounding buffer habitat on JRM lands by regulating human
34 and ungulate entry into the caves, where practicable.
- 35 7. Continue to support research conducted by GDAWR and UOG on the Mariana swiftlet, including
36 identification of potential habitat for the species on Guam and JRM lands, predation by the brown
37 treesnake, and effects of pesticides and diseases on the species.
- 38 8. Develop a public education and awareness program to educate installation personnel, dependents,
39 and the public about natural and cultural resources on JRM sites and the importance of avoiding
40 impacts to sensitive species habitat including caves which could provide habitat for Mariana
41 swiftlets.

- 1 9. Ensure that overflights follow guidelines within the Joint Guam Program Office (JGPO) BO and
2 that all aviation training will be conducted so that flights will approach the southern portion of the
3 NMS over the Talafofo River watershed and Fena Reservoir at heights of 1,000 feet (305 meters)
4 or greater above ground level. Flights may go up the Ugum River at altitudes of 1,000 feet (305
5 meters) or greater above ground level until they reach 9,843 feet (3,000 meters) from the mouth
6 of the river at Highway 4 and then flights may conduct low-level terrain flights. Low-level
7 training flights should be restricted to the southernmost portion of the NMS to avoid adverse
8 effects to Mariana swiftlets utilizing caves on the NMS.
- 9 10. Consistent with the MIRC BO, the DOD will maintain 328-foot (100-meter) no training buffers
10 around the known Mariana swiftlet nesting caves (e.g., Mahlac Cave, Fachi Cave, Maamong
11 Cave) on the NMS. [Requirement from BO]
- 12 11. Continue to trap brown treesnakes in areas around the three swiftlet caves to reduce and/or
13 prevent brown treesnakes predation on swiftlets.
- 14 12. Continue to monitor Mariana swiftlets in occupied roosting and nesting habitat following
15 guidelines in the Mariana swiftlet Monitoring Program Standard Operating Procedure.
- 16 13. Continue to support development methods employed by USFWS, GDAWR and UOG for
17 reintroduction of the species to the wild where practicable. Support will include providing
18 monitoring data to agencies charged with reintroducing species on Guam and CNMI.
- 19 14. Review the status of actions prescribed under TE-5 at the annual INRMP review meeting. Initiate
20 actions based on the review to ensure that actions are, or will be, implemented as prescribed
21 pending available funding.

22 **Monitoring Criteria:** Continue to coordinate with the USFWS and GDAWR in meeting Mariana
23 swiftlet recovery objectives without compromising the mission. JRM should also conduct species
24 population number trend analysis to monitor species recovery and stability, to determine if recovery
25 efforts are effective and to identify any necessary changes in management.

26 5.4.6 TE-6: Protection and Recovery of the Mariana Common Moorhen

27 **Concern:** The Mariana common moorhen is federally endangered throughout its range in the Mariana
28 Islands.

29 **Objective:** With respect to mission requirements, continue to assist the USFWS and GDAWR in
30 achieving Mariana common moorhen recovery goals by (1) protecting and managing wetlands to
31 maximize productivity and survival of the Mariana common moorhen, (2) restoring a population of
32 600 individuals on JRM managed lands, and (3) achieving full recovery of the species in perpetuity.

33 All strategies described as follows for JRM will be developed and implemented in coordination with the
34 AMT.

35 **Strategies:**

- 36 1. Conduct quarterly surveys for Mariana common moorhen on JRM sites per guidelines contained
37 within the JRM species management SOP. Areas to be surveyed include wetlands, tributaries,
38 reservoirs, and other suitable habitat for the Mariana common moorhen. [Requirement from BO]
- 39 2. Conduct a feasibility study for improvement of wetlands for Mariana common moorhen habitat.
40 The study should include recommendations for predator control and habitat improvements for
41 Mariana common moorhen habitat.

- 1 3. Continue to maintain a standardized, up-to-date inventory and GIS map of Mariana common
2 morehen including historic distribution, current distribution, numbers of individuals; nesting sites
3 or breeding locations; maps of important habitat; and other status information useful for long-
4 term management.
- 5 4. Develop a restoration plan for the Camp Covington wetlands with the objective for increasing
6 suitable habitat for the Mariana common morehen. [Requirement from BO]
- 7 5. Develop and implement a Mariana common moorhen habitat monitoring program for Fena
8 Reservoir and its tributaries. The plan will include specific goals, objectives and strategies for
9 monitoring moorhen habitat. The plan will be developed in coordination with USFWS and
10 GDAWR.
- 11 6. Develop a public education and awareness program to educate installation personnel, dependents,
12 and the public about natural and cultural resources on JRM sites.
- 13 7. Conduct a survey for the common snapping turtle in Fena Reservoir to determine if control
14 or/eradication is needed to protect bird habitat within the reservoir and its surrounding wetlands.
- 15 8. Survey the biological component of Fena Reservoir and tributaries as part of a long-term trend
16 analysis of the reservoir ecosystem and its relationship to Mariana common moorhen habitat and
17 species recovery.
- 18 9. Restore degraded Mariana common moorhen habitat through the removal of *Phragmites karka*
19 from wetlands where appropriate. Enhance habitat for Mariana common moorhen nesting and
20 foraging by planting native wetland vegetation. Control *Phragmites karka* in suitable Mariana
21 common moorhen habitat in a manner that minimizes disturbance to moorhens.
- 22 10. Implement strategies prescribed in the JRM Ungulate Management Plans (see **Appendix O**) to
23 eradicate, or reduce ungulate populations to levels that will allow natural wetlands to function
24 properly. This is necessary to maintain adequate foraging and nesting resources for the Mariana
25 common moorhen.
- 26 11. Review the status of actions prescribed under TE-6 at the annual JRM INRMP review meeting.
27 Initiate actions based on the review to ensure that actions are, or will be, implemented as
28 prescribed pending available funding.

29 **Monitoring Criteria:** Continue to coordinate with the USFWS, GDAWR, and CNMI Division of Fish
30 and Wildlife for meeting Mariana common moorhen recovery objectives without compromising the
31 mission. JRM should also conduct species population number trend analysis to monitor species recovery
32 and stability, to determine if recovery efforts are effective and to identify any necessary changes in
33 management.

34 5.4.7 TE-7: Protection and Recovery of the Micronesian Megapode

35 **Concern:** The Micronesian megapode is a federally endangered species on the islands of Tinian and
36 FDM.

37 **Objective:** With respect to mission requirements, continue to assist the USFWS in achieving
38 Micronesian megapode recovery goals by (1) preventing extinction, (2) controlling invasive ungulates
39 and predator species on Tinian, and (3) achieving full recovery of the species in perpetuity.

40 All strategies described as follows for JRM will be developed and implemented in coordination with the
41 AMT.

1 Strategies:

- 2 1. Develop and implement a program to protect habitat where the Micronesian megapode is known
3 to forage and nest.
- 4 2. Develop a public education and awareness program to educate installation personnel, dependents,
5 and the public about natural and cultural resources on JRM sites.
- 6 3. Conduct a Micronesian megapode life history study on Saipan and Sarigan as prescribed by the
7 MIRC Biological Opinion. [Requirement from BO]
- 8 4. Continue to maintain a standardized, up-to-date inventory and GIS map of Micronesian
9 megapode including historic distribution, current distribution, numbers of individuals; nesting
10 sites or breeding locations; maps of important habitat; and other status information useful for
11 long-term management.
- 12 5. Conduct a study to determine reasons for Megapode population decline and to determine
13 specifically whether hunting has majorly contribute to decline of the species on Tinian. Create
14 public outreach information on Megapode to emphasize the ecological and cultural importance.
- 15 6. Continue to conduct annual monitoring of the Micronesian megapode population on Tinian.
16 Regular monitoring will help conservation managers understand population trends and will assist
17 in the development of an adaptive management plan. Compile findings in an annual report.
18 [Requirement from BO]

19 **Monitoring Criteria:** Continue to coordinate with the USFWS and CNMI DLNR in meeting
20 Micronesian megapode recovery objectives without compromising the mission. JRM should also conduct
21 species population number trend analysis to monitor species recovery and stability, to determine if
22 recovery efforts are effective, and to identify any necessary changes in management.

23 5.4.8 TE-8: Protection and Recovery of Marine Mammals

24 **Concern:** Marine mammals in the waters surrounding Guam are endangered.

25 **Objective:** With respect to mission requirements, continue to assist the NMFS in achieving marine
26 mammal recovery goals by (1) determining the diversity and distribution of marine mammals in JRM
27 submerged lands, and (2) assessing the potential for mission activities to affect marine mammal
28 populations in JRM submerged lands.

29 All strategies described as follows for JRM will be developed and implemented in coordination with the
30 AMT.

31 Strategies:

- 32 1. Work closely with the NMFS Pacific Islands regional Office Marine Mammal Stranding
33 Coordinator to implement the management strategy to respond to beached and stranded marine
34 mammals at all JRM submerged lands shorelines.
- 35 2. Develop a public education and awareness program to educate installation personnel, dependents,
36 and the public about natural and cultural resources on JRM sites.
- 37 3. Educate personnel about the status of marine mammals and sea turtles in the Marianas, through
38 in-shop briefs; required training for use of Morale, Welfare and Recreation (MWR) marine
39 recreational facilities; and through signage at MWR beaches, marinas, and boat ramps.

1 **Monitoring Criteria:** Continue to coordinate with the NMFS, GDAWR, and CNMI DLNR for meeting
2 marine mammal recovery objectives without compromising the mission.

3 5.4.9 TE-9: Protection and Recovery of Sea Turtles

4 **Concern:** The green sea turtle is threatened and the hawksbill is endangered. Green sea turtles and
5 hawksbill sea turtles have been known to nest on Andersen AFB and NBG; both species also use marine
6 habitats on Navy submerged lands around Guam.

7 **Objective:** With respect to mission requirements, continue to assist the USFWS, NMFS, and GDAWR
8 in achieving threatened and endangered sea turtle recovery goals.

9 Implement the *Sea Turtle Management Plan* recently developed for the coastal areas of the Tarague Basin
10 on Andersen AFB (see **Appendix J**), and continue to implement the SOP developed by the Navy to
11 monitor sea turtle activity on nesting habitat on JRM lands.

12 Coordinate with other agencies (e.g., NMFS and USFWS) to obtain permits for managing sea turtles.

13 All strategies described as follows for JRM will be developed and implemented in coordination with the
14 AMT.

15 **Strategies:**

- 16 1. Conduct a study of sea turtle population abundance estimates, demographics, near-shore habitat
17 use, baseline populations, and long-term population parameters. [Requirement from BO]
18 Conduct studies including in-water surveys to determine sea turtle distribution and habitat use in
19 the area including Apra Harbor and Sasa Bay. Continue to support research on the ecology of
20 green and hawksbill sea turtles and conduct studies to identify migration patterns and nesting
21 trends of hawksbill and green sea turtles in the JRM area including Tinian.
- 22 2. Prevent or minimize, to the extent possible, potential lighting impacts to sea turtles at Tarague,
23 Scout, Sirena, and Spanish Steps. To the maximum extent practical, hooded and night-adapted
24 lights will be used where lights illuminate beaches, beach roads, and parking areas. [Requirement
25 from BO]
- 26 3. Cooperate with USFWS and NMFS in a joint investigation of sea turtle population abundance
27 estimates, demographic information, near shore habitat use, baseline populations, and long-term
28 population parameters. This will be a 3 to 5 year joint DOD-USFWS-NMFS capture-mark-
29 recapture laparoscopy program for green sea turtles occurring in near shore waters surrounding
30 Guam, Saipan, Tinian and Rota. [Requirement from BO]
- 31 4. Conduct a predator study to determine if sea turtle populations are impacted by activities of feral
32 cats or dogs, brown treesnakes, feral pigs, rats, or monitor lizards on JRM sites. Based on study
33 results, develop and implement a plan to reduce the impact of predation by these species on
34 nesting beaches managed by JRM.
- 35 5. Continue to monitor for sea turtle nesting activity on JRM beaches following guidelines in the
36 Sea Turtle Monitoring SOP.
- 37 6. Increase the monitoring program to nightly patrols during peak nesting seasons, or during
38 expected hatchling emergence.
- 39 7. Provide annual training for VCOs, patrolling military officials, lifeguards at Tarague Beach, and
40 others who could encounter sea turtles or their tracks.

- 1 8. Establish an annual meeting with USFWS, NMFS, and GDAWR to address conservation topics
2 important to Guam, including sea turtles.
- 3 9. Prohibit vehicle and all-terrain vehicle usage on beaches.
- 4 10. Develop a public education and awareness program to educate installation personnel, dependents,
5 and the public about natural and cultural resources on JRM sites.
- 6 11. Enhance turtle nesting habitat on JRM lands through removal of nonnative invasive plants,
7 replacing nonnative species with native species, controlling predators, and conducting beach
8 clean-up to remove plastic and wood debris.
- 9 12. Assess the condition of sea turtle habitat at the Pati Point Marine Preserve and the suitability of
10 that habitat for nesting sea turtles.
- 11 13. Develop a public education and awareness program to educate installation personnel, dependents,
12 and the public about natural and cultural resources on JRM sites. This program would provide
13 detailed information about protected species, such as sea turtles and marine mammals, and
14 sensitive habitats, such as coral reefs.
- 15 14. Conduct turtle surveys at FDM. Sea turtles are known to inhabit the waters surrounding FDM.
16 Observations of sea turtles in waters surrounding FDM are observed during quarterly overflights
17 of FDM. The sea turtle surveys are important for developing an understanding of population
18 trends. [Requirement from BO]
- 19 15. Remove debris from Tinian beaches, which is used by sea turtles for nesting sites. Removal of
20 debris will restore nesting habitat.
- 21 16. Support the development of, and cooperation with, volunteer groups that are dedicated to habitat
22 restoration (beach and stream clean-ups and replacement of non-native vegetation), data gathering
23 for protected species, and other support of NAVFACMAR Environmental programs.
- 24 17. Review the status of actions prescribed under TE-9 at the annual INRMP review meeting. Initiate
25 actions based on the review to ensure that actions are, or will be, implemented as prescribed
26 pending available funding.

27 **Monitoring Criteria:** Continue to monitor for sea turtles and their habitats on JRM. Continue to
28 coordinate with the USFWS, NMFS, GDAWR, and CNMI DLNR in meeting sea turtle recovery
29 objectives without compromising the mission.

30 5.4.10 TE-10: Protection and Recovery of *Serianthes nelsonii*

31 **Concern:** *Serianthes nelsonii* is federally endangered throughout its range in the Mariana Islands.

32 **Objective:** With respect to mission requirements, continue to assist the USFWS, GDAWR, and the
33 Guam Department of Agriculture Division of Forestry and Soil Resources in achieving *Serianthes*
34 *nelsonii* recovery goals on Guam, including Andersen AFB and NBG to: (1) downgrade the species to
35 threatened status, and (2) achieve full recovery of the species in perpetuity.

36 All strategies described as follows for JRM will be developed and implemented in coordination with the
37 AMT.

Strategies:

1. Define and develop strategies for management for *Serianthes nelsonii* considering long-term ecosystem management goals to enhance the restoration of native habitat over the long-term, and implement strategies once developed.
2. Continue to manage existing occupied and unoccupied limestone forest on Andersen AFB and at the HERA, including preventing forest clearing and fires where practicable. Continue to control and remove invasive plants according to prescriptions identified in the long-term ecosystem management section. Repair, maintain, and upgrade all ungulate enclosure fences around *Serianthes nelsonii* individuals. Develop and implement a monitoring protocol for maintaining ungulate enclosure fencing. Monitoring should occur at least two to three times per year.
3. Continue to manage and reduce direct threats to the species by supporting the control of grazing by ungulates and insect pests in occupied habitat, installation of ungulate enclosures, implementation of the JRM Ungulate Management Plans (see **Appendix O**), and insect pest management.
4. Continue to manage additional key threats to the species by supporting the control of nonnative competitors or predators and preventing the release of additional noxious exotic species.
5. Develop and implement a program to monitor individuals of *Serianthes nelsonii*. The program should include monitoring health of individual trees, checking the integrity of enclosures, and maintaining enclosures. Regular checks of all known trees and enclosures should be made as soon as possible after typhoons. Seeds can be salvaged off downed limbs and root and any trunk damage that has occurred should be addressed.
6. Continue to support research on the ecology (including microclimate and soil ecology) of *Serianthes nelsonii* on Guam through funding research to increase knowledge of the life history of the species (pollination, seed dispersal in particular) as suggested in USFWS Recovery Plan; include research to increase knowledge of seed production and seed storage for the species.
7. Implement long-term ecosystem management discussed in **Section 5.3**, which includes native habitat restoration over the long term
8. Consult with the Guam Department of Agriculture Division of Forestry and Soil Resources on propagation techniques, nursery support, and outplanting.
9. Develop an outplanting program for *Serianthes nelsonii* with appropriate monitoring and maintenance protocols.
10. Develop a public education and awareness program to educate installation personnel, dependents, and the public about natural and cultural resources on JRM sites.
11. Review the status of actions prescribed under TE-10 at the annual INRMP review meeting. Initiate actions based on the review to ensure that actions are, or will be, implemented as prescribed pending available funding.

Monitoring Criteria: Continue to observe the known tree for health and viability, to ensure the effectiveness of replanting nursery cultivated individuals, and to ensure that recovery objectives are being met. Provide support for and partner with the newly formed Guam Plant Extinction Prevention Program to monitor wild and outplanted populations in managed wild sites. Continue to coordinate with the USFWS, GDAWR, the Guam Department of Agriculture Division of Forestry and Soil Resources, and the CNMI Forestry Division in meeting *Serianthes nelsonii* recovery objectives without compromising the mission.

1 5.4.11 TE-11: Protection of Other Candidate, Locally Rare or GovGuam-Listed Species

2 **Concern:** A variety of other locally rare or GovGuam-listed plant and animal species occur or have the
3 potential to occur on JRM lands, including the Micronesian starling and Federal candidate species
4 including the Pacific sheath-tailed bat, Mariana eight-spot butterfly, Mariana wandering butterfly, Guam
5 tree snail, humped tree snail, and fragile tree snail.

6 **Objective:** With respect to mission requirements, continue to assist GDAWR in the study and protection
7 of other locally rare or GovGuam-listed plant and animal species, including the Micronesian starling. To
8 enhance habitats for native species, implement the strategies in **Section 5.3** to restore and enhance habitat
9 for native species over the long term.

10 All strategies described as follows for JRM will be developed and implemented in coordination with the
11 AMT.

12 **Strategies:**

- 13 1. Continue to coordinate with USFWS, GDAWR, and GovGuam and other agencies studying the
14 ecology of candidate species, locally rare or GovGuam-listed species and the impacts of key
15 threats on these species, especially the brown treesnake, and support the development of new
16 control methods against key threats.
- 17 2. Conduct surveys for the moth skink and Pacific slender-toed gecko on DOD lands. [Requirement
18 from BO]
- 19 3. Conduct study to determine populating size and location of the Micronesian starling on JRM
20 managed lands. Enhance nesting opportunities for the Micronesian starling by placing nest boxes
21 on JRM managed lands.
- 22 4. Enforce NBG closure of all coconut crabbing and enforce crabbing regulations on Andersen
23 AFB.
- 24 5. If species that were presumed to be extirpated are discovered, developed strategies to manage
25 species and their habitat.
- 26 6. Continue to support species propagation programs such as the installation of nest boxes for
27 Micronesian starling on Andersen AFB where practicable. Begin pilot translocations of starlings
28 from Andersen AFB to other suitable locations on Guam including NMS and NBG with the use
29 of nesting boxes.
- 30 7. Restore and enhance habitat for federally and locally listed species per requirements in the JGPO
31 BO (e.g., limestone forest restoration, and implementation of the NBG and Andersen AFB
32 Ungulate Management Plans). [Requirement from BO]
- 33 8. Continue to maintain a standardized, up-to-date inventory and GIS map of Federal and
34 GovGuam-listed threatened and endangered species, species identified by GDAWR of great
35 conservation need, and unique vegetation communities on JRM that includes historic distribution
36 of the species, current distribution of the species, numbers of populations or subpopulations, and
37 numbers of individuals per population or subpopulation; nesting sites or breeding populations;
38 maps of important habitat; and other status information useful for long-term management.
- 39 9. Develop a public education and awareness program to educate installation personnel, dependents,
40 and the public about natural and cultural resources on JRM sites.
- 41 10. Develop long-term watershed and a forest management plans as described in **Section 5.3** and
42 implement the plans in cooperation with the USFWS, GDAWR, and CNMI DLNR.

- 1 11. Continue to support the reintroduction of indigenous species of birds or other native wildlife in
2 coordination with GDAWR as predator-controlled areas are established.
- 3 12. Review the status of actions prescribed under TE-12 at the annual INRMP review meeting.
4 Initiate actions based on the review to ensure that actions are, or will be, implemented as
5 prescribed, pending available funding.

6 **Monitoring Criteria:** Continue to monitor the wild populations for health and viability, to ensure the
7 effectiveness of replanting nursery-cultivated or captive-bred individuals, and ensure that recovery
8 objectives are being met.

9 5.4.12 TE-12: Protection and Recovery of *Tabernaemontana rotensis*

10 **Concern:** *Tabernaemontana rotensis* is a locally rare species on Guam. The 2007 Survey of
11 *Tabernaemontana rotensis* on Andersen AFB conducted by the UOG suggests a widely distributed extant
12 population (21,669 individuals) of healthy, reproductively viable, and resilient *Tabernaemontana* plants
13 with a robust population structure represented by mature, young reproductive, juvenile, and seedling
14 recruits. Thus, population structure is not a current conservation concern. However, the spatial
15 distribution is a major concern, since many individuals were found to be growing in close proximity on
16 only 265 sites throughout the installation. The aggregated pattern increases the vulnerability of the
17 population, especially to the threat of habitat loss. This threat is exacerbated by the fact that almost all of
18 the *Tabernaemontana* trees on Andersen AFB are located on sites with less than 15 percent slope, which
19 is also terrain suitable for human development (UOG 2007).

20 **Objective:** Continue to assist UOG, GDAWR, the Guam Department of Agriculture Division of Forestry
21 and Soil Resources, and the CNMI Forestry Division in the study and protection of the locally rare
22 *Tabernaemontana rotensis*, and to protect its essential habitat.

23 All strategies described as follows for JRM will be developed and implemented in coordination with the
24 AMT.

25 **Strategies:**

- 26 1. Continue to support the monitoring of existing populations and searches for new populations.
- 27 2. Contract out a project to grow and outplant *T. rotensis* into fenced areas on Andersen AFB.
28 Money would be used to grow, plant, and manage plantings for 2 years. Implement prescriptions
29 identified in long-term ecosystem management section above (**Section 5.3**). [Requirement from
30 BO]
- 31 3. Continue to support research on the ecology of the species, the impacts of key threats to the
32 species, and the development of new control methods against key threats. Implement
33 prescriptions identified in long-term ecosystem management section (**Section 5.3**).
- 34 4. Continue to manage existing limestone forest on Andersen AFB, HERA, and OPERA including
35 preventing development, forest clearing, and fires where practicable.
- 36 5. Develop a public education and awareness program to educate installation personnel, dependents,
37 and the public about natural and cultural resources on JRM sites.
- 38 6. Continue to manage the primary key threats to the species by implementing long-term ecosystem
39 management discussed in **Section 5.3**, which includes native habitat restoration over the long
40 term.

- 1 7. Review the status of actions prescribed under TE-11 at the annual INRMP review meeting.
- 2 Initiate actions based on the review to ensure that actions are, or will be, implemented as
- 3 prescribed pending available funding.

4 **Monitoring Criteria:** Continue to observe the wild populations for health and viability to ensure the
5 effectiveness of replanting nursery cultivated individuals, and ensure recovery objectives are being met.
6 Continue to coordinate with the USFWS, GDAWR, the Guam Department of Agriculture Division of
7 Forestry and Soil Resources, and the CNMI Forestry Division in meeting *T. rotensis* recovery objectives
8 without compromising the mission.

9 5.4.13 TE-13: Sensitive Species Habitat Protection

10 **Concern:** Sensitive species and their habitats might be significantly impacted as a result of JRM site
11 activities (e.g., grounds maintenance activities or construction).

12 **Objective:** Protocols must be established, and BMPs implemented, to mitigate future potential impacts
13 on sensitive species and their associated habitats. Minimize the potential for adverse effects on special
14 status species and their associated ecosystems while protecting the operational functionality of the
15 installation mission by using an ecosystem-based management approach. Note: Special status species
16 include any species which is listed, or proposed for listing, as threatened or endangered by the USFWS or
17 NMFS under the provisions of the Endangered Species Act; any species designated by the USFWS as a
18 listed, candidate, sensitive or species of concern, and any species which is listed by a State or Territory in
19 a category implying potential danger of extinction.

20 All strategies described as follows for JRM will be developed and implemented in coordination with the
21 AMT.

22 **Strategies:**

- 23 1. Initiate habitat improvement projects to conserve biodiversity and protect plant and animal
24 habitats, as funding is available and when such projects will not adversely affect the military
25 mission (e.g., invasive species removal).
- 26 2. Initiate projects to remove, or control nonnative invasive species and reestablish native vegetation
27 in habitats that are important to threatened and endangered species (e.g., habitats destroyed by
28 ungulates at Tarague Basin and Pati Point).
- 29 3. Implement erosion control BMPs to ensure adverse environmental impacts on sensitive species
30 habitat do not occur.
- 31 4. Minimize vegetation removal, and preserve emerging trees (i.e. Yoga, Dukduk, or Faia), where
32 possible, during construction.
- 33 5. Revegetate with native species.
- 34 6. A native forest habitat restoration plan will be developed and implemented for JRM managed
35 lands on Guam in cooperation with the USFWS and GDAWR and will benefit Mariana crow,
36 Mariana fruit bat, Micronesian kingfisher, Guam rail, and *Serianthes nelsonii* habitat. In addition,
37 a native forest habitat restoration plan will be developed and implemented for JRM managed
38 lands on Tinian in cooperation with the USFWS and DFW in the Tinian Monarch mitigation area
39 established between USFWS, DOD, and CNMI.
- 40 7. Establish an education program for military personnel who might have contact with sensitive
41 species or their habitats.

- 1 8. Develop a public education and awareness program to educate installation personnel, dependents,
2 and the public about natural and cultural resources on JRM sites.
- 3 9. Periodically review the natural resources management program to ensure that management
4 actions do not adversely impact habitat for species of concern.
- 5 10. Maintain accurate, usable, and informative GIS data for ease in management planning and
6 documentation.

7 **Monitoring Criteria:** Continue monitoring species and their habitat as described in this INRMP and
8 adapt monitoring and management actions as needed. Use monitoring information and other information
9 to guide adaptive management. Continue to coordinate with the USFWS, NMFS, and GDAWR to protect
10 sensitive species habitat without compromising the mission.

11 5.4.14 TE-14: Current Training Activities Could Impact Sensitive Species

12 **Concern:** JRM activities could impact sensitive species including the following:

- 13 1. Sensitive marine species as part of training and research, development, testing, and evaluation
14 activities within the MIRC.
- 15 2. Federal and Guam-listed species resulting from construction and operations activities associated
16 with the relocation of U.S. Marine Corps from Okinawa, Japan to Guam.

17 **Objective:** Host, tenant, and transient training requirements should be evaluated to assess their impacts
18 on sensitive species and their habitats.

19 All strategies described as follows for JRM will be developed and implemented in coordination with the
20 AMT.

21 **Strategies:**

- 22 1. Without decreasing readiness proficiency, training requirements and areas should be scheduled in
23 time and place to mitigate impacts on sensitive species.
- 24 2. Consider rotating the area of training activities to minimize the impacts on any one area.
- 25 3. Place vicinity markers (e.g., Siebert stakes) around threatened and endangered species habitat to
26 delineate no entry (training) areas in sensitive habitats (e.g., near the Mariana swiftlet caves on
27 the NMS).
- 28 4. Personnel who participate in, or are responsible for, conducting planning and training activities,
29 should receive a brief outlining natural resources concerns, and be provided with maps illustrating
30 sensitive habitat areas. During the planning process, direction will be provided to restore damage
31 to areas used for training or bivouacking (i.e. creation of ruts removal or trees, damage to
32 grassland areas, especially if training occurs in a location that is, or was restored or enhanced by a
33 JRM project).
- 34 5. Use GIS to maintain a standardized, up-to-date inventory of threatened and endangered species
35 and their habitat, and facilitate coordination between JRM personnel and natural resources
36 personnel for long-term management.
- 37 6. Develop marine benthic habitat maps for all DOD submerged lands and to use these maps as
38 guidance for managing DOD activities and to avoid and minimize impacts on sensitive marine
39 habitats and resources.

1 **Monitoring Criteria:** Training activities should continue to be monitored for impacts on threatened and
2 endangered species, species habitat, and sensitive species.

3 5.5 Wetlands and Waters of the United States Management

4 USACE defines wetlands as “those areas that are inundated or saturated with ground or surface water at a
5 frequency and duration sufficient to support, and that under normal circumstances do support, a
6 prevalence of vegetation typically adapted to life in saturated soil conditions. Wetlands generally include
7 swamps, marshes, bogs, and similar areas” (33 CFR Part 328). Wetlands are an important natural system
8 because of the diverse biological and hydrologic functions they perform. These functions can include
9 water quality improvement, groundwater recharge, pollution treatment, nutrient cycling, provision of
10 wildlife habitat and niches for unique flora and fauna, storm water storage, and erosion protection.

11 Wetlands are protected under EO 11990 - *Protection of Wetlands (43 Federal Register 6030)*, the purpose
12 of which is to reduce adverse impacts associated with the destruction or modification of wetlands.
13 According to OPNAVINST 5090.1C CH-1, the Navy will comply with the national goal of no net loss of
14 wetlands, and will avoid loss of size, function, and value of wetlands.

15 Threats

- 16 1. Feral ungulates.
- 17 2. Invasive species encroaching into wetland habitat.
- 18 3. Human disturbance.
- 19 4. Erosion and sedimentation from either anthropogenic or natural causes.

20 Management Strategy

21 The following goals and those summarized in **Table 5-6** apply to coastal water resources and any nontidal
22 wetlands that occur on, or might be identified on, JRM sites in the future. The major goal in wetland
23 management is to minimize the impact that JRM missions have on wetlands and coastal waters. To
24 minimize impacts on wetlands, JRM natural resources staff strive to maintain healthy, functional wetlands
25 and coastal waters that can sustain minor operational influences outside indirect infringement of the
26 resources. To achieve these goals it is necessary to have an accurate and complete understanding of the
27 extent of these habitats on the JRM sites. It is also the goal to maximize native floral diversity of wetland
28 communities which, in turn, maximizes the faunal diversity of the ecosystem. Through achieving these
29 goals, JRM can manage for no net loss of wetland acreage, functions and values. The goals for wetland
30 management are summarized in **Table 5-6**.

31 **Table 5-6. Summary of Wetlands and Waters of the United States Management Goals**

Wetlands and Waters of the United States Management Goals
<ul style="list-style-type: none"> • Remain in compliance with USACE and GovGuam wetlands regulations. • Minimize the operational impact of JRM missions on wetlands and coastal waters. • Maximize native floral and faunal diversity of wetland communities in the ecosystem. • Manage for no net loss of wetland functions and values. • Maintain water quality to protect surface waters and wetlands from excessive sediment-laden runoff. • Ensure that mapping of wetlands and other waters of the United States. is conducted based on the 1987 USACE Wetlands Delineation Manual and the 2010 Draft Interim Regional Supplement to the U.S. Army Corps of Engineers Wetland Delineation Manual: Hawaii and Pacific Islands Region, and is accurate and consistent across JRM sites.

1 The major goal in wetland and floodplain management is to minimize the impact that JRM has on
2 wetlands and floodplains. When possible, it is the goal to enhance wetland functions to create wetlands
3 that maximize the values that wetlands have within the ecosystem and to society (e.g., floodwater
4 retention, water quality protection).

5 5.5.1 WT-1: Wetlands and Waters of the United States

6 **Concern:** Some surface waters and wetlands have the potential to be impacted due to a lack of a current
7 understanding of the extent of these habitats on JRM sites. Some potential wetlands and other waters of
8 the United States have not been evaluated and mapped and others that were previously mapped need to be
9 reevaluated. A current understanding of the condition and extent of these habitats is necessary to develop
10 management goals and strategies to protect, manage, and, where feasible, enhance these habitats.

11 **Objective:** Identify and characterize all wetlands within the boundaries of the INRMP according to
12 National Wetlands Inventory standards. Consult with Region 1, USFWS, National Wetlands Inventory
13 coordinator on status of mapping for the region and potential to update the inventory maps with basic
14 functional assessment. Maintain healthy, functional wetlands that can sustain minor operational
15 influences and minor, inadvertent encroachments, and manage to enhance their habitat functions where
16 feasible.

17 All strategies described as follows for JRM will be developed and implemented in coordination with the
18 AMT.

19 **Strategies:**

- 20 1. Conduct characterization and assessments of the current conditions of wetlands and other waters
21 on the JRM sites and evaluate potential for water quality and habitat enhancement.
- 22 2. Plan development and training activities to avoid wetland impacts to the maximum extent
23 possible and mitigate unavoidable impacts on wetland functions.
- 24 3. Delineate wetlands as needed on JRM lands including the military leased area on Tinian based on
25 USACE standards.
- 26 4. Coordinate with appropriate agencies (e.g., USACE, GDAWR, and CNMI DLNR) as necessary.
- 27 5. Remain in compliance with the CWA, EO 11988 (floodplain protection), and EO 11990 (wetland
28 protection). Implement procedures to manage for a no net loss of wetland and floodplain acreage,
29 functions, and values.
- 30 6. Reduce habitat fragmentation and control the spread of invasive species per guidelines contained
31 within the OPERA, HERA, and JRM Exotic and Invasive Species Management Plan.
- 32 7. Implement guidelines within the JRM Ungulate Management Plans to control feral ungulate
33 populations around wetlands and riparian areas.
- 34 8. Develop and implement a program to manage tilapia in Fena Reservoir.
- 35 9. Periodically review the natural resources management program to ensure that management
36 strategies do not adversely impact wetlands. Address impacts or degradation of wetlands habitats
37 that result from management strategies or operations, and remediate, restore and enhance
38 protection accordingly.
- 39 10. Develop and implement erosion control BMPs for all operations and development activities as
40 needed to prevent sedimentation and water quality degradation of any wetlands or waters.

- 1 11. Conduct a feasibility study for improvement of wetlands for Mariana common moorhen habitat.
2 The study should include recommendations for predator control and habitat improvements for
3 Mariana common moorhen habitat.
- 4 12. Establish water-monitoring stations with devices to measure storm water runoff velocity and
5 quantity, turbidity, and other parameters.
- 6 13. Update GIS to include an accurate and consistent layer of wetlands and other waters of the United
7 States occurring on JRM lands.
- 8 14. Maintain accurate, usable, and informative GIS data for ease in management planning and
9 documentation.

10 5.5.2 WT-2: Stream Stability

11 **Concern:** The streams on Guam are heavily impacted by exotic ungulates, which have reduced overall
12 habitat and stream quality. Military activities, such as construction, can also result in stream
13 destabilization.

14 **Objective:** Identify and develop measures to reduce impacts on streams resulting from exotic ungulates
15 or military activities.

16 **Strategies:**

- 17 1. Conduct surveys of rivers and streams within the JRM sites to establish base line data from which
18 the impacts of ungulates and training could be established.
- 19 2. Develop actions specific to each unstable river or stream reach that can be undertaken to assist
20 with stream recovery. Support stream stability by managing activities that affect riparian buffers
21 and water entering streams.
- 22 3. Assess the status and condition of riparian ecosystems and adjacent local drainages within the
23 Fena Watershed to determine small-scale and large-scale processes that influence the water shed
24 integrity. Results from this assessment aligned with a baseline assessment (conducted in 2001)
25 will provide a measure of cumulative impacts applicable for large-scale planning efforts (Special
26 Area Management Plans) to compare various "project alternatives" through a simulation of the
27 potential impacts, to develop a restoration plan for riparian ecosystems in the watershed and to
28 reduce maintenance and general operational costs for the Fena Water Treatment Plant.
29 [Requirement from BO]
- 30 4. Maintain accurate, usable, and informative GIS data for ease in management planning and
31 documentation.

32 5.6 Fish and Wildlife Resources Management

33 Management of fish and wildlife species on JRM is primarily accomplished by managing habitats, and
34 monitoring species populations. Projects to manage wildlife habitat include invasive plant control,
35 protecting wetlands, and conducting species surveys.

36 Habitat loss has a direct correlation to a decline or loss of fish and wildlife populations. Installation
37 INRMPs are meant to be used as tools in operational, training, and construction planning endeavors to
38 minimize or prevent loss of habitat. The following management criteria will ensure that JRM provides
39 wise stewardship ethics in managing their fish and wildlife resources.

1 **Program and Project Review:** The JRM Conservation Program Manager, NAVFACMAR and
2 installation natural resources specialists, and the Environmental Flight Chief are part of the team that
3 reviews all proposed projects, operations, and training plans for possible impacts on habitat and fish and
4 wildlife at respective JRM sites. If impacts on habitat or fish and wildlife are identified,
5 recommendations are provided so that changes or mitigation can be considered early in the planning
6 process.

7 **Habitat Inspections:** JRM site natural resources managers periodically inspect various habitats for
8 unauthorized encroachment or impacts, and stay familiar with fish and wildlife use of these areas. These
9 natural resources managers have the ability to elevate concerns about habitat impacts on JRM sites to
10 their respective COs.

11 **Habitat Management – Developed Areas:** The following items will enhance wildlife habitat:

- 12 • *Use native vegetation for landscaping around buildings.* Native vegetation is well-suited to local
13 conditions and will require less maintenance to keep healthy. Native vegetation provides better
14 wildlife habitat than exotic, nonnative plants and trees.
- 15 • *Inspect plants* at source to ensure pest-free status or apply a pre-treatment pesticide before
16 planting.
- 17 • *Reduce pesticide/herbicide/fertilizer use.* Reducing the use of chemicals will help protect surface
18 and groundwater quality on JRM sites.

19 For the purposes of this INRMP, wildlife management is defined as manipulation of the environment and
20 wildlife populations to produce desired objectives. The primary goal of wildlife management at JRM is
21 to maintain wildlife populations at levels compatible with land use objectives while promoting the
22 existence, importance, and benefits of nongame species.

23 The basis of managing a rich assemblage of nongame wildlife is to provide a mosaic of habitats that are
24 structurally and biologically diverse. In managing for a diversity of habitats and diversity within those
25 habitats, the potential exists for numerous species to be found. JRM should employ these basic
26 techniques for managing wildlife.

27 **Monitoring Wildlife.** The information obtained through monitoring can be analyzed to detect any long-
28 term changes in population size or structure. Creating, monitoring, and updating GIS data on wildlife
29 species will allow JRM sites to store, retrieve, present, and analyze the data to make informed
30 management decisions.

31 **Protecting Sensitive Areas.** JRM should maintain biological diversity by protecting, to the extent
32 practical, sensitive areas that provide unique habitat niches including the OPERA, HERA, and
33 JRM-managed portions of the GNWR. Protection measures might include restricting vehicle movement,
34 and protecting habitats of exceptional biological value by establishing protective buffers and maintaining
35 healthy and diverse ecosystems.

36 Management Strategy

37 Opportunities for the management of fish and wildlife species on JRM sites are primarily accomplished
38 by managing habitats and sensitive areas (e.g., OPERA, HERA and JRM-managed portions of GNWR).
39 JRM site natural resources personnel coordinate with GDAWR and USFWS to identify, prioritize, and
40 implement habitat enhancement projects targeted for particular species (e.g., Mariana fruit bat) or groups

1 of species. Projects to manage wildlife habitat include invasive plant control, enhancing and protecting
2 wetlands, and conducting surveys.

3 **Table 5-7** presents a summary of the wildlife and fisheries management goals for JRM.

4 **Table 5-7. Summary of Wildlife and Fisheries Management Goals**

Wildlife and Fisheries Management Goals
<ul style="list-style-type: none"> • Manage based on an ecosystem management approach, rather than from a single-species paradigm. • Employ a systematic approach to managing fish and wildlife resources, using a process that includes inventory, monitoring, modeling, management, and assessment. • Minimize fish and wildlife-related health risks, safety risks, and environmental damage. • Restore and maintain a diversity of fish and wildlife in areas on JRM sites where there will be no conflict with the military mission. • Continue to remain in compliance with Federal, territorial, and local laws and regulations governing fish and wildlife. • Maintain and develop partnerships with agencies and groups involved in fish and wildlife management.

5 The recognition of these goals has led to the identification of a variety of management issues. A series of
6 management objectives and specific management strategies and the appropriate monitoring criteria have
7 also been developed that address management issues and their associated goals. The management issues
8 and their related actions for adaptive fish and wildlife management are presented below.

9 5.6.1 FWM-1: Wildlife Management

10 **Concern:** Native marine and terrestrial ecosystems on Guam have been substantially impacted by
11 introduced nonnative predators, human disturbance, and invasive plant species resulting in many of the
12 native fauna and flora becoming endangered, threatened, and extirpated.

13 **Objective:** Employ a systematic approach to managing wildlife resources, using a process that includes
14 inventory, monitoring, modeling, management, assessment, and evaluation.

15 All strategies described as follows for JRM will be developed and implemented in coordination with the
16 AMT.

17 **Strategies:**

- 18 1. Survey Fena Reservoir and tributaries for long-term trend analysis of the lake ecosystem to
19 facilitate management of water resources used for potable water and habitat which supports
20 native species.
- 21 2. Ensure that the natural resources staff members responsible for wildlife management and
22 conservation obtain annual focused training regarding management of these resources as related
23 to conservation on a military installation.
- 24 3. Continue to determine occurrence, relative abundance, and distribution of native plants and
25 animals including migratory birds, reptiles, land crabs, land and tree snails, rare plants, and
26 marine species. Record species sightings and ensure data are entered into GIS database.

- 1 4. Periodically review the monitoring program, discussed in strategy 3, to ensure it still meets
2 ecosystem management goals.
- 3 5. Conduct a study to determine if Mariana tree snail habitat is present on Tinian. Based on surveys
4 results, develop and implement BMPs for the snail.
- 5 6. Once finalized, implement DOD PARC Strategic Plan.
- 6 7. Develop and implement a project to estimate the abundance and distribution of reptiles and
7 amphibians on JRM sites. Several introduced species of reptiles and amphibians have become
8 established on JRM. Through predation and competitive exclusion these invasive species have
9 adversely impacted native reptiles, birds, and other species. Identifying the abundance and
10 distribution of native and nonnative herpetofauna will provide information to direct management
11 and conservation efforts on JRM. Survey for and monitor herpetofauna populations using
12 guidelines recommended by Partners in Amphibian and Reptile Conservation (PARC).
- 13 8. Revegetate areas on JRM with native species and control the spread of invasive species.
- 14 9. Continue to control harvesting of native species through the vegetation-removal permit program
15 or other management efforts.
- 16 10. Evaluate predator control and develop strategies to control invasive predators (e.g., brown
17 treesnake).
- 18 11. Develop and implement recommendations for inclusion in appropriate management plans
19 (e.g., OPERA, HERA) to reduce habitat fragmentation and improve habitat connectivity.
- 20 12. Manage the HMU at Andersen AFB as a cooperative interagency site for natural resources
21 management. [Requirement from BO]
- 22 13. Maintain and promote partnerships with agencies and groups involved in wildlife management.
- 23 14. Increase the conservation area around the existing MLA zone at Tinian.

24 **Monitoring Criteria:** Populations of native fish and wildlife species will be evaluated in incremental
25 biological surveys on JRM sites. Continue to coordinate with USFWS, GDAWR, and CNMI DLNR to
26 ensure meeting wildlife management goals without compromising the mission.

27 5.6.2 FWM-2: Migratory Bird Management

28 The MBTA (16 U.S.C. 703–712) protects all migratory birds and prohibits the taking of migratory birds,
29 their young, nests, and eggs, except as permitted by the USFWS. The protection of migratory birds is
30 also a requirement of the SAIA for developing and implementing DOD INRMPs, and a requirement
31 within DOD Instruction 4715.03 and OPNAVINST 5090.1C CH-1 for natural resources management.
32 The USFWS recommends that JRM avoid impacting birds protected under the MBTA by conducting
33 regular surveys for migratory birds on JRM sites.

34 The MBTA implements various treaties and conventions between the United States, Canada, Japan,
35 Mexico, and the former Soviet Union for the protection of migratory birds. Under the Act, taking, killing,
36 or possessing migratory birds is unlawful.

37 **Prohibited Acts:** Unless permitted by regulations, the Act provides that it is unlawful to pursue, hunt,
38 take, capture, or kill; attempt to take, capture, or kill; possess, offer to or sell, barter, purchase, deliver, or
39 cause to be shipped, exported, imported, transported, carried or receive any migratory bird, part, nest, egg
40 or product, manufactured or not.

1 **Managing for Migratory Birds.** The MBTA provides for a year-round closed season for nongame birds
2 and prohibits the taking of migratory birds, nests, and eggs, except as permitted by the USFWS. Impacts
3 on birds protected under the MBTA will be avoided through surveying for nesting birds in areas proposed
4 for disturbance and, if necessary, waiting until the nesting and fledging process is complete.
5 Alternatively, the USFWS recommends that conducting activities outside of nesting areas or outside of
6 the general migratory bird-nesting season can help avoid direct impacts; in the case of Guam outside of
7 the breeding season, or during periods when most migrants occur on the island.

8 On March 15, 2005, the USFWS published in the Federal Register (FR 70[49]: 12710–12716) a final list
9 of the bird species to which the MBTA does not apply because they are not native to the United States, or
10 its territories, and have been introduced by humans everywhere they occur in the nation. The list is
11 required by the Migratory Bird Treaty Reform Act of 2004. The actual list of migratory birds protected
12 by the MBTA is published in the CFR (Title 50, Part 10.13). When it became law in 2004, the Reform
13 Act excluded any species from protection not specifically included on the Title 50, Part 10 list.

14 Section 315 of the National Defense Authorization Act for FY 2003 (P.L. 107-314) directed the Secretary
15 of the Interior to develop regulations for issuing permits for the “incidental takings” of migratory birds
16 during military training exercises, and provided an interim exemption from the MBTA while these
17 regulations were drafted (CRS 2007). A U.S. district court had ruled that Federal agencies, including
18 DOD, are required to obtain permits for incidental takings. DOD had argued that an exemption was
19 needed to prevent the delay of training activities until takings permits could be issued. In February 2007,
20 the USFWS finalized regulations for issuing incidental takings permits to DOD. The interim exemption
21 expired on the effective date of these regulations, March 30, 2007. DOD is now required to obtain
22 permits for activities that could result in incidental takings (CRS 2007).

23 In 2008, DOD approved a new "Coordinated Bird Monitoring (CBM) Plan" designed jointly by DOD and
24 USGS biologists and managers during the previous 3 years. The CBM Plan outlines procedures for
25 ensuring that bird monitoring and assessment address important issues for DOD; follow accepted
26 procedures for design, data collection, and analysis; and that the data be preserved in long-term archives.
27 This project includes maintaining the database and developing decision support tools of special
28 importance to DOD. The Navy is also working closely with DOD to follow the guidelines in the DOD
29 CBM Plan. Assistance includes (1) specifying what DOD issue(s) will be addressed using the survey
30 data, (2) how to phrase the objectives in quantitative terms, (3) design of the sampling plan for selecting
31 survey times and places, (4) choice of the field methods, (5) preparation of the field forms, (6) formatting
32 the data for entry into the CBM database, and (7) preparation of the metadata. USGS personnel will also
33 be available to help with analysis as needed. The Great Basin Bird Observatory, USACE, USGS, and the
34 American Bird Conservancy, all of whom were involved in the year two project, will continue their
35 collaboration to provide technical assistance to DOD installations throughout the United States.

36 JRM supports the conservation of migratory birds that occur on Guam including the federally endangered
37 Mariana crow, Micronesian kingfisher, Mariana common moorhen, Guam rail, and Mariana swiftlet, and
38 other non-listed migratory birds that occasionally or regularly occur on JRM lands. Some examples of
39 ways in which JRM supports conservation of migratory birds are through habitat conservation,
40 restoration, and enhancement. Conserving biological diversity on JRM lands within the context of its
41 mission is an important goal. Conserving native species in natural ecosystems is a crucial element of
42 maintaining biological diversity. In this context it is in JRM’s best interest to manage migratory birds
43 through such programs as Monitoring Avian Productivity and Survivorship (MAPS) and other habitat and
44 species management programs such as Partners in Flight.

45 **Objective:** Maintain and enhance migratory bird populations and their habitats on JRM sites.

1 All strategies described as follows for JRM will be developed and implemented in coordination with the
2 AMT.

3 **Strategies:**

- 4 1. Assess the effects of all projects on migratory birds during the NEPA process. Ensure
5 compliance with the MOU between USFWS and DOD on the Conservation of Migratory Birds
6 and the “Migratory Bird Rule.”
- 7 2. Identify any actions that require an MBTA permit and, if necessary, obtain appropriate permit for
8 intentional take of migratory birds.
- 9 3. Develop effective management for minimizing the unintentional take of migratory birds.
- 10 4. Conduct regular surveys for migratory birds on JRM lands to examine distribution and
11 abundance; data will be used to support management of migratory birds and their habitats.
- 12 5. Once finalized, implement monitoring protocols contained within the DOD Coordinated Bird
13 Monitoring Plan. Contribute data to the Coordinated Bird Monitoring Database.
- 14 6. Develop migratory bird-specific BMPs and ensure these BMPs are included in project plans.
- 15 7. Develop and implement a project to examine the movement of migratory birds over and around
16 the Island of Guam during spring and fall migration periods. Most migratory birds pass over
17 Guam and do not use the island as a wintering site or stopover site; this factor, along with the
18 presence of nocturnal movements of flocks, would require methods such as radar to estimate the
19 number of birds and the route of migrants accurately over and around the island. Estimating the
20 number of birds migrating over JRM sites and identifying migratory routes over Guam will
21 provide information to assist in identification of turbine and other sites that have potential to
22 impact migratory birds.
- 23 8. Develop and implement a strategy to identify habitat use by migratory birds on JRM. Identifying
24 habitats that support migrants and the variables that contribute to habitat selection will provide
25 data that can be used for land use planning purposes, such as identifying strategies for managing
26 grass fields and other migratory bird habitats.
- 27 9. Develop and distribute outreach and education materials on migratory birds.
- 28 10. Participate in DOD Partners in Flight Initiative.
- 29 11. Ensure feral dog and cat colonies are eliminated from JRM sites per Secretary of the Navy
30 Instruction (SECNAVINST) 6401.1A.

31 **5.6.3 FWM-3: Conduct a Coconut Crab Study to Determine Sustainable Population Level**

32 **Concern:** JRM follows GDAWR regulations for conservation and management of coconut crabs, but
33 further study is needed to ensure sustainable yields. In addition, nonanthropogenic threats to coconut crab
34 populations on JRM sites need to be determined.

35 All strategies described as follows for JRM will be developed and implemented in coordination with the
36 AMT.

37 **Objective:** Conduct a study of sustainable population levels of coconut crabs by identifying areas of
38 habitat for reproduction and feeding and determining carrying capacity and population replacement
39 levels.

1 **Strategies:**

- 2 1. A survey should be conducted to determine the presence of coconut crab populations and habitat
3 on JRM lands.
- 4 2. Conduct survey of coconut crabs at Tarague Basin. Prior to survey, conduct research on carrying
5 capacity of habitat and population replacement levels. Once the survey has been completed,
6 ensure results of the survey are included in this INRMP.
- 7 3. Research should be conducted on the carrying capacity of the habitat and population replacement
8 levels.
- 9 4. Coordinate and share research with GDAWR staff.

10 **Monitoring Criteria:** Monitor the population of coconut crabs. Develop a management plan for the
11 coconut crab and implement management strategies prescribed in the plan.

12 **5.6.4 FWM-4: Management of BASH at Andersen AFB**

13 Bird strikes to aircraft, or bird/wildlife aircraft strike hazard (BASH), are a serious safety and economic
14 problem in the United States, annually causing millions of dollars in damage to civilian and military
15 aircraft and occasionally loss of human life. The USAF is responsible for implementing the BASH
16 program at Andersen AFB. The USAF actively implements a BASH Reduction Plan, thereby reducing
17 the potential for a bird strike to occur on the airfield. Birds can be encountered at altitudes of 30,000 feet
18 (9,144 meters) and higher. However, most birds fly close to ground level, and more than 95 percent of all
19 reported incidents in which an aircraft has struck a bird have been below 3,000 feet (914 meters) above
20 ground level (AGL). Approximately half of these bird strikes occur in the airfield environment, and
21 approximately one-quarter occur during low-altitude training. Strike rates rise significantly as altitude
22 decreases, which is partly due to the greater number of low-altitude missions, but mostly because birds
23 are commonly active close to the ground. Any gain in altitude represents a substantially reduced threat of
24 a bird strike (USAF 1997).

25 More than one-half of all bird-aircraft strikes occur at or below 600 feet (183 meters) AGL during
26 low-level flights (AFSC 2011). In addition, the majority of the total costs associated with bird-aircraft
27 strikes result from strikes in this region of airspace. Many low-level strikes occur on low-level routes
28 associated with airdrops and bombing runs (USAF 1997). During these flights, aircrews are involved in
29 specific duties that leave little time to monitor bird activity. Instead, flight crews use the Low-Level Bird
30 Avoidance Model (BAM) to understand risks associated with each particular route. Should the BAM
31 show an unacceptable level of risk, the operation time or route is adjusted to maximize safety.

32 BAM is used to analyze BASH visually during flight planning. The majority of costs incurred during
33 spring and fall migration of species. Refer to the Andersen AFB BASH Reduction Plan for data specific
34 to Andersen AFB.

35 Several bird species that might be present and pose a hazard to military aircraft include Pacific golden-
36 plovers, whimbrels, yellow bitterns, cattle egret, black drongos, Micronesian starlings, Eurasian tree
37 sparrows, and island collard doves. Abundance of birds on JRM lands peaks during the spring and fall
38 migration periods; abundance remains relatively high throughout the nonbreeding season (September -
39 May). Proximity of habitat commonly utilized by bird and other wildlife species to airfield should also be
40 considered as a part of BASH management planning.

41 **Concern:** High BASH-threat species could be attracted as a result of sensitive species habitat
42 modification and management activities. Therefore, a BASH strike threat exists at Andersen AFB.

1 **Objective:** The USAF and USDA-WS personnel will continue their extremely effective approach in
2 identifying and reducing the BASH and wildlife strike threat on Andersen AFB. All habitat modification
3 and management activities should be assessed for their potential to affect the safety of the flying mission
4 prior to their incorporation into this INRMP.

5 All strategies described as follows for JRM will be developed and implemented in coordination with the
6 AMT.

7 **Strategies:**

- 8 1. Continue implementation of the BASH program at Andersen AFB in accordance with U.S. Air
9 Force Instruction (AFI) 91-202.
- 10 2. Continue USDA-WS studies to determine the resident populations and seasonal influxes of
11 migratory species. As the species composition changes on Andersen AFB, management
12 strategies will be modified on an as-needed basis.
- 13 3. Monitor sensitive species to assess potential threats to the safety of the flying mission.
- 14 4. Alter habitat enhancement activities when necessary to minimize BASH threat.
- 15 5. Continue to remove deer, feral pigs, feral dogs, and feral cats from the flightline area as needed
16 and monitor for deer access to the flightline.
- 17 6. Continue to harass birds as necessary using a variety of techniques (e.g., pyrotechnics, model
18 aircraft, propane cannons) to minimize wildlife-aircraft strikes. The use of a vehicle-mounted
19 propane gun harassment device will be evaluated to reduce the habituation of BASH threat
20 species to such devices.
- 21 7. Remove large debris piles in proximity to the airfield, as they serve as harborages for wildlife and
22 can contribute to the increase of the BASH threat.
- 23 8. Obtain additional training (e.g., Annual Bird Strike Committee USA meetings) to ensure the use
24 of the most current methods in wildlife damage prevention and control.
- 25 9. Maintain current USFWS and GDAWR depredation permits.

26 **Monitoring Criteria:** Continued evaluation of the BASH hazard at Andersen AFB will be used to assess
27 the effectiveness of the BASH program. Management activities should be continually assessed during
28 implementation, and should be modified as necessary if they result in the attraction of high BASH threat
29 species.

30 **5.7 Vegetation and Habitat Management**

31 Vegetation and habitat management is a broad term that encompasses a wide range of issues affecting fish
32 and wildlife; threatened and endangered species; and host, tenant, and transient training requirements.
33 Habitat management could be required to decrease the abundance of certain wildlife species or to reduce
34 animal damage or bird strike hazards. Habitat management in JRM will attempt to (1) protect and
35 conserve threatened and endangered species through habitat conservation and enhancement at selected
36 locations, (2) restore native forest ecosystems through revegetation using native plants, (3) deter animals
37 from foraging or roosting in areas near or adjacent to areas of low-level flight activity, and (4) attract
38 wildlife to areas away from the areas of low-level flight activity.

1 Threats

- 2 1. Loss of native vegetation.
- 3 2. Invasive plant and insect species.
- 4 3. Feral ungulates.
- 5 4. Erosion and sedimentation.
- 6 5. Habitat loss from development

7 Management Strategy

8 The goals for habitat management are summarized in **Table 5-8**.

9 **Table 5-8. Summary of Vegetation and Habitat Management Goals**

Vegetation and Habitat Management Goals
<ul style="list-style-type: none"> • Protect native habitat diversity. • Maximize use of regionally native plant species and avoid introduction of invasive, exotic species in revegetation activities. • Enhance habitat for native species by removing invasive vegetation and replacing with native vegetation. • Maintain and enhance vegetation community structure, functionality, and species diversity. • Lessen or avoid adverse effects from activities on the overall ecosystem and its sensitive resources.

10 To meet the goals of habitat management, the following concerns relative to achieving particular goals
11 have been identified, and objectives and management strategies have been designed.

12 5.7.1 VHM-1: Habitat Protection, Restoration, and Rehabilitation

13 **Objective:** Develop and implement a program for natural land and habitat restoration and rehabilitation.

14 All strategies described as follows for JRM will be developed and implemented in coordination with the
15 AMT.

16 **Strategies:**

- 17 1. Conduct long-term resource monitoring to detect changes caused by military activities. Continue
18 to coordinate with operation and construction planners to ensure that military activities do not
19 have short term adverse impacts to natural resource and that any unavoidable impacts are
20 mitigated as appropriate.
- 21 2. Continue invasive and noxious weed identification and control as necessary.
- 22 3. Continue conducting surveys of vegetation plots on NBG and Tinian every 5 years to monitor
23 ecosystem health, and to determine species presence at existing permanent plots. Data will be
24 linked to GIS for mapping and analysis.
- 25 4. Regularly inventory established survey plots to develop long-term trend data on biodiversity and
26 endangered species recovery on JRM. Ensure that GIS is updated and linked to current maps and

1 analyzed when collection from each JRM site is complete. Recurring re-measurement of the
2 long-term plots is critical to meeting the biodiversity strategies outlined in the INRMP, and being
3 prepared to prepare biological assessments for ESA Section 7 consultation with the USFWS.

- 4 5. Develop and implement measures to protect and enhance fish and wildlife resources on JRM
5 managed lands at OPERA and HERA. OPERA and HERA include terrestrial and marine
6 (submerged lands) components. Measures should ensure an ecosystem and watershed approach
7 to protect native and migratory species that inhabit the terrestrial and marine environments
8 through the following: controlling nonnative invasive plant and animal species, controlling
9 overharvesting of fish and animal species, and incorporating a public education program on the
10 purpose and function of the ERAs.
- 11 6. Annually update informational and training materials regarding plant community conservation.
- 12 7. Develop specifications and standards for reseeded/revegetation of disturbed sites for use in
13 contracts, maintenance, and other projects.
- 14 8. Develop a program to grow, plant, and monitor for 3 years, native forest species in areas where
15 feral ungulate populations have been eradicated. The program would also include monitoring for
16 nonnative vegetation, and removing nonnative vegetation when necessary within feral ungulate
17 population eradication areas. The program would begin after ungulates have been removed from
18 fenced areas. Growing, planting, and monitoring of native and nonnative vegetation would be
19 conducted through an outside contract.
- 20 9. Monitor the effects of increasing rodent populations on forest regeneration and restoration efforts
21 in areas where brown treesnake populations have been depressed through trapping and other
22 control measures.
- 23 10. Periodically review management to ensure it still meets ecosystem management goals.

24 **Monitoring Criteria:** Continue to monitor habitats on JRM lands to protect and enhance floral and
25 faunal resources on JRM managed lands. Continue to monitor for and removed invasive floral and faunal
26 species from JRM lands.

27 5.7.2 VHM-2: Soil Resources

28 **Concern:** Soil erosion and compaction affects the productivity of some sites and threatens to expand
29 these effects to unacceptable levels without protection and restoration.

30 **Objective:** Minimize soil compaction and restore erosion sites.

31 **Strategies:**

- 32 1. Complete evaluation and prioritization of active erosion sites.
- 33 2. Tailor land uses to appropriate soil types.
- 34 3. Continue to implement plans for eroded site rehabilitation.
- 35 4. Identify additional sites for land rehabilitation planning.
- 36 5. Survey areas where soil erosion and compaction might occur to ensure that BMPs within the
37 Erosion-Control Plan are implemented and are effective.
- 38 6. Continue to manage erosion on JRM sites, track successes, and progress and revise the INRMP as
39 appropriate.

1 **Monitoring Criteria:** Continue to monitor for soil erosion and compaction on JRM lands, and
2 implement BMPs within the Erosion-Control Plan.

3 5.7.3 VHM-3: Monitoring of Forest Regeneration in Ungulate Enclosures

4 **Concern:** The removal of ungulates is usually followed by the invasion of noxious plant species.

5 **Objective:** Monitoring of forest regeneration in any new enclosures and areas of wildlife habitat will be
6 conducted after their installation. A baseline survey of vegetation should be completed prior to
7 installation of the enclosures. The data gleaned from such monitoring can be used to determine the
8 effects of ungulate removal on the vegetation, to determine the effectiveness of revegetation efforts, and
9 to improve management strategies toward native forest recovery.

10 All strategies described as follows for JRM will be developed and implemented in coordination with the
11 AMT.

12 **Strategies:**

- 13 1. Monitor vegetative regeneration in the enclosures to examine changes to vegetation composition
14 and structure.
- 15 2. If natural regeneration of these areas is not representative of species in the native limestone forest,
16 adapt management strategies to assist towards revegetation of desirable native species.
- 17 3. Continue to identify and remove invasive plant species that might out-compete the desirable
18 native species.

19 **Monitoring Criteria:** Monitor enclosures and revegetate with native species as necessary, control and
20 eradicate invasive species, and adapt management strategies to achieve recovery of the native limestone
21 forest ecosystem in these areas.

22 5.7.4 VHM-4: Habitat Biodiversity Monitoring

23 **Concern:** Healthy native habitats are necessary for the maintenance and continuing evolution of
24 biodiversity on Guam.

25 **Objective:** Habitat Biodiversity Monitoring will reevaluate established vegetation transects to measure
26 changes in the condition of the resource. This information will be used to evaluate long-term trends in the
27 condition of the resource and compare results with adjacent areas.

28 All strategies described as follows for JRM will be developed and implemented in coordination with the
29 AMT.

30 **Strategies:**

- 31 1. Monitor faunal and floral diversity in the vegetation plots, record data observations, and compare
32 to baseline survey data. Ensure that monitoring techniques encompass all species groups present
33 or likely to be present in the vegetation plots.
- 34 2. Evaluate long-term trends in the condition of these resources. If these areas show severe
35 degradation or simplification of the ecosystem that is not representative of native biodiversity,
36 then adapt management strategies to assist towards the recovery of more representative native

1 ecosystems (e.g., invasive species removal, revegetation with native species, creation of
2 biological corridors).

3 3. Classify and delineate vegetation on JRM sites and identify the spatial distribution of target
4 species (i.e., threatened and endangered species, invasive species, and species of concern).
5 Vegetation data will be used to identify and develop habitat maps for threatened and endangered
6 species on JRM, where appropriate.

7 **Monitoring Criteria:** Continue to monitor these plots, evaluate long-term trends, and adapt management
8 strategies to maintain or achieve recovery of the native biodiversity in these areas.

9 5.7.5 VHM-5: Survey of Culturally Important Plants

10 **Concern:** There is a high demand for harvesting culturally important plants on Andersen AFB. The
11 majority of the plant harvest occurs in the Tarague Basin, an easily accessed and popular location on
12 Andersen AFB. Prior to 1995, there were no guidelines for the management of harvested plants such as
13 breadfruit, coconuts, or moss. There is a need to address the management of these plants to prevent
14 overharvesting and degradation of the native forests that support them.

15 **Objective:** Currently, people intending to harvest plant resources from Andersen AFB properties are
16 charged a fee of \$10.00 per person per day. The harvest of plants is permitted on a year-round basis and
17 only in the areas designated as open for harvest. Concurrently, Andersen AFB should initiate research on
18 the ecological requirements of harvested species to ensure natural regeneration and to determine any
19 needed limitations to harvesting. Information from the Chief Conservation Officer and research on
20 harvestable plants will aid in the development of a more-refined management plan for plant resources on
21 Andersen AFB and other JRM sites.

22 All strategies described as follows for JRM will be developed and implemented in coordination with the
23 AMT.

24 **Strategies:**

- 25 1. A survey should be conducted to determine the presence of culturally important plants in special
26 access areas.
- 27 2. Research should be conducted on the population size, distribution, sustainable harvest methods,
28 and sustainable yield of culturally important plants.
- 29 3. A management plan for the sustainable harvest of culturally important plants should be developed
30 based on the research conducted. This plan will identify locations of populations suitable for
31 sustainable harvest.

32 **Monitoring Criteria:** Continue to monitor the harvest of culturally important plants to ensure
33 maintenance of sustainable population levels.

34 5.8 Coastal, Marine, and Submerged Lands Management

35 Coastal, marine, and submerged lands management applies to any installation habitat/property within the
36 JRM that is partially or totally inundated by ocean waters. These areas include intertidal and estuarine
37 areas and submerged lands, which are areas in coastal waters extending from the Guam coastline into the
38 ocean 3 nautical miles (U.S. Navy 2010a). In addition to supporting a diverse aquatic ecosystem, these
39 areas support a significant amount of current and proposed military training and recreational activities.
40 Management of coastal, marine, and submerged lands in JRM will (1) protect and conserve threatened

1 and endangered species through habitat conservation and enhancement, (2) ensure health and
 2 sustainability of coral reefs, and (3) provide continued access to training and recreational areas. The goals
 3 for coastal, marine, and submerged lands management are summarized in **Table 5-9**.

4 **Table 5-9. Summary of Coastal, Marine, and Submerged Lands Management Goals**

Coastal, Marine, and Submerged Lands Management Goals
<ul style="list-style-type: none"> • Conservation and restoration of coastal, marine, and submerged lands that provide habitat for a variety of native marine plants and animals, especially coral reef systems. • Preclude designation of critical habitat for coral species by meeting criteria for special management and protection. • Complete a comprehensive baseline assessment and establish a permanent monitoring program for coral reef health. • Develop BMPs for accommodating military training needs and recreation while conserving coral habitat. • Ensure JRM sites remain in compliance with Magnuson-Stevens Fishery Conservation and Management Act and other appropriate federal regulations.

5 Threats

- 6 1. Habitat loss.
- 7 2. Erosion and sedimentation.
- 8 3. Water quality.
- 9 4. Invasive species.
- 10 5. Lack of data.
- 11 6. Lack of conservation enforcement.
- 12 7. Harvesting and other anthropogenic impacts.

13 To meet the goals of coastal, marine and submerged lands management, the following concerns relative to
 14 achieving particular goals have been identified, and objectives and management strategies have been
 15 designed.

16 5.8.1 SLM-1: Protection of Corals and Marine Ecosystems

17 **Concern:** On February 10, 2010, NMFS announced a 90-day finding on a petition to list 82 species of
 18 corals as threatened or endangered under the ESA (75 FR 6616 2010). NMFS solicited scientific and
 19 commercial information regarding these coral species including information pertaining to threats of ocean
 20 warming, ocean acidification, and other impacts that affect these species, stating that immediate action is
 21 needed to reduce greenhouse gas concentrations to levels that do not jeopardize these species. The
 22 petition also asserts that the species are being affected by dredging, coastal development, coastal point
 23 source pollution, agricultural and land use practices, disease, predation, reef fishing, aquarium trade,
 24 physical damage from boats and anchors, marine debris, and aquatic invasive species. The Status Review
 25 is ongoing for 82 corals. Per a settlement agreement between the petitioner and NMFS, NOAA's
 26 12-month finding whether or not to propose any of those corals for listing as threatened or endangered

1 under the ESA was due by April 15, 2012. This date has been extended to allow for additional needed
2 assessment.

3 Forty-four of the 82 species being evaluated by NMFS occur, or potentially occur within Navy
4 installations, training ranges, and OPAREAs in the United States or U.S. territories. Most of the stony
5 coral species (84 percent) that are being petitioned are found within the Pacific Ocean region (NAVFAC
6 ESC SDS 2010).

7 JRM is faced with an unusual situation on Guam. Well-developed reefs are present within many of the
8 nearshore portions of JRM submerged Lands, yet the Navy does not control the use of most of these areas
9 nor can it control the anthropogenic factors, such as intentional burning, inadequate public wastewater
10 systems/treatment, and tourist diving operations that have had and continue to have serious adverse
11 impacts on marine natural resources. The management strategies following are proposed based on the
12 constraints with which the Navy must deal and the physical and biological realities of Guam (NAVFAC
13 ESC SDS 2010).

14 **Objective:** It is Navy policy to preclude designation of critical habitat, when appropriate, by
15 demonstrating special management of a listed species. Special management or protection is a term that
16 originates in the definition of occupied critical habitat in Section 3 of the ESA. ESA does not require
17 additional special management/critical habitat designation if adequate management and protection is
18 already in place. Adequate special management or protection is provided by a legally operative INRMP
19 that addresses the maintenance and improvement of the primary constituent elements important to the
20 species and manages the long-term conservation of the species. Three criteria are used to determine if
21 such special management and protection are provided: (1) there is a conservation benefit, (2) there are
22 assurances that the management plans will be implemented, and (3) there are assurances that the
23 conservation efforts will be effective. These three criteria will be met through the strategies that follow,
24 and therefore, designation of critical habitat is neither necessary nor legally required (NAVFAC ESC
25 SDS 2010).

26 **Strategies:**

- 27 1. JRM should attempt to protect corals and coral reefs within JRM submerged lands, which extend
28 from the intertidal zone to the 160-foot (48.7-meter) depth contour, which is the limit of the
29 ecological reserve.
- 30 2. Conduct a feasibility study for placement of mooring buoys within Navy Submerged lands, and
31 coordinate with GDAWR and other GovGuam agencies. Develop and implement buoy
32 placement and maintenance protocols, and incorporate BMPs for boating into educational
33 outreach materials.
- 34 3. Delineate benthic habitats and identify the spatial distribution of target species (i.e., threatened
35 and endangered species, candidate species, and invasive species) on submerged lands around the
36 island of Guam.
- 37 4. Annually review and revise, as needed, the Naval Base Guam Fishing Instruction and ERA
38 management plans. Coordinate review with USFWS, GDAWR and NMFS to ensure goals and
39 objectives of the fishing instructions and ecological reserve guidance are consistent with Federal
40 and territorial objectives.
- 41 5. Ensure that the Base Fishing Instruction and ERA guidance, no-fishing, or collection of marine
42 organisms policies are implemented.

6. Analyze the feasibility of using artificial reefs to encourage coral reef establishment. Coordinate with the USFWS, GDWAR, and NMFS to ensure goals and objectives of this proposal are consistent with Federal and territorial resource agency conservation goals and regulations.
7. Develop marine benthic habitat maps for DOD Submerged lands seaward to include Agat Bay, Orote Point, Apra Harbor, and Piti Bay. Benthic maps should describe the complex marine habitats and resources that exist in the DOD submerged lands within this management area. The marine benthic habitat maps should be used to support DOD management activities.

Monitoring Criteria: Implementation of these recommendations would greatly increase the effectiveness of the ERAs, and the HAPCs and create de facto preserves. These measures could enhance corals, coral reefs, fisheries, and all nearshore marine organisms for the entire island of Guam (NAVFAC ESC SDS 2010)

5.8.2 SLM-2: Monitoring of Coral Reefs

Concern: Long-term evaluation and monitoring of coral reefs in JRM submerged lands is required to provide comprehensive data on ecosystem health and sustainability and provide analysis of any potential military impacts. Submerged Land Management Plans (SLMP) were prepared in 2007 to supplement the Navy's INRMP (COMNAV Mariana 2001), the OPERA General Management Plan, and the HERA General Management Plan were prepared in 2010 (SWCA 2010a and 2010b) (see **Appendix J**). Both plans provide management objectives that will assist in the evaluation of future military activities in JRM as they apply to submerged lands and especially to corals.

Objective: Implementation of the SLMP and establishing long-term coral reef monitoring will enhance protection and restoration of coral habitat and compound the benefit of the strategies described in **Section 5.7.1**.

Strategies:

1. Coral reef ecosystems should be monitored using permanent transects, and a GIS database of nearshore coral reef ecosystems should be created and should include seagrass habitats and areas suitable for other marine life. Coordinate with USFWS, NMFS, GDAWR and CNMI DLNR where possible in the development of a long-term coral reef monitoring program.
2. Conduct preliminary surveys of corals within Pati Point Marine Preserve and establish permanent transects to monitor coral health. Coordinate surveys with the National Wildlife Refuge at Ritidian Point. Develop a written report on Pati Point Marine Preserve to incorporate into the SLMP.
3. Investigate and, if appropriate, deploy Autonomous Reef Monitoring Structures to monitor diversity of the coral reef ecosystem.
4. Continue remote monitoring with CRMS (Coral Reef Monitoring System) at additional locations in Apra Harbor.
5. Assess public and recreational use of JRM submerged lands and educate users of ERAs and other JRM submerged lands on the importance of coral reef preservation.

Monitoring Criteria: A JRM Coral Reef Habitat Baseline Survey and long-term monitoring will provide additional information for coordination and response to future NMFS decisions related to listing and critical habitat designation. The survey and monitoring should also be coordinated with the USFWS to ensure appropriate metrics are collected for the purposes of avoiding, minimizing and mitigating JRM operational impacts on marine fish and wildlife resources.

1 5.8.3 SLM-3: Conservation Measures from Biological Opinions

2 **Concern:** With the increasing military presence and reorganization of operations on Guam, consultation
3 with USFWS and NMFS has resulted in BOs that specifically address coastal, marine and submerged
4 lands associated with JRM managed lands.

5 **Objective:** Address recommended conservation measures, as related to coastal, marine, and submerged
6 land habitat to the fullest extent possible for the following BOs:

- 7 1. NMFS Biological Opinion on the U.S. Navy's Proposed Guam and Commonwealth of Northern
8 Mariana Islands Military Relocation, dated August 25, 2010.
- 9 2. USFWS Biological Opinion for the Joint Guam Program Office Relocation of the U.S. Marine
10 Corps from Okinawa to Guam and Associated Activities on Guam and Tinian, dated September
11 8, 2010.
- 12 3. USFWS Biological Opinion on the Establishment and Operation of an Intelligence, Surveillance,
13 Reconnaissance, and Strike Capability Project on Andersen Air Force Base, Guam, dated October
14 3, 2006.

15 All strategies described as follows for JRM will be developed and implemented in coordination with the
16 AMT.

17 **Strategies:**

- 18 1. Ensure all construction and military operations incorporate prescribed BO conservation measures
19 into planning, funding and execution. Coordinate with USFWS, the GDAWR and the NMFS to
20 identify the least environmentally damaging practicable alternative for construction projects and
21 military operations, with an emphasis to avoid, minimize or mitigate for unavoidable impacts on
22 fish and wildlife resources.
- 23 2. Map all nearshore marine resources on JRM submerged lands to provide comprehensive
24 information when evaluating potential impacts on sensitive species and associated habitat.
25 Coordinate marine benthic habitat mapping activities with the USFWS, the GDAWR and the
26 NMFS to ensure habitat classification consistency, appropriate mapping methodology is
27 employed and mapping conservation objectives are shared among agencies.
- 28 3. Expand the OPERA based on the Mitigation Plan for MILCON P-502, Kilo Wharf Extension (see
29 **Table 5-3**). [Requirement from BO]
- 30 4. Modify the OPERA to restrict fishing and other types of consumptive activities that could
31 adversely affect the essential fish habitat within the OPERA. [Requirement from BO]

32 **Monitoring Criteria:** Future consultation with NMFS and USFWS will demonstrate compliance with
33 recommended conservation measures.

34 5.9 Exotic and Invasive Species Management

35 An invasive species is defined in EO 13112, *Invasive Species*, as a species that is nonnative (i.e., alien or
36 exotic) to the ecosystem under consideration and whose introduction causes or is likely to cause economic
37 or environmental harm, or harm to human health. Invasive species can be plants, animals, and other
38 organisms (e.g., microbes). Human actions are the primary means of invasive species introductions.
39 Invasive species have had a catastrophic effect on the native flora and fauna of Guam. Attributes of

1 island biota include small geographic ranges and population size, low reproductive rates, and lack of the
2 ability to coevolve with invasive species and disturbed habitats. Islands typically have lower numbers of
3 species than mainland areas, which results in fewer predators and competitors that could prohibit the
4 establishment of invasive species. These limitations have caused exotic and invasive species to replace
5 native island species (Wiles et al. 2003). As a result of evolving in isolation, island plants and animals
6 have few defenses when exposed to introduced competitors and predators. These limitations on Guam
7 have caused exotic and invasive species to replace native island species (Wiles et al. 2003).

8 Many of the native species on Guam are imperiled due to introduced predators, such as the brown
9 treesnake, feral cats and dogs, and introduced ungulates such as the Philippine deer, feral pig and carabao
10 that have altered native vegetation. Several species of rats, including the brown rat, black rat, and
11 Polynesian rat, have colonized the island and also prey on the eggs and young of native species and
12 destroy native flora. There are also several invasive flora and fauna species that have well-established
13 control and removal programs, such as the Brown Treesnake Control Program. Other management
14 programs include the control of feral ungulates and removal of invasive plants to allow native species to
15 flourish in degraded areas. Harvesting of wildlife on JRM needs to be managed to ensure compatibility
16 with endangered and threatened species, and protection of the native ecosystem in perpetuity.

17 Invasive species control and removal efforts are mandated by Federal, DOD, and JRM regulations and
18 MOA such as the following:

- 19 • *EO 11987, Exotic Organisms*. Agencies shall restrict the introduction of exotic species into the
20 natural ecosystems on lands and waters which they administer.
- 21 • *EO 13112, Exotic and Invasive Species*. Directs Federal agencies whose actions might affect the
22 status of invasive species, to the extent practicable to prevent the introduction of invasive species
23 and provide for their control and to minimize the economic, ecological, and human health impacts
24 that invasive species cause.
- 25 • *Animal Damage Control Act (7 U.S.C. § 426–426b, 47 Stat. 1468)*. Provides authority to the
26 Secretary of Agriculture for investigation and control of mammalian predators, rodents, and birds.
27 DOD installations can enter into cooperative agreements with USDA-WS to conduct animal
28 control projects.
- 29 • *Federal Noxious Weed Act of 1974, 7 U.S.C. § 2801–2814*. The Act provides for the control and
30 management of nonindigenous weeds that injure or have the potential to injure the interests of
31 agriculture and commerce, wildlife resources, or the public health.
- 32 • *Non-Indigenous Aquatic Nuisance Prevention and Control Act of 1990 (104 Stat. 4761, 16 U.S.C.
33 § 4701)*. P.L. 101-646 establishes a broad Federal program to prevent the introduction of and
34 control the spread of introduced aquatic nuisance species and the brown treesnake. The Act also
35 established the Aquatic Nuisance Species Task Force which coordinates all government efforts
36 relating to aquatic invasive species in the United States with those of the private sector and other
37 North American interests via regional panels and issue-specific committees and work groups.
- 38 • *Brown Tree Snake Control and Eradication (7 U.S.C. 8501 et seq.)*. The law provides for the
39 control, interdiction, research, and eradication of the brown treesnake, including quarantine
40 protocols to be undertaken to control the introduction and spread of the species.
- 41 • *MOA for Brown Treesnake Control. June 1, 2011*. Executed among the U.S. Department of
42 Interior, DOD, USDA, U.S. Department of Transportation, National Invasive Species Council,
43 GovGuam, the State of Hawaii, and CNMI. This agreement establishes a policy framework and
44 working relationship to facilitate implementation of the BTS Control Plan.

- 1 • *DOD Instruction 4150.07 DOD Pest Management Program. May 29, 2008.* Implements policy,
2 assigns responsibilities, and prescribes procedures for the DOD Integrated Pest Management
3 (IPM) Program.
- 4 • *U.S. Army Corps of Engineers Invasive Species Policy. June 2, 2009.* Establishes a consistent,
5 nationwide policy that is applied to all Civil Works projects and programs. It complements the
6 National Invasive Species Act. Measures to either prevent or reduce establishment of invasive
7 and non-native species will be a component of all USACE Operations and Maintenance (O&M)
8 at project sites and a part of implementation of a Civil Works project.

9 **Table 5-10** presents a summary of the invasive species management goals for JRM. The primary goal of
10 invasive species management in JRM is to control or remove invasive species that are having an adverse
11 effect on native flora and fauna and create areas that are predator-free to assist in the recovery of a healthy
12 native ecosystem that is compatible with the military missions.

13 **Table 5-10. Summary of Exotic and Invasive Species Management Goals**

Exotic and Invasive Species Management Goals
<ul style="list-style-type: none"> • Prevent invasive species impacts on native ecosystems. • Continually monitor and reduce the effects invasive species have upon the native ecosystems of Guam, such as habitat alteration, competition for resources, and predation. • Employ a systematic approach for early detection and rapid response to control or remove invasive species that are having an adverse effect on native ecosystems. • Minimize invasive species-related health risks, safety risks, and environmental damage. • Continue to remain in compliance with Federal, territorial, and local laws and regulations governing invasive species. • Maintain and involve partnerships with agencies and groups involved in invasive species control and removal. • Develop BMPs to ensure that invasives species from Guam are not spread to other locations on and off the Island of Guam. • Ensure JRM activities do not result in the introduction and spread of invasive species.

14 Threats

- 15 1. Decrease/loss of native species.
- 16 2. Habitat loss or fragmentation for native species.
- 17 3. Disease.
- 18 4. Predation.
- 19 5. Population expansion to nearby islands.
- 20 6. Erosion and sedimentation from vegetation removal.

1 5.9.1 ISM-1: Conduct an Exotic and Invasive Species Survey and Prepare a Management 2 Plan

3 **Concern:** Invasive plant and animal species are endangering and sometimes extirpating populations of
4 native species and creating lower quality habitat for wildlife.

5 **Objective:** Develop methods to reduce populations of invasive plant and animal species using
6 approaches that will cause the least disturbance of native species that might be present. Develop and
7 adopt proactive management measures to control the proliferation of invasive plant and animal species.

8 All strategies described as follows for JRM will be developed and implemented in coordination with the
9 AMT.

10 **Strategies:**

- 11 1. Conduct baseline surveys to determine extent of invasive insects and other invertebrates, feral
12 ungulates and cats, rodents, reptiles and amphibians, and plants on JRM sites. Include surveys
13 results in this INRMP and in the GIS database.
- 14 2. Develop and implement an Exotic and Invasive Species Management Plan to prevent the
15 introduction of new populations of invasive species on JRM and include it in **Appendix O** of this
16 INRMP once it has been completed.
- 17 3. Develop and implement a rat exclusion study on Tinian.
- 18 4. Perform surveys at 5 year intervals to determine the presence and extent of invasive or noxious
19 plant species.
- 20 5. Create GIS layers depicting high concentrations of invasive plant species on JRM sites. A
21 combination of mechanical and chemical measures will be used to control the spread of these
22 species.
- 23 6. Evaluate approaches to control ants and nonnative flatworms, and develop and implement
24 strategies as a result of evaluations.
- 25 7. Coordinate with the USFWS, GDAWR, USGS BRD, USDA, and local regulators to assist in
26 identifying any new invasive plant and animal species.

27 **Monitoring Criteria:** Continue to survey as needed for new invasive plant and animal species and
28 implement a plan to control or eradicate these species. Update the plan as needed.

29 5.9.2 ISM-2: Assessment and Management of the Coconut Rhinoceros Beetle

30 **Concern:** A quarantine regulation has been imposed by the Guam Department of Agriculture, which
31 prohibits transport of green waste from within a prescribed quarantine zone without inspection or
32 treatment, if necessary. The area of the quarantine zone has been extended several times since the
33 beginning of the CRB infestation. The extent of the quarantine area, set on September 24, 2010, is 28,360
34 acres (11,477 hectares). Quarantine might have slowed down the initial spread of the CRB, but there are
35 current CRB sites that are outside the quarantine area which extends north from the southern end of
36 Tumon Bay and includes Andersen AFB (Moore 2011). CRBs have been caught in traps across most of
37 Guam, NBG Main Base, north of NBG, and on Andersen South.

38 **Objective:** Early detection of the occurrence of the CRB is essential for their control and eradication.
39 There are currently 25 traps on JRM sites and biologists record detections of the CRB in support of the

1 Guam CRB Eradication Project. Currently there are no traps on Andersen AFB, and detections of CRB
2 along the southern and western boundary indicate that the beetle probably occurs on the installation.
3 Coconut palm stands around various locations in JRM will be monitored for signs of the occurrence of the
4 CRB, including visual surveys for signs of the beetle's presence and continued monitoring of baited traps.
5 If the CRB is found, coordination with the Guam Department of Agriculture will be conducted to notify
6 them of the occurrence and to coordinate management approaches. A management plan should be
7 developed to address ongoing monitoring for CRB, coordination with Guam Department of Agriculture,
8 and suppression and eradication of the beetle where it is detected.

9 All strategies described as follows for JRM will be developed and implemented in coordination with the
10 AMT.

11 **Strategies:**

- 12 1. Survey coconut palm and *Pandanus* stands in various locations in JRM for signs of the
13 occurrence of the CRB.
- 14 2. Continue to monitor traps on JRM lands and report detections of CRB to UOG and
15 USDA-APHIS. Locate additional traps on JRM sites as necessary to develop a comprehensive
16 assessment of the extent of the CRB on JRM lands.
- 17 3. If beetles are found coordinate with USDA-APHIS to determine best course of action, including
18 increased trap placement, survey for infestation, and treatment.
- 19 4. Continue monitoring CRB traps on NBG weekly and replace pheromone tablets as needed.
- 20 5. If new locations of CRB are found, coordinate with the UOG and USDA-APHIS to notify them
21 of the occurrence and to coordinate management approaches.
- 22 6. Develop a public education and awareness program to educate installation personnel, dependents,
23 and the public about natural and cultural resources on JRM sites and the impacts of nonnative and
24 invasive species, including the CRB.
- 25 7. Continue to coordinate with UOG, the Guam Invasive Species Council and USDA-APHIS for
26 monitoring of CRB, coordination with Guam Department of Agriculture, and suppression and
27 eradication of the beetle where it is detected. Update the INRMP during the annual revision to
28 reflect the current status of eradication efforts, and the extent of the occurrence of CRB on JRM
29 sites.

30 **Monitoring Criteria:** Palm stands will be monitored for signs of the presence of CRB. Coordinate with
31 UOG and USDA-APHIS to determine appropriate course of action to manage CRB on JRM lands.

32 5.9.3 ISM-3: Assessment and Treatment of Cycad Scale and Cycad Blue Butterfly

33 **Concern:** The cycad scale has destroyed in excess of 70 percent of the endemic cycads on Guam. The
34 Navy has a Cycad Collection located at the base of Mount Lasu on Tinian. In 2005, Navy Region
35 Marianas contracted surveys and collected viable seed for propagation from habitats throughout Guam.
36 More than 3,000 cycad seeds were collected, cleaned of scale insects, and the source of each seed
37 documented by individual mother-tree habitat type. Seeds were then stored over a period of 12 months,
38 and then transported to a nursery on Tinian until they reached maturity. In 2008, 1,000 of these seedlings
39 were planted in a mapped experimental design on Tinian. The plants have been monitored monthly and
40 encroaching vines and weed-like vegetation is removed. As a preventative measure, young plants are
41 sprayed twice monthly to eliminate any infestations of cycad blue butterfly larvae.

1 **Objective:** An assessment of the current status of cycad scale damage on JRM sites should be conducted.
2 Support UOG efforts in the research and control of cycad scale and other insects impacting cycads.
3 Management and control of cycad scale and other insects should be considered on an ecosystem
4 management scale. Continue to monitor and manage cycads introduced to Tinian from Guam.

5 All strategies described as follows for JRM will be developed and implemented in coordination with the
6 AMT.

7 **Strategies:**

- 8 1. Monitor cycads introduced to Tinian from Guam on a regular basis. Invasive insects, plants, and
9 vines will be removed from the cycads as appropriate using methods prescribed in either the
10 integrated pest management plan (IPMP), by UOG, or in the literature.
- 11 2. Develop and implement provisions to treat cycads (e.g., using hot water/steam) to prevent the
12 spread of contaminants to Tinian from Guam.
- 13 3. Support UOG efforts in research and control of cycad scale and other insects impacting cycads.
- 14 4. Evaluate biocontrol to determine the most effective method for controlling the insect.
- 15 5. Continue to monitor treated cycads on a regular basis and reapply the treatment if the scale insect,
16 or cycad blue butterfly larvae reappears.
- 17 6. Develop strategies that include monitoring, detection, treatment, and response and continued
18 monitoring for absence or presence.

19 **Monitoring Criteria:** Cycads will be monitored for signs of the presence of the scale insect, and cycad
20 blue butterfly larvae, and treated as appropriate. Treated cycads will be monitored on a regular basis and
21 reapplication of the treatment will occur if the scale insect reappears.

22 **5.9.4 ISM-4: Control of Feral Ungulates**

23 Past recreational hunting and depredation efforts have not resulted in adequate control of feral pigs and
24 deer on DOD properties, as evidenced by continued habitat degradation through ungulate browsing and
25 foraging activities. JRM has recently developed a JRM NBG Ungulate Management Plan and a JRM
26 Andersen AFB Ungulate Management Plan, which provide direction for management of ungulates on
27 JRM sites. These plans are included in **Appendix O**.

28 **Concern:** Control of feral ungulates in JRM is an important ongoing management issue because of the
29 extensive damage feral pigs, Philippine deer, and feral carabao cause to native ecosystems.

30 **Objective:** Follow guidelines in the NBG and Andersen AFB Ungulate Management Plans to eradicate
31 or reduce densities and to allow for natural forest regeneration.

32 All strategies described as follows for JRM will be developed and implemented in coordination with the
33 AMT.

34 **Strategies:**

- 35 1. Implement the JRM NBG Ungulate Management Plan, and the JRM Andersen AFB Ungulate
36 Management Plan (see **Appendix O**). Develop a database to monitor ungulate control techniques
37 and management. Review each management plan annually and update as necessary to ensure
38 management prescriptions within the plan are current.

- 1 2. Remove feral ungulates from special ecological areas and endangered species' habitat on JRM.
2 Coordinate with GDAWR when appropriate.
- 3 3. Continue to remove deer and pigs from the flightline area on Andersen AFB as needed and
4 monitor for deer access to the flightline.
- 5 4. Implement a study to examine home range and habitat use of ungulates on JRM lands

6 **Monitoring Criteria:** Continually evaluate the presence of feral animals on JRM. Implement strategies
7 within the JRM NBG Ungulate Management Plan and the JRM Andersen AFB Ungulate Management
8 Plan for removing feral ungulate species from JRM managed lands.

9 5.9.5 ISM-5: Construction of Ungulate Enclosures and Ungulate Removal in Areas of 10 Wildlife Habitat on Andersen AFB

11 **Concern:** Wildlife habitats on Andersen AFB are currently occupied by ungulates, feral cats, and brown
12 treesnakes, which are detrimental to the habitat viability and survival of native species. As required by
13 the Conservation Measures established in the Northwest Field Beddown Section 7 Letter, for the
14 ISR/Strike Capability BO, and the Final EA for the Beddown of Training and Support Initiatives at
15 Northwest Field, three units would be constructed at Ritidian Point enclosing approximately 628 acres
16 (254 hectares) of Primary and Secondary limestone forest. These enclosures will be located near Ritidian
17 Point.

18 **Objective:** To help improve habitat quality for all endangered native forest birds and bats on Andersen
19 AFB, including those proposed for release, ungulate removal will be conducted in areas of wildlife
20 habitat. This would reduce the key threat of habitat destruction within these areas due to overgrazing,
21 rooting, and trampling. It would also eliminate the key threat of feral pig predation on Guam rail eggs.

22 All strategies described as follows for JRM will be developed and implemented in coordination with the
23 AMT.

24 **Strategies:**

- 25 1. Begin significant reduction of ungulates in the areas of wildlife habitat both inside and outside of
26 enclosures. If not totally eradicated, ensure that populations of ungulates are reduced to levels
27 that allow for forest regeneration and self-sustaining populations of native animals, bats, or
28 nesting turtles that might inhabit these areas.
- 29 2. Manage ungulates per guidelines contained within the NBG and Andersen AFB Ungulate
30 Management Plans. [Requirement from BO]
- 31 3. Evaluate cost and feasibility of erecting and maintaining an ungulate-proof fence around
32 limestone forests within the NMS.
- 33 4. Reduce population numbers of Philippine deer, feral pigs, and carabao on JRM sites.
34 [Requirement from BO]
- 35 5. Conduct fence line reconnaissance and perform annual maintenance of enclosure areas.
36 Reconnaissance of enclosure fence lines should be conducted on a routine basis and following
37 typhoon events. [Requirement from BO]
- 38 6. Identify and prioritize areas in conjunction with the USFWS and GDAWR for the construction of
39 enclosures.

- 1 7. Record information on ungulate kills. Measurements should be obtained from carcasses. The
2 metrics should include sex, weight age determination, and fertility status. This information
3 should be made available to research specialists.
- 4 8. Begin revegetation of the areas of wildlife habitat with important forest plants immediately
5 following eradication of ungulates to ensure that noxious plant species do not reclaim these areas.
- 6 9. Continue to monitor the areas of wildlife habitat to ensure that noxious plants do not establish a
7 foothold and exclosures are effectively controlling entry of ungulates.
- 8 10. Investigate the viability of using exclosure areas for outplanting of *Serianthes nelsonii* and
9 *T. rotensis*.
- 10 11. Coordinate management activities with the appropriate cooperating resource agencies such as
11 USFWS, USDA, and GDAWR.

12 **Monitoring Criteria:** The exclosures will be continually monitored to determine if feral cats, ungulates,
13 or brown treesnakes are entering; noxious plants are becoming established; outplanting sites remain
14 viable; and exclosure conditions are suitable for release of Guam rail or Guam Micronesian kingfisher.

15 5.9.6 ISM-6: Assessment and Management of Feral Cat and Dog Populations

16 Management of feral animals is a component of pest management on JRM. Feral animals, especially feral
17 cats and dogs, pose a potential threat to public health and safety. They also pose a threat to wildlife,
18 especially federally listed species and migratory birds. Existing Navy policy included in SECNAVINST
19 6401.1A of 16 August 1994 regarding veterinary health services prohibits dogs, cats, and other privately
20 owned or stray animals from running free on military installations. The CNO issued a policy letter on
21 10 January 2002 that clarifies the application of SECNAVINST 6401-1A. An objective of the existing
22 policy is to control feral animals in a humane manner to prevent injury or disease to Navy personnel and
23 eliminate adverse impacts on native wildlife. The instruction requires Navy commands to institute
24 proactive pet management procedures to prevent establishment of free-roaming cat and dog populations.

25 **Concern:** Resident and transient feral cats and dogs pose a risk to native wildlife and threaten future
26 releases of captive-bred threatened and endangered species in JRM.

27 **Objective:** A baseline survey should be conducted to determine the population size of the feral cats and
28 dogs, and a management plan should be developed to control the population. Sterilization is not likely to
29 be an effective management measure and the plan should instead focus on trapping and a public education
30 program that focuses on not releasing pet cats or dogs, or allowing them to roam freely, and teaching
31 community members to refrain from feeding feral cats or dogs. Installation of feral cat exclosures will
32 help ensure final preparation of release areas of threatened and endangered species from captive breeding
33 programs by eliminating a potential predator of, and key threat to, the species. Installation of exclosures
34 should be coordinated with the USFWS and GDAWR.

35 All strategies described as follows for JRM will be developed and implemented in coordination with the
36 AMT.

37 **Strategies:**

- 38 1. Conduct a survey to assess the population of feral cats and dogs in JRM and identify areas of high
39 density and potential resource impacts.
- 40 2. Develop and implement a Feral Cat and Dog Management Plan. Ensure that the plan identifies
41 areas where control is needed and provide targets for control efforts in those areas. In addition,

- 1 because feral cats are known to be important predators of Mariana crows and Guam rails, the plan
2 should identify how implementation will benefit these species.
- 3 3. The use of feral cat enclosures should be examined to determine the best areas for their
4 installation and the most effective technologies to be used.
- 5 4. Install/retrofit feral cat excluding devices to the HMU brown treesnake barrier at Andersen AFB.
6 Cat enclosures should be tested and evaluated for wind-loading on the bulge barrier fence,
7 effectiveness of excluding cats, and any impact on brown treesnake deterrence of the fence before
8 being installed on the HMU. Purchase supplies and equipment necessary to implement cat
9 control in the HMU. [Requirement from BO]
- 10 5. Coordinate installation of enclosures with the USFWS and GDAWR, and monitor enclosures to
11 ensure their effectiveness.

12 **Monitoring Criteria:** Implement the Feral Cat Management Plan and continually evaluate the presence
13 of feral cat populations to determine the effectiveness of control measures.

14 5.9.7 ISM-7: Area-wide Brown Treesnake Control

15 In June 2011, an MOA on brown treesnake control was signed by the Department of Interior, USDA,
16 U.S. Department of Transportation, GovGuam, State of Hawai'i, and the CNMI. This agreement
17 facilitates implementation of the Brown Treesnake Control and Interdiction Plan.

18 In addition, several projects addressing brown treesnake control and eradication have either been initiated,
19 or are planned for future implementation on DOD lands on Guam. Examples of these projects include
20 targeted aerial application of acetaminophen, research on large-scale population suppression efforts,
21 investigating use of a protein substrate for brown treesnake attraction and as bait, and development of
22 non-prey bait for delivery of acetaminophen. A detailed description of these projects, including the
23 agency performing the project, project time frame, funding source, project location, and the project
24 purpose, can be found in **Appendix O**.

25 **Concern:** Brown treesnakes continue to pose a threat to native fauna through predation. It is also a
26 serious urban pest causing widespread power outages and concerns for human safety.

27 **Objective:** Control and reduce the brown treesnake population on JRM managed lands.

28 **Strategies:**

- 29 1. Continue brown treesnake control around Mariana swiftlet nesting and roosting caves on the
30 NMS.
- 31 2. Continue to maintain the HMU snake barrier on Andersen AFB to ensure barrier integrity in
32 preventing snake ingress (barrier inspections, barrier maintenance, and vegetation maintenance).
33 [Requirement from BO]
- 34 3. Develop and implement a strategy for the eradication of brown treesnakes from the HMU and
35 develop a monitoring protocol to determine when eradication is complete. This plan should
36 identify snake-control goals and identify areas where these efforts will occur.
- 37 4. Develop and implement a brown treesnake monitoring protocol within the HMU after snake
38 eradication is complete to detect potential snake ingress.
- 39 5. Upgrade the HMU chain-link mesh barrier to an all-concrete brown treesnake barrier as funding
40 becomes available. [Requirement from BO]

- 1 6. Monitor and implement control BMPs for nonnative rodent populations in areas where brown
2 treesnake populations have been reduced through trapping and other control measures per
3 requirements in the JGPO BO. [Requirement from BO]
- 4 7. Secure funding for applied research efforts by USDA-NWRC. The applied research efforts will
5 focus on: 1) developing aerial broadcast techniques of toxicants; 2) development of artificial lures
6 and attractants for brown treesnake toxicants; and 3) development of more cost-effective
7 strategies to control or eliminate brown treesnakes in field situations. [Requirement from BO]
- 8 8. Continue to cooperate and coordinate with USFWS, GDAWR, USGS-BRD, USDA-WS, and
9 USDA-NWRC in snake control efforts.. [Requirement from BO]

10 **Monitoring Criteria:** Continue to monitor the effectiveness of snake-control methods. Continue to
11 inspect the HMU to reduce the risk of brown treesnake ingress or breaches. Implement brown treesnake
12 monitoring protocol after eradication is complete.

13 5.10 Watershed Management

14 Watershed management is important to natural resources management because it directly affects both
15 surface water and groundwater quality and is critical to maintain valuable aquatic habitats, including
16 downstream marine resources and coral reefs. The watershed protection management objectives and
17 strategies presented in this INRMP are designed to reduce or control nutrient and sediment inputs. In
18 addition, JRM natural resources staff seek to minimize nonpoint source pollution of both surface and
19 groundwater on Guam. However, to manage watersheds effectively on JRM sites on Guam, natural
20 resources staff must understand ecosystem dynamics within the watershed in an effort to prevent or
21 respond to threats to its integrity. A summary of the watershed management goals is presented in
22 **Table 5-11.**

23 **Table 5-11. Summary of Watershed Management Goals**

Watershed Management Goals
<ul style="list-style-type: none"> • Gain an understanding of ecosystem dynamics within the watershed in an effort to prevent and respond to threats to its integrity. • Maintain healthy and stable soils, rehabilitate damaged areas to reduce soil and sediment erosion inputs into the watershed that degrade water quality. • Minimize nonpoint source pollution of both surface and groundwater in the watershed through the implementation of BMPs. • Manage watersheds to maintain natural hydrology.

24 Management Strategy

25 In addition, several topics of concern have been identified. The following watershed topics of concern,
26 objectives, and strategies are designed to meet the watershed management goals of this INRMP.

27 5.10.1 WP-1: Erosion and Sedimentation from Land-Disturbing Activities

28 Healthy, stable soils are the foundation of a healthy ecosystem. As soils lose their structure and begin to
29 erode, other systems also begin to fail. Vegetation and wildlife decline in numbers and diversity, and the
30 quality of surface water declines as it becomes loaded with eroded sediments. Some soil types, such as
31 those found on Guam, took centuries to develop and are not easily replaced or repaired if lost or damaged.

1 The fragile nature of these soils makes the protection of soils vital for maintaining many of the systems
2 that make up a healthy ecosystem.

3 OPNAVINST 5090.1C CH-1 requires that installation sources of dust, runoff, silt, and erosion debris be
4 controlled to prevent damage to land, water resources, equipment, and facilities, including adjacent
5 properties. An erosion-and-sediment-control plan must be implemented where appropriate. Maintenance
6 of vegetative cover is consistent with ecosystem management goals expressed earlier. Other materials
7 can be used including gravel, fabrics, riprap, and recycled concrete and pavement that are
8 environmentally safe and compatible with the site. Where bare ground is necessary, other measures for
9 dust, sedimentation, and erosion control should be implemented (e.g., check dams, wind breaks,
10 diversions). To minimize land maintenance expenditures and help ensure environmental compliance,
11 physically intensive activities should be located on those areas least susceptible to erosion. The erosion
12 potential of a site and adjacent water resources need to be identified and analyzed in preparing
13 development, training, and land use plans.

14 **Concern:** Land-disturbing activities on JRM sites could cause erosion and sedimentation. Erosion- and
15 sedimentation-control measures are needed to reduce blockage in the associated pipes and ditches.
16 Disturbed areas can also require additional erosion- and sedimentation-control measures.

17 **Objective:** Protect soils by maintaining stable soils and reducing runoff, erosion, and gully formation.

18 Reduce erosion and sedimentation through the development of an Erosion and Sedimentation Control
19 Plan and the implementation of BMPs and calculated management activities that reduce sediment inputs
20 into the watershed.

21 All strategies described as follows for JRM will be developed and implemented in coordination with the
22 AMT.

23 **Strategies:**

- 24 1. Monitor and rehabilitate degraded soil resources. Soil resources will be monitored, evaluated,
25 and rehabilitated. Survey results will be analyzed to assist with identification of degraded soils or
26 eroded areas.
- 27 2. Develop and implement erosion-control BMPs to prevent and repair eroded areas on JRM sites
28 (e.g., planting acacia and vetiver to control erosion in eroded areas). Periodically review
29 erosion-control BMPs to ensure that they are still adequate to control erosion and sedimentation
30 on JRM sites. Conduct surveys to determine whether activities on JRM sites are adversely
31 impacting soil and water resources as a result of erosion and sedimentation.
- 32 3. Implement watershed and erosion control management plans developed for JRM. Annually
33 review plans to ensure guidelines are still effective and revise plans as necessary.
- 34 4. Develop erosion and sedimentation BMPs, then disseminate informational materials and conduct
35 a short seminar on the erosion-control BMPs and watershed-protection issues for personnel
36 (e.g., contractors) who are likely to impact the watersheds.
- 37 5. Implement the 2009 Wildland Fire Management Plan for JRM.
- 38 6. Continue efforts to identify and protect all aquifer recharge zones on JRM.
- 39 7. Continue to plant trees and vetiver grass in eroded or savanna habitat to reduce erosion and
40 suppress fires.
- 41 8. Protect vegetation in primary aquifer recharge areas and revegetate exposed soils using suitable
42 species.

- 1 9. Conduct water resources monitoring that assesses water quality at in-flow and out-flow points of
2 rivers and streams on the JRM sites.
- 3 10. Ensure that monitoring requirements, BMPs, and water quality parameter limits, as required by
4 the NPDES storm water permits for JRM sites, are met.
- 5 11. Maintain accurate, usable, and informative GIS data for ease in management planning and
6 documentation

7 **Monitoring Criteria:** Ensure that the BMPs are followed by inspecting construction sites and
8 problematic areas periodically on JRM sites. Also, ensure that baseline water quality data collected as
9 part of NPDES storm water monitoring show no net increase in nutrient and sediment loading in outfalls
10 from JRM sites. Continue to coordinate with USDA-NRCS, GDAWR, CNMI DLNR, and UOG to assist
11 in the management of sedimentation and erosion issues on JRM without compromising the mission.

12 5.10.2 WP-2: Exposed Soils

13 JRM has been implementing studies and projects since the early 1990s to determine the best methods for
14 restoring vegetation on eroded sites on JRM. Planning guidance to reduce soil erosion was developed by
15 NRCS for the Pacific Basin Area in July 2004. In response, the Fena Ordnance Annex Conservation Plan
16 was developed to provide guidance for reducing impacts on the Fena watershed resulting from DOD
17 activities. Since then, 41 acres (16.6 hectares) of paspalum and vetiver grasses have been planted on the
18 bare eroding sites on JRM, and 80 acres (32.4 hectares) of acacia tree seedlings have been planted in the
19 savanna grasslands establishing shaded fuel breaks to prevent wildland fire. In addition, these plantings
20 have reduced erosion and sedimentation entering the watershed and nearby coral reef ecosystems.

21 **Concern:** Areas on JRM might have exposed soils, which could impact onsite and offsite water quality.

22 **Objective:** Revegetate areas of exposed soil with suitable ground cover, native species when feasible,
23 and suitable nonnative species like vetiver and acacia in a manner consistent with natural resources
24 management guidelines included in this INRMP.

25 All strategies described as follows for JRM will be developed and implemented in coordination with the
26 AMT.

27 **Strategies:**

- 28 1. Prioritize areas of exposed soil for revegetation based on surveys.
- 29 2. Identify native flora to be used in revegetation efforts as part of a SOP. This SOP should also
30 include prescriptions for techniques and monitoring to ensure revegetation is successful.
- 31 3. Revegetate exposed soils with assistance from local USDA, NRCS, and USFWS personnel.

32 **Monitoring Criteria:** Periodically examine the revegetation sites in accordance with the SOP to
33 determine if the restoration effort is producing the desired results, and continue to implement BMPs based
34 on monitoring.

35 5.11 Developed Land Management

36 Environmentally and economically beneficial landscaping practices can reduce maintenance costs while
37 also providing wildlife habitat. Planting windbreaks around buildings and parking areas, and reducing
38 mowing are ways to spend dollars more wisely, educate the public about the benefits of reduced
39 maintenance, and become better stewards of the environment. In managing natural resources, JRM site

1 personnel acknowledge their responsibilities as listed in the White House Memorandum, *Environmentally*
2 *and Economically Beneficial Practices on Federal Landscaped Grounds* (1994). The memorandum's
3 requirements include the following:

- 4 1. Using regionally native plants for landscaping.
- 5 2. Using construction practices that minimize adverse effects on the natural habitat.
- 6 3. Reduce pollution by reducing the use of fertilizer and pesticides, using IPM, recycling green
7 waste, and minimizing runoff.
- 8 4. Implementing water-efficient practices.
- 9 5. Creating demonstrations of these practices to promote their use elsewhere.

10 Contracted grounds maintenance personnel perform most grounds maintenance activities at JRM sites.
11 Normal grounds maintenance operations are focused on lawn care, drainage ditch maintenance, road and
12 runway maintenance, airfield management, landscaping maintenance, and pest management.

13 Grounds maintenance requires a variety of chemicals including pesticides, herbicides, fungicides,
14 cleaning agents, oils, fuels, solvents, and paints. The use of chemicals for grounds maintenance should be
15 optimized because of the need to protect wildlife species that occur on Guam. Guidance on the grounds
16 maintenance program is contained in the JRM site IPMP, or site-specific Spill Prevention Control and
17 Countermeasures (SPCC) plans.

18 An integrated grounds maintenance program requires periodic review and upgrading of maintenance
19 practices. Maintenance practices that ensure plants are healthy will reduce the need for intensive
20 chemical treatments. Current maintenance practices should be reviewed to ensure that fertilizer, watering,
21 and pesticide application rates are optimal. Local specialists should be consulted when problems are
22 encountered.

23 Native plants are best adapted for existing climatic and soil conditions and the use of potentially invasive
24 plants should be avoided and eliminated. The list of approved plants in the Guam Landscaping Guide
25 should be used to determine suitable plants to be included in JRM site plans. This will reduce
26 maintenance costs while enhancing the appearance of JRM sites.

27 Management Strategy

28 In the process of identifying grounds-maintenance strategies, a list of goals (see **Table 5-12**) was
29 generated that was used to create ecologically sustainable management objectives.

1

Table 5-12. Summary of Land Management Goals

Land Management Goals	
	<ul style="list-style-type: none"> • Lessen or avoid adverse effects from grounds-maintenance activities to the overall ecosystem and its sensitive resources. • Make maximum use of regionally native plant species and avoid introduction of invasive, exotic species in revegetation activities. • Reduce chemical usage, and maintenance inputs in terms of energy, water, manpower, equipment, and chemicals. • Ensure compliance with environmental legislation, regulations, and guidelines. • Control pests and invasive species. • Ensure the orderly and scientific management of the urban trees on JRM to the extent compatible and consistent with the mission.

2 Objectives, strategies, and monitoring criteria designed to address specific management issues on JRM
3 sites are presented below.

4 **5.11.1 LM-1: Develop and Implement an Integrated Grounds Maintenance Plans for NBG**
5 **and Andersen AFB**

6 **Concern:** An integrated grounds maintenance plan is important to minimize cost, protect the
7 environment (particularly the sole-source aquifer and threatened and endangered species), and support the
8 military mission.

9 **Objective:** Develop and implement an integrated grounds maintenance plan that minimizes cost, protects
10 the environment (particularly the sole-source aquifer and threatened and endangered species), and is
11 compatible with the military mission.

12 All strategies described as follows for JRM will be developed and implemented in coordination with the
13 AMT.

14 **Strategies:**

15 1. Maintain or convert as much improved grounds to semi-improved acreage as possible by
16 reviewing grounds maintenance areas, evaluating grounds maintenance requirements, and
17 adjusting grounds maintenance maps as needed. Parcels should be chosen based on their current
18 cover type, slope, and aspect to ensure that healthy grounds can subsist with minimal physical
19 manipulation to the site. Converted improved grounds will be managed as semi-improved
20 grounds.

21 2. Provide landscaping that is functional in nature, simple and informal in design, compatible with
22 adjacent surroundings, and complementary to the overall tropical setting of JRM.

23 3. Protect native wildlife and their habitat as follows:

24 a. Ensure grounds-maintenance and landscaping projects are coordinated with other natural
25 resources programs including the protection of threatened and endangered species, the BASH
26 program, IPM, and the Cultural Resources Management Program.

- 1 b. Continue to coordinate with JRM site natural resources staff to reduce or avoid disturbing
2 threatened and endangered species, or migratory birds during routine or special grounds
3 maintenance projects by rescheduling or redirecting work to avoid excessive disturbance to
4 species and by developing a sign program.
- 5 c. Provide training to JRM site staff and contractors on the natural history and natural and
6 cultural resources concerns at JRM sites, advising staff of responsibilities for wildlife
7 protection, and assisting with the development of posters or brochures to aid in staff
8 awareness of environmental concerns.
- 9 d. Ensure the GIS database is current and includes grounds management units.

10 **Monitoring Criteria:** Periodically investigate areas converted to semi-improved acreage to assess the
11 effects of the conversions on the military mission and the health and viability of the native vegetation.
12 Evaluate the cost saving associated with conversions.

13 5.11.2 LM-2: Use of Native Species for Revegetation and Landscaping Activities

14 The Guam Landscaping Guide includes the following guidance for landscaping activities at JRM sites:

- 15 1. Ensure use of at least 50 percent native species for all landscaping projects.
- 16 2. Ensure at least 50 percent of the plants used are native species when existing landscape plants
17 need to be replaced.
- 18 3. Implement a strategy of clumping several individual plants together whenever possible to
19 increase potential for survival of plants during typhoons.
- 20 4. When possible, schedule planting to occur during the wet season between June and September to
21 allow plants to become established before the dry season in January and May.

22 **Concern:** Nonnative and invasive species can be introduced to JRM sites during revegetation efforts and
23 landscaping activities.

24 **Objective:** Maintain an aesthetically pleasing landscape on JRM sites that preserves natural ecosystem
25 functions, conserves water in landscaped areas, and promotes pollinator species.

26 All strategies described as follows for JRM will be developed and implemented in coordination with the
27 AMT.

28 **Strategies:**

- 29 1. Continue to revegetate exposed soils after ground-disturbing activities are conducted. In some
30 situations, non-native species will have to be used to provide nutrients to the soil at some JRM
31 sites (e.g., NMS) before native species are planted. Areas where non-native vegetation was used
32 will be replaced in 5 to 10 years with native vegetation.
- 33 2. Implement recommendations within the Guam Landscaping Guidelines (see **Appendix P**).
- 34 3. Ensure that regionally native species are selected for landscape plantings in accordance with
35 EO 13148 and JRM site design standards.
- 36 4. Ensure that all plants are inspected at source to ensure pest-free status (e.g., little fire ants) or
37 apply a pre-treatment pesticide before planting.

1 5. Provide professional advice to assist the grounds landscaping and maintenance program in the use
2 of native species.

3 6. Ensure that plant material (including that which is contract grown and plant parts used for plant
4 creation such as propagules) used for revegetation and landscaping activities come from local
5 sources and is not introduced from other islands, or locations to retain the genetic specificity of
6 native species at a local level.

7 **Monitoring Criteria:** JRM site natural resources management staff will monitor the use and success of
8 native species to rehabilitate exposed soils and the use of regionally native species for landscape
9 plantings.

10 5.11.3 LM-3: Need for Control of Invasive Vegetation

11 **Objective:** Develop and adopt proactive management measures to prevent the spread of invasive and
12 nonnative vegetation from landscaping activities.

13 All strategies described as follows for JRM will be developed and implemented in coordination with the
14 AMT.

15 **Strategies:**

16 1. Develop and implement BMPs to prevent the spread of invasive and nonnative species into other
17 habitats adjacent to landscaped area.

18 2. For landscaping, use plants within the Guam Landscaping Guidelines.

19 **Monitoring Criteria:** Monitor landscaped areas where invasive plant species are known to occur and
20 where management measures have been implemented. Survey landscaped areas for the emergence of
21 invasive, exotic species and implement control measures as necessary.

22 5.11.4 LM-4: Implementation of the Pest Management Plan

23 Pest management objectives at JRM sites include the protection of real estate, control of potential disease
24 vectors or animals of other medical importance, control of undesirable or nuisance plants and animals
25 (including insects), and prevention of damage to natural resources. Two pest management plans have
26 been developed for JRM sites, one for NBG that is in draft form as of July 2011, and one for Andersen
27 AFB that was completed in 2009. Authority for pest management activities on JRM is directed under the
28 Federal Insecticide, Fungicide and Rodenticide Act as amended (7 U.S.C. 136r-1), DOD Instruction
29 4150.07, OPNAVINST 6250.4 series and OPNAVINST 5090.1C, Chapter 17, and AFI 32-1053, Pest
30 Management Program.

31 **Objective:** Continue to implement the IPMP and ensure compliance with environmental legislation,
32 regulations, and guidelines.

33 All strategies described as follows for JRM will be developed and implemented in coordination with the
34 AMT.

35 **Strategies:**

36 1. IPM should use chemical, mechanical, physical, biological, and educational methods to maintain
37 pests at populations low enough to prevent undesirable damage or annoyance.

- 1 2. Continue implementation of the IPMP at JRM sites.
- 2 3. Methods that can be used to prevent the destruction of structures at JRM sites include the
- 3 following:
- 4 a. Prevent the entry of pests into buildings by closing holes, cracks, and crevices.
- 5 b. Incorporate the latest barrier type technologies to minimize insect damage and chemical use.
- 6 c. Apply poison to eliminate rodents that have established themselves in building interiors.
- 7 d. Capture animals that pose a threat to building or infrastructure integrity for release or
- 8 euthanasia. If released, these animals will be placed at a distance great enough from the
- 9 improved areas of the site to prevent their reoccurrence.
- 10 4. Management measures to control pests posing a potential threat to human health include the
- 11 following:
- 12 a. Ensure proper sanitation and housekeeping to remove any food sources that might be
- 13 attractive to interior pests (e.g., cockroaches, ants, flies).
- 14 b. Remove the excrement of birds from underneath roosts on buildings and facilities to prevent
- 15 the growth of harmful bacteria.
- 16 c. Eliminate artificial breeding and larval habitat for flies and mosquitoes.
- 17 d. Control mosquitoes, ants, termites, and other large insect infestations.
- 18 5. General management measures that should be used to control nuisance pests include the
- 19 following:
- 20 a. Capturing individual large animals for removal or euthanasia.
- 21 b. Using snap traps and glue boards to trap rodents.
- 22 6. The IPMP should be reviewed and updated every 5 years to ensure that it reflects changes in pest
- 23 populations and current management issues.

24 **Monitoring Criteria:** Monitor pest and invasive species populations. Track use of active ingredients
25 and man-hours spent controlling pest and invasive species during implementation to ensure that the
26 management strategies are sufficient.

27 5.12 Coastal Zone Management Act Compliance

28 The Coastal Zone Management Act (CZMA) (U.S.C. Title 16, Chapter 33) defines the coastal zone of a
29 given area as “the coastal waters (including the lands therein and there under) and the adjacent shorelands
30 (including the waters therein and there under) strongly influenced by each other and in proximity to the
31 shorelines of the several coastal states and territories, and includes islands, traditional and intertidal areas,
32 salt marshes, wetlands and beaches” (U.S.C. Title 16, Chap. 33). Coastal zones are important to natural
33 functions because of the diversity of biological and hydrological interactions which occur in them. These
34 include water and land forms interacting as integrated ecological units; and interactions between estuaries,
35 brackish and saline water, shorelands, offshore islands, and freshwater wetlands within estuarine
36 drainages. These interrelated features are crucial to coastal fish and wildlife and their habitats and to
37 coastal waters in general.

38 The entire Island of Guam is designated as coastal zone. The CZMA was enacted to “preserve, protect
39 and where possible, to restore or enhance, the resources of the Nation’s coastal zone for this and
40 succeeding generations” (U.S.C. Title 16, Chapter 33). One of the main provisions of the Act is to

1 manage coastal development to minimize the loss of life and property caused by improper development in
 2 flood-prone, storm surge, geological hazard, and erosion-prone areas; in areas likely to be affected by or
 3 vulnerable to sea level rise, land subsidence, and saltwater intrusion; and by the destruction of natural
 4 protective features such as beaches, dunes, wetlands, and barrier islands (U.S.C. Title 16, Chapter 33). In
 5 doing so, the CZMA encourages the states and territories to exercise their full authority over the lands and
 6 waters in the coastal zone by assisting them in cooperation with Federal and local governments and other
 7 vitally affected interests, in developing land and water use programs for the coastal zone. These include
 8 unifying policies, criteria, standards, methods, and processes for dealing with land and water use
 9 decisions of more than local significance (U.S.C. Title 16, Chapter 33).

10 GovGuam implements the requirements of the CZMA through the *Organic Act of Guam of 1950, as*
 11 *amended, 64 Stat. 384* (48 U.S.C. § 1421, et seq.). This Act specifies that the Governor shall be
 12 responsible for executing the laws of Guam and applicable U.S. laws in Guam.

13 Coastal issues overlap with management issues and concerns for outdoor recreation and public access.
 14 Coastal areas at JRM support significant biological resources in a relatively undisturbed condition
 15 including native limestone cliffs and forests, native coastal plain forests, coastal strand vegetation,
 16 beaches, and the marine environment. The coastal areas provide habitat for the endangered Mariana fruit
 17 bat, nesting habitat for threatened and endangered sea turtles, and foraging areas for a variety of native
 18 shorebirds. Offshore, a rich and diverse marine ecosystem supports threatened and endangered sea
 19 turtles, marine mammals, and a variety of seabirds and shorebirds. Risk Assessment procedures ensure
 20 that coastal resources will be protected by ensuring consideration early in the planning stages, and
 21 through proper coordination with the appropriate agencies.

22 Management Strategy

23 A summary of the CZMA compliance goals is presented in **Table 5-13**.

24 **Table 5-13. Summary of Coastal Zone Management Act Compliance Goals**

Coastal Zone Management Act Compliance Goals	
<ul style="list-style-type: none"> • Collaborate with Federal agencies, GovGuam, and local interests in preserving the marine environment through unifying policies, criteria, standards, methods, and processes for dealing with land and water use decisions of more than local significance. • Ensure that the future maintenance of JRM's coastal zone resources is performed in a manner that supports shoreline stabilization and the reduction of erosion and sedimentation into marine environments without compromising the military mission. • Ensure that future maintenance of JRM's coastal zone resources is performed in a manner that supports the diverse biological and hydrological functions unique and significant to coastal zones. 	

25 5.12.1 CZ-1: Protection, Maintenance, and Enhancement of Natural Resources in Coastal 26 Zones

27 **Concern:** Coastal areas of JRM are important to the health of the endangered Mariana fruit bat, nesting
 28 habitat for threatened and endangered sea turtles, and foraging areas for a variety of native shorebirds.
 29 Offshore, a rich and diverse marine ecosystem supports threatened and endangered sea turtles, marine
 30 mammals, and a variety of seabirds and shorebirds.

1 **Objective:** Continue to protect, maintain, and enhance natural resources in the coastal zone of JRM in a
2 manner consistent with the CZMA.

3 All strategies described as follows for JRM will be developed and implemented in coordination with the
4 AMT.

5 **Strategies:**

- 6 1. Ensure activities in the coastal zone have obtained Federal Consistency Review.
- 7 2. Ensure that human activities in the coastal zone do not affect coastal zone resources by:
 - 8 i. Minimizing future lighting in the beach areas and adjust existing lights to prevent disturbance
9 to threatened and endangered nesting sea turtles.
 - 10 ii. Limiting development in the shoreline areas to perpetuate their natural and scenic values.
 - 11 iii. Continue to inform the public about the regulations regarding protection of coastal resources.
- 12 3. Review the status of actions prescribed under CZ-1 at the annual INRMP review meeting.
13 Initiate actions based on the review to ensure that actions are, or will be, implemented as
14 prescribed pending available funding.

15 **Monitoring Criteria:** Continue to ensure that proposed development activities have obtained Federal
16 Consistency Review, human activities in the coastal zone are not adversely affecting the coastal and
17 marine environment, and regulations are being enforced. Continue to inform, educate, and provide
18 opportunities for the public with respect to the coastal zone.

19 **5.13 Wildland Fire Management**

20 Federal wildland fire policy requires that all Federal lands with burnable vegetation have a fire plan and
21 resources to safely mitigate losses. This policy was adopted by the DOD Wildland Fire Policy Working
22 Group in 1996. DOD fire policy was developed by DOD Instruction 6055.06 Fire and Emergency
23 Services Program.

24 This is of particular concern because of the safety and mission-related consequences that could occur if
25 wildland fires were to damage the Fuel Farm or ordnance-storage facilities. Although these dangers exist,
26 wildland fire management has been limited to the construction and maintenance of fuel breaks, mowing
27 and trimming grass, and the suppression of the smaller fires that are accessible to fire engines and larger
28 fires encroaching into the wildland-urban interface. Helicopters have been used periodically, but
29 infrequently, on problem fires. Recently the Navy identified the need for a more comprehensive wildland
30 fire management program and is in the process of developing a Wildland Fire Management Plan for JRM.

31 **Threats**

- 32 1. Erosion and sedimentation.
- 33 2. Loss of native habitat.
- 34 3. Increased opportunity for invasive species.
- 35 4. Safety and security within the Sasa Valley and Tenjo Vista fuel farms.

1 Management Strategy

2 **Table 5-14** identifies the wildland fire goal for this INRMP.

3 **Table 5-14. Summary of Wildland Fire Management Goals**

Wildland Fire Management Goals
<ul style="list-style-type: none"> • Support a Wildland Fire Management Program to protect high-value natural resources areas and operational facilities from catastrophic wildfire while conserving resources and military operational flexibility.

4 **5.13.1 WFM-1: Managing for Wildland Fire on JRM**

5 **Objective:** Update and implement a Wildland Fire Management Program for JRM and ensure it is
6 compliant with DOD Instruction 6055.06, meets the goals and objectives of this INRMP, and is
7 compatible with the mission.

8 All strategies described as follows for JRM will be developed and implemented in coordination with the
9 AMT.

10 **Strategies:**

- 11 1. Continue revegetation of badlands within the NMS.
- 12 2. Follow and implement all goals and objectives within the Wildland Fire Management Plan.
13 Review and update the Wildland Fire Management Plan according to DOD Instruction 6055.06.
- 14 3. Implement all erosion conservation strategies contained within JRM site conservation plans, and
15 wildland fire management assessment for Fena Reservoir watershed, and the NMS. Implement
16 recommendations identified in Wildland Fire Management Assessment and Fena Ordnance Site
17 Conservation Plan, including critical area plantings of eroding sites, changing of forest fuel
18 characteristics through establishing green forests for fuel breaks, and other soil and water
19 conservation measures.
- 20 4. Determine areas on JRM sites that are susceptible to wildland fire, and continue to establish
21 greenbelts to reduce spread of savanna grassland fires on JRM sites.
- 22 5. Develop and implement a Wildland Fire Management Plan for Tinian to control wildfire at
23 Tinian's MLA.

24 **5.14 Urban Forestry Management**

25 Andersen AFB has made a considerable investment in beautifying the installation by planting ornamental
26 trees throughout improved areas, and by conservation planting in other areas. Andersen AFB possesses a
27 significant urban forestry resource that must be managed properly. No commercial forestry resources are
28 present on Andersen AFB. Native forest trees that were once considered important timber species do
29 occur in limestone forests at Andersen AFB. However, these areas are currently managed as habitat for
30 threatened and endangered species and to preserve native biodiversity.

1 Management Strategy

2 **Table 5-15** identifies the urban forestry goal for this INRMP.

3 **Table 5-15. Summary of Urban and Commercial Forestry Management Goals**

Urban and Commercial Forestry Management Goals
<ul style="list-style-type: none"> • Ensure the orderly and scientific management of the urban trees on JRM sites to the extent compatible and consistent with the mission. • Promote use of native plants in landscaping where applicable. Replace any trees removed from landscaped areas with native trees.

4 5.14.1 FOR-1: Management of Andersen AFB Urban Forest Resources

5 Urban areas on Andersen AFB and other JRM sites are managed primarily for aesthetics, recreation, and
6 compatible wildlife preservation; and for visual and noise-buffering capacity. Urban forest management
7 is accomplished largely by removal of trees that are dead, dying, diseased, or damaged; or that pose safety
8 hazards, and by occasional brush removal. Trees used for urban planting should be native to the region
9 and require minimal amounts of maintenance.

10 **Concern:** Andersen AFB and other JRM sites have urban forestry resources that require continuous
11 management.

12 **Objective:** Ensure that management of urban trees on JRM sites is compatible with the goals and
13 objectives within this INRMP.

14 All strategies described as follows for JRM will be developed and implemented in coordination with the
15 AMT.

16 **Strategies:**

- 17 1. Continue to implement the integrated grounds maintenance program to minimize the amounts of
18 chemicals and water needed to maintain grounds and landscaped areas in healthy and attractive
19 conditions. Collaborate with technical specialists from local agencies to develop an Urban
20 Forestry Plan for JRM that includes specifications for soil types, planting requirements, watering
21 and fertilizer regimens, pest control, disease treatments, and other maintenance practices.
- 22 2. Develop and maintain an urban forestry database to catalogue existing trees and provide a
23 schedule for their maintenance. Such a database will be useful in assessing the diversity of urban
24 tree species and to gauge the selection of species for future plantings.
- 25 3. Continue to manage urban forest resources for disease, damage, and replacement.
- 26 4. Plant native trees along the cliff tops to provide native seed rain for passive native forest
27 recovery.
- 28 5. Review the status of actions prescribed under FOR-1 at the annual INRMP review meeting.
29 Initiate actions based on the review to ensure that actions are, or will be, implemented as
30 prescribed pending available funding.

1 **Monitoring Criteria:** Ensure that urban forest resources are managed in accordance with the goal
 2 established in this section. Specific changes to management of urban tree species should be based on
 3 annual recommendations made by a consulting arborist/urban forester.

4 5.15 Law Enforcement

5 JRM has established the following objectives for enforcement: (1) enforce laws and regulations pertaining
 6 to the implementation of the natural resources program, (2) integrate natural resources enforcement into
 7 the overall natural resources program, and (3) use enforcement personnel to enhance the natural resources
 8 program at JRM.

9 Threats

- 10 1. Harvesting of marine and terrestrial species.
- 11 2. Illegal or unsustainable harvesting of marine and terrestrial species.
- 12 3. Destruction of habitat.

13 Management Strategy

14 A summary of the law enforcement goals is provided in **Table 5-16**.

15 **Table 5-16. Summary of Natural Resources Law Enforcement Goals**

Natural Resources Law Enforcement Goals
<ul style="list-style-type: none"> • Ensure compliance with Guam and Federal natural resources laws and regulations. • Provide training to personnel responsible for enforcement of applicable laws and regulations. • Secure and sustain dedicated conservation law enforcement personnel. • Ensure the community is aware of Guam and Federal natural resources laws and regulations, and the responsibilities of law enforcement personnel.

16 **Objective:** Ensure compliance with Guam, Federal, and JRM natural resources laws and regulations.

17 **Strategies:**

- 18 1. Provide training to personnel responsible for enforcement of applicable laws and regulations.
- 19 2. Continue to protect rare, threatened, endangered, and species of concern and natural communities.
- 20 3. Cooperate with other agencies, particularly the USFWS and GDAWR, to ensure that natural
 21 resources laws are adequately enforced.
- 22 4. Establish and fill at least two conservation officer positions to patrol JRM sites (terrestrial and
 23 submerged lands) and enforce natural resources regulations (i.e., hunting, fishing).
- 24 5. Periodically review Federal and Guam laws and regulations to ensure natural resources laws and
 25 regulations are adequately enforced.

1 5.16 Outdoor Recreation Management

2 It is the policy of DOD to make lands accessible to the public for educational or recreational use of
 3 natural and cultural resources when such access is compatible with military mission activities; ecosystem
 4 sustainability; and other considerations such as security, safety, and fiscal soundness. Also, section 2904
 5 of the SAIA states that each INRMP shall provide, to the extent appropriate, for the “sustainable use by
 6 the public of natural resources to the extent that the use is not inconsistent with the needs of fish and
 7 wildlife resources” and “subject to requirements necessary to ensure safety and military security.”

8 Public access for recreational use of natural resources on JRM has varied over time and has included the
 9 following:

- 10 • Access to beaches and coastal areas for swimming, beachcombing, fishing, trapping, boating, bird
 11 watching, snorkeling, and SCUBA diving.
- 12 • Access to NMS, Fena Reservoir, HERA, OPERA, Tarague Basin, and Pati Point natural areas.
- 13 • Access to NBG TS and Andersen AFB for Philippine deer and feral pig hunting.
- 14 • Access to undeveloped lands for nature hiking, gathering of medicinal plants, and subsistence
 15 collection of forest fruits and seeds.
- 16 • Access to inland waters and coastal areas for kayaking, sailing, and boating.

17 Outdoor recreation includes activities to maintain morale, and these activities are available to DOD
 18 personnel, civilians, and their guests. Outdoor recreation programs ensure that DOD personnel, civilians,
 19 and their guests are properly educated on the natural resources of Guam, the concerns and threats to those
 20 resources, and good stewardship practices to ensure that resources are maintained.

21 Threats

- 22 1. Harvesting of marine and terrestrial resources.
- 23 2. Illegal or unsustainable harvesting of marine resources.
- 24 3. Anchoring on reefs for recreational diving or fishing.
- 25 4. Lack of conservation enforcement.
- 26 5. Lack of public education.
- 27 6. Other anthropogenic impacts.

28 Management Strategy

29 A summary of the goals used for managing outdoor recreation resources is provided in **Table 5-17**.

30 **Table 5-17. Summary of Outdoor Recreation/Public Access Management Goals**

Outdoor Recreation Management Goals
<ul style="list-style-type: none"> • Provide quality outdoor recreation experiences while sustaining ecosystem integrity. • Ensure that outdoor recreation activities are not in conflict with mission priorities or natural resources management objectives. • Ensure recreational activities comply with Federal and local laws and installation instructions.

1 The following are natural resources management issues and concerns that need to be addressed to
2 maximize positive benefits of outdoor recreation programs and minimize potential adverse impacts on the
3 environment.

4 5.16.1 OR-1. Coordination of Outdoor Recreation Programs at JRM

5 **Concern:** Outdoor recreation programs need to be coordinated with appropriate personnel to ensure that
6 there will be no adverse impacts on wildlife, important wildlife habitat, or the mission.

7 **Objective:** Provide quality outdoor recreation experiences while sustaining ecosystem integrity and not
8 conflicting with mission priorities.

9 All strategies described as follows for JRM will be developed and implemented in coordination with the
10 AMT.

11 **Strategies:**

- 12 1. Continue to limit public access and outdoor recreation for reasons that include general security
13 and liability issues, the presence of federally endangered and threatened species, and safety.
- 14 2. Remain in compliance with the requirements associated with the provisions of the American with
15 Disabilities Act of 1990, as amended and the Disabled Sportsman Access Act, as amended.
- 16 3. Identify and evaluate suitable outdoor recreation opportunities for JRM personnel in undeveloped
17 areas that do not contain or have the potential to impact sensitive species.
- 18 4. Develop outreach and education materials to inform recreational users about sensitive and
19 protected marine resources. Distribute information in welcome aboard packages; through
20 required training or certification programs (e.g., for MWR dive gear and boat rentals); and
21 through signage at JRM recreational beaches, marinas, and boat ramps. [Requirement from BO]
- 22 5. Collaborate with local dive shops to educate dive operators on low-impact diving activities and
23 implement “reef friendly” diving practices.
- 24 6. Collaborate with GDAWR to conduct Limit of Acceptable Change process for marine
25 recreational activities.
- 26 7. Continue to ensure effective communication between the planners and recreational planners and
27 users to protect natural resources through full consideration early in the planning process and
28 through consultation to reduce or avoid adverse impacts on wildlife and their habitat in ERAs as
29 follows:
 - 30 a. Coordinate new recreation programs and projects with the appropriate personnel (e.g.,
31 Environmental Flight at Andersen AFB, and NBG).
 - 32 b. Continue to evaluate the need for and environmental impact of proposed recreational
33 activities and provide recommendations to minimize impacts on the coastal environment.

34 **Monitoring Criteria:** Continue coordination to protect habitat and the integrity of the coastal
35 environment.

36 5.16.2 OR-2. Minimizing Human Disturbance to Threatened and Endangered Species

37 Proposed recreational development projects should be coordinated with GDAWR and the USFWS when
38 these projects are in close proximity to habitats of threatened and endangered species.

1 **Concern:** Noise from jet skies, bands, boom boxes, recreational hunting and the human disturbance
2 inherent in large crowds could have an adverse impact on wildlife at the HERA, OPERA, Spanish Steps,
3 Gab Gab Beach, San Luis Beach, Tarague Basin, and other JRM sites.

4 **Objective:** Prevent human disturbance of threatened and endangered species.

5 All strategies described as follows for JRM will be developed and implemented in coordination with the
6 AMT.

7 **Strategies:**

- 8 1. Coordinate with appropriate JRM site personnel to protect all beaches with turtle nesting activity.
- 9 2. Develop and distribute educational outreach materials including signage and pamphlets, to
10 discourage human disturbance to listed species.
- 11 3. Enforce off-limit areas using trained military law enforcement staff.
- 12 4. Increase monitoring and enforcement in fruit bat roosting areas.
- 13 5. Enforce marine preserve rules, regulations, and laws.
- 14 6. Develop information signs concerning wildlife protection.
- 15 7. Coordinate with the USFWS to monitor outdoor recreation program demands and resources and
16 enforce use limits if deemed necessary.

17 **Monitoring Criteria:** Ensure that coordination and enforcement continues to protect threatened and
18 endangered species.

19 **5.16.3 OR-3: Protection of Coastal Habitat**

20 **Concern:** Coastal areas at JRM sites provide habitat for many species. Public use of coastal areas
21 increases the amount of solid waste that is introduced into the environment, the risk of the spread of
22 noxious plants, and the risk of development that compromises the integrity of these areas.

23 **Objective:** Preserve and protect high-quality habitat and coastal areas.

24 All strategies described as follows for JRM will be developed and implemented in coordination with the
25 AMT.

26 **Strategies:**

- 27 1. Develop BMPs to prevent debris resulting from either recreational or construction activities from
28 polluting the environment.
- 29 2. Establish a policy to ban driving on beaches, through placing barriers on beaches to prevent
30 vehicular access for vehicles other than emergency responders. Develop signs that provide
31 emergency phone numbers and place near barriers.
- 32 3. Beach lighting should be minimized to protect essential nesting areas at the Tarague Basin Area.
33 Replace any lights at the public areas of Tarague and other active nesting sites that are adjacent to
34 turtle nesting sites or beaches. All new facilities should be constructed in such a way that lighting
35 impacts on sea turtle nesting beaches are reduced or avoided.

1 **Monitoring Criteria:** Ensure that coordination and enforcement continues to protect habitat and the
2 integrity of the coastal environment.

3 5.16.4 OR-4: Expansion of Interpretive Programs to Educate Installation Personnel and 4 the Public about Natural Resources on JRM Sites

5 Recreational facilities with specific natural resources management strategies on NBG and Andersen AFB
6 include the following (U.S. Navy 2010b):

7 **Orote Point.** The 1-mile (2-kilometer) hike begins at the end of Orote Peninsula. The trail leads through
8 a forested area and through cave bases and terminates at a coral pebble beach. Hikers may swim and
9 snorkel at the beach. The trail passes within the explosive arc for Kilo Warf, so access is limited.

10 **Old Fuel Piers.** North of the Old Fuel Piers are the remains of two Japanese seaplanes. Visitors may
11 scuba dive or snorkel.

12 **Shark Pit.** This dive spot marks the site where, after World War II, AMTRACS, mess hall trays, old
13 china, food, and garbage were dumped and ultimately attracted sharks. Sharks could be present, and tuna,
14 jacks, butterfly fish, and parrotfish are abundant. Water depths range from 1 to more than 130 feet
15 (40 meters).

16 **Blue Hole and Crevice.** This crevice is a deep canyon with a large boulder at the mouth off Orote
17 Peninsula. There are sea fans, whips, fish, moray eels, shells, and corals in 60 to more than 130 feet
18 (18 to 40 meters) of water.

19 **Sponge Reef.** This 300-foot (91-meter) reef is relatively flat where numerous corals, anemones, and fish
20 are present at depths ranging from 40 to 100 feet (12 to 30 meters).

21 **Finger Reef.** The water depth at this reef reaches 100 feet (30 meters) in depth.

22 **San Luis Beach and Fort San Luis.** This beach offers picnic facilities and a swimming area.

23 **Gab Gab Beach.** This beach is noted for snorkeling and plenty of fish in waters reaching 100 feet
24 (30 meters) in depth. There are picnic tables and shelters on site.

25 **Dadi Beach.** Dadi Beach is a kayak starting point to Turtle Rock, North Tupalao Cave, and Agat Marina.

26 **Polaris Point Beach.** A small beach located at Polaris Point. There is a small MWR club there with
27 cabanas, canoes, and fishing boats to rent.

28 Guided interpretive outings at the Tarague Basin Nature Trail are provided on a time-allowed basis.
29 These programs could be expanded to a regularly scheduled quarterly event if staffing permits. If staffing
30 is a limited factor in presenting interpretive programs, JRM should consider using docents or volunteer
31 work programs such as the Student Conservation Association (SCA) program. The SCA program allows
32 volunteers with an interest in working in natural resources management-related fields to gain experience
33 in interpretation and resource management.

34 Protection of historic and cultural resources, and development of interpretive programs that integrate
35 cultural values, are important management concerns for outdoor recreation programs. Trails should be
36 located to ensure protection of resources, but also to allow study and observation of these sites.
37 Coordination of outdoor programs with the Guam Historic Preservation Officer and the Cultural

1 Resources Planner will ensure that the public enjoyment of cultural resources is conducted in a manner
2 that is culturally sensitive and meets mission requirements.

3 Educational and interpretive programs and materials (such as signs, brochures, lectures, and guided
4 walks) foster an increased understanding of and appreciation for the unique natural heritage of
5 recreational areas, encourage a conservation ethic, promote public safety, and inform the public of
6 wildlife laws and USAF regulations. The development, installation, and maintenance of interpretive signs
7 and kiosks simultaneously benefit both Natural Resources and Outdoor Recreation programs.

8 A Legacy Program project was completed in 2000 that established an interpretive trail and public
9 program in the Tarague Basin. The project integrated the natural and cultural resources of the area into an
10 interpretive trail. An interpretive brochure *Journey into Tarague's Past* was created and is available at
11 information kiosks at the start of the Tarague Basin Interpretive Trail.

12 Adequate funding and staffing of outdoor recreation programs is essential to provide a safe, enjoyable,
13 and quality outdoor recreation experience. Camping programs generate income, while intensive beach
14 recreation areas tend to consume funds because of costs associated with lifeguard salaries, facility
15 maintenance costs, and operations expenses. Other programs, such as hiking programs, do not generate
16 income, but also do not require extensive cash outlays.

17 **Concern:** There is a high demand for access to outdoor areas at JRM sites.

18 **Objective:** Continue to provide opportunities for public access and enjoyment of natural resources by
19 implementing new interpretive programs that balance mission requirements for outdoor recreation with
20 the need to protect and recover threatened and endangered species, and conserve other elements of natural
21 biodiversity.

22 All strategies described as follows for JRM will be developed and implemented in coordination with the
23 AMT.

24 **Strategies:**

- 25 1. Develop and conduct natural resources education classes for all new JRM personnel and local
26 dive shops. [Requirement from BO]
- 27 2. Develop and implement a plan for recreational activities occurring within submerged lands. Plan
28 development will include conducting user surveys and developing strategies to minimize impacts
29 on coral reefs and other marine resources.
- 30 3. Continue to develop and distribute information about the natural resources at JRM sites.
31 [Requirement from BO]
- 32 4. Continue to provide information about natural resources and outdoor recreation activities and
33 services at JRM sites to JRM personnel and the public through the installation newspapers,
34 "Commander's Channel," signs, flyers, briefings, and pamphlets.
- 35 5. Continue to seek out new funding sources for interpretive programs.
- 36 6. Coordinate with resource agencies to develop signage to inform visitors and recreational users
37 about the protected resources present at particular sites, including restrictions against interactions
38 with those resources.

1 **Monitoring Criteria:** Maintain programs and associated materials to improve JRM personnel and the
 2 public's knowledge of natural and cultural resources on JRM sites. Inform JRM personnel about the
 3 interpretive areas and their availability for outdoor recreation.

4 5.17 JRM Overlay Lands Management

5 NBG Main Base, NMS, NBG TS, and Andersen AFB all share borders, or have GNWR lands within their
 6 boundaries. Overlay Refuge Units were established between JRM (through the DoN and USAF) and the
 7 USFWS through an MOU. The establishment and management of the Refuge on JRM lands provides a
 8 commitment by DOD and the USFWS to institute a coordinated program centered on the protection of
 9 threatened and endangered species and other native flora and fauna, maintenance of native ecosystems,
 10 and the conservation of native biological diversity in cooperation with the GDAWR; and in support of the
 11 national defense mission of JRM. This INRMP guides JRM in determining priorities for natural
 12 resources management on the lands in the Overlay Refuge Unit.

13 Management Strategy

14 As summarized in **Table 5-18**, the goal for this section is to manage JRM sites through a regional
 15 ecosystem-based approach that conserves biodiversity while protecting the operational functionality of
 16 the mission of JRM from natural resources-related infringement. To meet this goal, the following
 17 management issues have been identified and objectives, strategies, and monitoring criteria have been
 18 developed.

19 **Table 5-18. Summary of Surrounding Lands Management Goal**

Surrounding Lands Management Goal
<ul style="list-style-type: none"> • Encourage cooperative efforts on adjacent lands that are complementary to the INRMP.

20 5.17.1 SL-1: Continued Coordination with the USFWS Regarding the GNWR JRM Overlay 21 Units

22 **Concern:** Establishment of critical habitat by the USFWS on JRM sites could compromise the mission.

23 **Objective:** Manage overlay refuge units, and submerged lands on JRM according to the guidelines
 24 within this INRMP, thereby precluding critical habitat designation for any of the species managed on
 25 overlay units within JRM site jurisdiction.

26 All strategies described as follows for JRM will be developed and implemented in coordination with the
 27 AMT.

28 **Strategies:**

- 29 1. Continue to participate in the Annual Work Plan meetings of the GNWR and other opportunities
 30 to establish and maintain professional contacts with other agencies, exchange information,
 31 evaluate ongoing projects, develop and prioritize new management efforts, coordinate efforts, and
 32 maximize staffing and funding resources.
- 33 2. Continue to implement management strategies that are identified within this INRMP that are
 34 applicable to overlay areas.

1 **Monitoring Criteria:** Coordination with the USFWS is important for management of the GNWR
2 overlay refuge units, as it relates to JRM.

3 5.18 Geographic Information Systems Management, Data Integration, Access, and 4 Reporting

5 Natural resources data will be stored and maintained within the GIS database. The GIS database will also
6 provide support for the entire environmental program and the training community. JRM will use GIS for
7 complex analyses such as project siting, data interpolations, and risk assessments.

8 GIS software enables installation staff to capture, store, update, manipulate, analyze, and display all forms
9 of geographically referenced data and tabular information about the JRM sites. The training of JRM staff
10 and the allocation of their time to data entry, mapmaking, analysis of data, and interpretation of the results
11 will determine the success of the installation GIS.

12 Once fully developed, the installation GIS databases can be used for projects such as the following:

- 13 • Providing maps.
- 14 • Selecting suitable areas for construction activities.
- 15 • Planning land rehabilitation projects.
- 16 • Providing special maps for Environmental Awareness materials.
- 17 • Ensuring avoidance of rare species habitats and other areas of special concern during construction
18 projects.
- 19 • Identifying site options for use during NEPA evaluation of alternative sites.
- 20 • Calculating drainages and water flows.
- 21 • Determining wildlife habitat preferences.

22 Management Strategy

23 The goals for establishing GIS management issues and strategies are summarized in **Table 5-19**.

24 **Table 5-19. Summary of GIS Management Goals**

GIS Management Goals
<ul style="list-style-type: none"> • Collect, store, and maintain data about historical conditions, trends, and current status of natural resources. • Use GIS information as benchmarks for developing future natural resources management goals and objectives.

25 5.18.1 GIS-1: Continued Use, Development, and Maintenance of GeoBase for Natural 26 Resources Management

27 **Concern:** A current and functional GIS database is required to effectively manage the natural resources
28 on JRM lands and meet nr goals and objectives.

1 **Objective:** Collect, store, develop, and maintain data about historical conditions, trends, and current
2 status for critical indicators of ecological integrity and sustainability.

3 **Strategies:**

- 4 1. Use GIS information as benchmarks for developing future natural resources management goals
5 and objectives.
- 6 2. Use GIS to develop natural resources constraints maps for use in JRM management and planning
7 decisions.
- 8 3. Ensure that GIS information is available to biologists, planners, contractors, and others in a quick
9 and timely manner.
- 10 4. Annually review GIS data to advise resource managers of needs to update data sets during budget
11 planning and programming.
- 12 5. Develop specific language that will be included in all contracts to ensure all spatial data produced
13 are fully compatible with the installation GIS database.
- 14 6. Develop a standardized system for recording and mapping significant resource observations
15 (e.g., plants, wildlife, erosion, damage) when incidentally encountered.
- 16 7. Provide annual funding for one person to be responsible for updating and maintaining the GIS
17 database. This should include the necessary hardware, software, and training for the use of GIS.

18 **Monitoring Criteria:** Progress will be measured by the effectiveness and accuracy of the GeoBase
19 Natural Resources theme in natural resources planning.

6. Implementation

The U.S. Navy and JRM intend to implement this INRMP within the framework of regulatory compliance, national U.S. Navy mission obligations, ATRP limitations, and funding constraints. Any obligation of funds for projects in this INRMP shall be subject to the availability of funds appropriated by Congress, and none of the proposed projects shall be interpreted to require obligation or payment of funds in violation of any applicable Federal law, including the Anti-Deficiency Act, 31 U.S.C. § 1341, et seq.

There are many strategies and recommendations of this INRMP that will not require specific funding, but that constitute the management direction adopted by the Commanding Officer for NBG, and the General for Andersen AFB and are expected to be implemented by existing resources and staff. **Appendix C** summarizes projects that will require a request of funds. Separate tables for NBG and Andersen are provided to facilitate planning, funding, and implementation.

6.1 Project Prescription Development

The most recent policy on INRMP implementation is contained in DOD Memorandum *Implementation of the Sikes Act Improvement Act: Updated Guidance* (DUSD [I&E] 2002). According to the memorandum, an INRMP is considered implemented if an installation does the following:

- Actively requests, receives, and uses funds for “must fund” projects and activities.
- Ensures that sufficient numbers of professionally trained natural resources management personnel are available to perform the tasks required by the INRMP.
- Coordinates annually with all cooperating offices.
- Documents specific INRMP action accomplishments undertaken each year.

Key elements of INRMP implementation (e.g., projects) are addressed in **Appendix C**.

Project priority within this INRMP is determined by funding classification, as defined in DOD Instruction 4715.03, *Environmental Conservation Program* (DOD 2011). The revised 4715.03 discusses recurring and non-recurring conservation management requirements. **Table 6-1** compares funding classes for recurring and non-recurring conservation requirements in DOD Instruction 4715.03, with the Environmental Readiness Levels (ERLs) used by the Navy (DoN 2007).

6.2 Project Development and Tracking

Natural resources projects are tracked and allocated funding via the Navy Environmental Program Requirements Web (EPR-web) (U.S. Navy 2006). The EPR-web is used by the Navy to determine programming and budgeting requirements for projects under the Planning, Programming, Budget, and Execution System (PPBES) process (DoN 2007). The information in the database is also used by the Navy to develop their annual Environmental Quality Report (EQR) for Congress (U.S. Navy 2006).

Projects identified in **Appendix C** will need to be entered into the EPR-web to ensure that natural resources management prescriptions identified in this revised INRMP are reviewed by the chain-of-command, and are documented for inclusion in the annual EQR report to Congress (U.S. Navy 2006). Once funding is allocated, natural resources personnel at JRM are responsible for ensuring that the EPR-web is updated with the date project funding was received, and progress made towards project completion (U.S. Navy 2006).

1 **Table 6-1. Funding Classes for Recurring and Non-Recurring Conservation Requirements and**
 2 **Navy Environmental Readiness Levels**

Recurring and Non-Recurring Conservation Requirements (DOD 4715.03)	Environmental Readiness Levels (DoN 2007)
<p>Class 0: Recurring Natural Resources Conservation Management Requirements:</p> <ul style="list-style-type: none"> a. Administrative, personnel, and other costs associated with managing the DOD Natural Resources Conservation Program that are necessary to meet applicable compliance requirements in Federal, state, and territorial laws; regulations; EOs; and DOD policies, or in direct support of the military mission. b. DOD components shall give priority to recurring natural resources conservation management requirements associated with the operation of facilities, installations, and deployed weapons systems. These activities include day-to-day costs of sustaining an effective natural resources management program, and annual requirements, including manpower, training, supplies, permits, fees, testing and monitoring, sampling and analysis, reporting and recordkeeping, maintenance of natural resources conservation equipment, and compliance self-assessments. 	<p>Environmental Readiness Level 4: Minimum level of environmental readiness capability required to maintain compliance with applicable legal requirements):</p> <ul style="list-style-type: none"> a. Supports all actions specifically required by law, regulation, or EO (DOD Class I and Class II requirements) just in time. b. Supports all DOD Class 0 requirements as they relate to a specific statute such as hazardous waste disposal, permits, fees, monitoring, sampling and analysis, reporting, and record keeping. c. Supports recurring administrative, personnel, and other costs associated with managing environmental programs that are necessary to meet applicable compliance requirements (DOD Class 0). d. Supports minimum feasible Navy executive agent responsibilities, participation in Office of the Secretary of Defense- (OSD) sponsored interdepartment and interagency efforts, and OSD-mandated regional coordination efforts.

Recurring and Non-Recurring Conservation Requirements (DOD 4715.03)	Environmental Readiness Levels (DoN 2007)
<p>Class I: Non-Recurring Natural Resources Management Requirements. Current Compliance. Includes installation projects and activities to support:</p> <ul style="list-style-type: none"> a. Installations currently out of compliance (e.g., received an enforcement action from an authorized Federal, state, or territorial agency or local authority). b. Signed compliance agreement or consent order. c. Meeting requirements with applicable Federal, state, or territorial laws, regulations, standards, EOs, or DOD policies. d. Immediate and essential maintenance of operational integrity or military mission sustainment. e. Projects or activities that will be out of compliance if not implemented in the current program year including the following: <ul style="list-style-type: none"> i. Environmental analyses for natural resources conservation projects, and monitoring and studies required to assess and mitigate potential impacts of the military mission on conservation resources. ii. Planning documentation, master plans, compatible development planning, and INRMPs. iii. Natural resources planning-level surveys. iv. Reasonable and prudent measures included in incidental take statements of BOs; biological assessments; surveys; monitoring; reporting of assessment results; or habitat protection for listed, at-risk, and candidate species so that proposed or continuing actions can be modified in consultation with the USFWS or NMFS. v. Mitigation to meet existing regulatory permit conditions or written agreements. vi. Nonpoint source pollution or watershed management studies or actions needed to meet compliance dates cited in approved state or territorial coastal nonpoint source pollution control plans, as required to meet consistency determinations consistent with Coastal Zone Management. vii. Wetlands delineations critical for the prevention of adverse impacts on wetlands, so that continuing actions can be modified to ensure mission continuity. viii. Compliance with missed deadlines established in DOD executed agreements. 	<p>Environmental Readiness Level 3:</p> <ul style="list-style-type: none"> a. Supports all capabilities provided by ERL 4. b. Supports existing level of Navy executive agent responsibilities, participation in OSD-sponsored interdepartment and interagency efforts, and OSD-mandated regional coordination efforts. c. Supports proactive involvement in the legislative and regulatory process to identify and mitigate requirements that will impose excessive costs or restrictions on operations and training. d. Supports proactive initiatives critical to the protection of Navy operational readiness.
<p>Class II: Non-Recurring Natural Resources Management Requirements. Maintenance Requirements. Includes those projects and activities needed to meet an established deadline beyond the current program year and maintain compliance. Examples include the following:</p> <ul style="list-style-type: none"> a. Compliance with future deadlines. b. Conservation, GIS mapping, and data management to comply with Federal, state, territorial, and local regulations; EOs; and DOD policy. c. Efforts undertaken in accordance with non-deadline specific compliance requirements of leadership initiatives. d. Wetlands enhancement to minimize wetlands loss and enhance existing degraded wetlands. e. Conservation recommendations in biological opinions issued pursuant to the ESA. 	<p>Environmental Readiness Level 2:</p> <ul style="list-style-type: none"> a. Supports all capabilities provided under ERL 3. b. Supports enhanced proactive initiatives critical to the protection of Navy operational readiness. c. Supports all Navy and DOD policy requirements. d. Supports investments in pollution reduction, compliance enhancement, energy conservation, and cost reduction.

Recurring and Non-Recurring Conservation Requirements (DOD 4715.03)	Environmental Readiness Levels (DoN 2007)
<p>Class III: Non-Recurring Natural Resources Management Requirements. Enhancement Actions Beyond Compliance. Includes those projects and activities that enhance conservation resources or the integrity of the installation mission, or are needed to address overall environmental goals and objectives, but are not specifically required by law, regulation, or EO, and are not of an immediate nature. Examples include:</p> <ol style="list-style-type: none"> Community outreach activities, such as International Migratory Bird Day, Earth Day, National Public Lands Day, Pollinator Week, and Arbor Day activities. Educational and public awareness projects, such as interpretive displays, oral histories, Watchable Wildlife areas, nature trails, wildlife checklists, and conservation teaching materials. Restoration or enhancement of natural resources when no specific compliance requirement dictates a course or timing of action. Management and execution of volunteer and partnership programs. 	<p>Environmental Readiness Level 1:</p> <ol style="list-style-type: none"> Supports all capabilities provided under ERL 2. Supports proactive actions required to ensure compliance with pending/strong anticipated laws and regulations in a timely manner or to prevent adverse impacts on Navy mission. Supports investments that demonstrate Navy environmental leadership and proactive environmental stewardship.

1 The Navy Natural Resource Metrics were developed to assist installations in evaluating INRMP
2 implementation. Annually, each installation receives a report card informing them on where they stand
3 regarding INRMP implementation. The program also requires each installation to address specific
4 questions related to implementation to ensure that the implemented INRMP meets all regulatory
5 requirements. Navy guidance suggests that project progress be updated at least twice per year in
6 EPR-web, and the information used to answer questions in the annual Natural Resources Data Call
7 Station, which will be used to evaluate INRMP implementation (U.S. Navy 2006).

8 6.3 Funding Sources and Mechanisms

9 The PPBES budget process employed by the DOD is an ongoing, continuously reviewed process that can
10 be summarized as follows (DOD 2005):

- 11 • The PPBES process consists of long-range planning to anticipate and secure requirements to meet
12 security threats and accomplish program goals.
- 13 • Resources to meet these requirements are estimated and programmed by program managers in the
14 Future Year Defense Plan (FYDP). The FYDP is a list of resource requirements for the next
15 6 years. Specifically, the FYDP composes the subsequent fiscal year budget and funding
16 requirements projected out 5 years.
- 17 • The FYDP resources are then analyzed via the Programming Process. In the Programming
18 Process, program managers reassess their requirements, reprioritize planned activity, reevaluate
19 existing funding guidance, and estimate their funding needs for the next budget year, plus the
20 subsequent 5 fiscal years (referred to as Program Objectives Memoranda (POMs) 1–5).
- 21 • The POM process takes place within Defense Components beginning in the fall of each year.
22 Then each DOD component submits the POM in the spring to the OSD. The OSD reviews the
23 budget submissions and develops the President’s budget that will be submitted to Congress. At
24 the installation level, data submissions to support this are made to the Major Commands twice
25 annually, in fall and spring.

- 1 • Based on POM decisions of each component, budget controls are issued to the field commands
2 for budget preparation.

3 The time scale of an INRMP fits well into the DOD PPBES forecasting process. One full cycle of the
4 DOD budget process includes the next budgeted fiscal year and projections for the following 5 fiscal
5 years. One full cycle of the INRMP, with upper command reapproval, covers a 5-year period. This
6 means that by relying on an INRMP that is updated regularly, natural resources managers should be able
7 to project relatively accurate funding requirements for 5-year periods, at a minimum (DOD 2005).

8 The Regional Commander or CO of NBG and the Wing Commander of Andersen AFB are responsible
9 for ensuring that JRM has sufficient staff to implement the INRMP. Each JRM facility environmental
10 office is responsible for annual coordination with USFWS and GDAWR, requesting funds for INRMP
11 implementation, and documenting implementation actions. Consequently, the projects and schedules
12 proposed in this INRMP are targets to facilitate natural resources program planning. When requested
13 funds are not received, natural resources management prescriptions and the programming schedule may
14 be reexamined. In addition, plans may be adapted to account for the revised project schedule and the
15 proposed budget may be adjusted to account for available funding.

16 6.3.1 Funding Sources

17 Once a project has been placed into the EPR-web a funding source needs to be determined. In general,
18 ERL Level 3 and 4 projects will receive funding, but it is up to natural resources managers to find funds
19 for ERL Level 1 and 2 projects (U.S. Navy 2006). The following are the primary funding sources for
20 Navy natural resources programs (U.S. Navy 2006):

- 21 1. **Operation and maintenance, Navy (O&MN) Environmental Funds.** The majority of natural
22 resources projects are funded with O&MN environmental funds. These appropriated funds are
23 the primary source of resources to support must-fund, just-in-time environmental compliance
24 (i.e., Navy ERL Level 4 projects). O&MN funds are generally not available for Navy
25 Environmental Readiness Levels 3–1 projects. In addition to the restriction to Environmental
26 Readiness Level 4 requirements, there are other limitations placed on the use of O&MN funds:
 - 27 a. Only the initial procurement, construction, and modification of a facility or project are
28 considered valid environmental funding requirements. The subsequent operation,
29 modification due to mission requirements, maintenance, repair, and eventual replacement is
30 considered a Real Property Maintenance (RPM) funding requirement. For example, the cost
31 of initially installing a BMP can be funded through O&MN, but future maintenance or repair
32 of that BMP must be paid by RPM funds.
 - 33 b. When natural resources requirements are tied to a specific construction project or other
34 action, funds for the natural resources requirements should be included in the overall project
35 costs. For example, if a permit for filling wetlands is required as part of a MILCON project,
36 the costs of obtaining the permit and implementing required mitigation should be paid by
37 MILCON funds as part of the overall construction project costs.
- 38 2. **Legacy Funds.** The Legacy Resource Management Program is a special Congressionally
39 mandated initiative to fund military conservation projects. The Legacy Program can provide
40 funding for a variety of conservation projects, such as regional ecosystem management
41 initiatives, habitat preservation efforts, archaeological investigations, invasive species control,
42 monitoring and predicting migratory patterns of birds and animals, and national partnerships and
43 initiatives, such as National Public Lands Day. If the installation plans to request Legacy
44 Program funds, it should be aware of the following:

- 1 a. The availability of Legacy funds is generally uncertain early in the year.
- 2 b. Pre-proposals for Legacy projects are due in March and submitted using the Legacy Tracker
- 3 Web site: <http://www.dodlegacy.org/>.
- 4 c. Project proposals are reviewed by the Navy chain-of-command before being submitted to
- 5 the DOD Legacy Resources Management Office for final project selection.
- 6 d. The Legacy Web site provides further guidance on the proposal process and types of
- 7 projects requested.
- 8 3. **Fish and Wildlife Fees.** User fees collected for the privilege of hunting, fishing, or trapping
- 9 will be collected, deposited, and used in accordance with the Military Construction
- 10 Authorization Act—Military Reservation and Facilities-Hunting, Fishing and Trapping
- 11 (10 U.S.C. 2671) and the DOD financial management regulations. This specifies that user fees
- 12 collected for hunting, fishing, or trapping shall be used only on the installation where collected.
- 13 Further, collections will be used exclusively for fish and wildlife conservation and management
- 14 on the installation where collected.
- 15 a. The same fee schedule will be used for all participants with the exception of senior citizens,
- 16 children, and the handicapped. Membership in an installation conservation organization will
- 17 not give members priority in participating in hunting, fishing, and trapping programs.
- 18 Efforts should be made to use the services of the installation's MWR function to collect and
- 19 administer these funds locally in accordance with SAIA authorization.
- 20 4. **Recycling Funds.** An installation with a Qualified Recycling Program (QRP) may use proceeds
- 21 for some types of natural resources projects. Proceeds must first be used to cover QRP costs.
- 22 Up to 50 percent of net proceeds may then be used for pollution abatement, pollution prevention,
- 23 composting, alternative fueled vehicle infrastructure support, vehicle conversion, energy
- 24 conversion, or occupational safety and health projects, with first consideration given to projects
- 25 included in the installation's pollution-prevention plans. Remaining funds may be transferred to
- 26 the non-appropriated MWR account for approved programs, or retained to cover anticipated
- 27 future program costs. Natural resources projects can be funded as pollution
- 28 prevention/abatement (e.g., wetlands or riparian forest restoration) or MWR projects (e.g., trail
- 29 construction and maintenance).
- 30 5. **Strategic Environmental Research and Development Program (SERDP) Funds.** SERDP is
- 31 DOD's corporate environmental research and development program, planned and executing in
- 32 full partnership with the Department of Energy and USEPA, with participation by numerous
- 33 other federal and non-Federal organizations. SERDP funds for environmental and conservation
- 34 are allocated through a competitive process. Within its broad areas of interest the SERDP
- 35 focuses on Cleanup, Compliance, Conservation, and Pollution Prevention technologies. The
- 36 purpose of the conservation technology program is to use research and development to provide
- 37 improved inventory and monitoring capabilities, develop more effective impact and
- 38 risk-assessment techniques, and provide improved mitigation and rehabilitation capabilities.
- 39 Recently, the program solicited Statements of Need for conservation technology proposals to
- 40 research indicators of stress on threatened and endangered species and to develop techniques to
- 41 inventory and monitor threatened and endangered species in accessible areas.
- 42 6. **Non-DOD Funds.** Many grant programs are available for natural resources management
- 43 projects, such as watershed management and restoration, habitat restoration, and wetland and
- 44 riparian area restoration. When federally funded, these programs typically require non-Federal
- 45 matching funds. However, installations may partner with other groups to propose eligible
- 46 projects.

- 1 a. The Five-Star Restoration Challenge Grants Program is sponsored by the National
2 Association of Counties; National Association of Service and Conservation Corps; National
3 Fish and Wildlife Foundation; and Wildlife Habitat Council in cooperation with USEPA,
4 NMFS, and other sponsors. This program provides modest financial assistance (\$5,000 to
5 \$20,000) on a competitive basis to support community-based wetland and riparian
6 restoration projects that build diverse partnerships and foster local natural resources
7 stewardship. Installations would need to partner with other groups to be eligible for this
8 type of program. Applications are due in March. Information is available online at
9 <http://www.epa.gov/owow/wetlands/restore/5star/>. INRMPs should include valid Class 2
10 and 3 projects and actions that would enhance an installation's natural resources.
- 11 b. National Public Lands Day Grants. Installations are eligible to receive DOD Legacy funds
12 in support of National Public Lands Day. Projects eligible for funds include habitat
13 restoration, wetland restoration, and stream cleanup.

14 Nontraditional sources of funding for natural resources programs include nonappropriated reimbursable
15 funds (i.e., agricultural or grazing outleasing, forestry, hunting and fishing fees), and appropriated
16 reimbursable funds (e.g., DOD Legacy Program, USDA Pest Management Program). These accounts are
17 sources of funds for Class 3 projects. Installations, however, should not depend on these programs to
18 fully fund their natural resources management programs.

19 **6.4 Effectiveness of INRMP Providing No-Net-Loss to Military Mission**

20 Implementation of this INRMP by JRM will ensure that the natural resources on JRM will continue to
21 support the JRM mission. This INRMP revision strives to integrate natural resources management with
22 other installation plans and activities. It also establishes goals that represent a long-term vision for the
23 health and quality of JRM's natural resources. The INRMP goals may be revised over time to reflect
24 changing missions and environmental conditions. Any future changes in mission, training activity, or
25 technology should be analyzed to assess their impact on natural resources. As new plans and DoN
26 guidance and regulations are developed, they will be integrated with the goals and management strategies
27 of this INRMP. The INRMP will be reviewed, assessed, and modified as needed on a regular basis to
28 ensure continued integration with other management plans or changes in military mission.

29 **6.5 Formal Adoption of INRMP by JRM Commanding Officers**

30 By signing this INRMP, the Installation Commanding Officer for NBG, and the General for Andersen
31 AFB are committing to "seek funding and execute, subject to the availability of funding, all ERL Level 4
32 projects and activities in accordance with specific timeframes identified in the INRMP" (U.S. Navy
33 2006).

34 **6.6 Federal Anti-Deficiency Act**

35 "All actions contemplated in this INRMP are subject to the availability of funds properly authorized and
36 appropriated under federal law. Nothing in this INRMP is intended to be, nor must be construed to be a
37 violation of the Anti-Deficiency Act (31 U.S.C. 1341 et seq.)" (U.S. Navy 2006).

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8. References

- 36 CES/CEVN 2003 36 CES/CEVN. 2003. *Environmental Assessment of a Brown Treesnake Barrier, Andersen AFB, Guam*. Prepared for AFCEE/ECS by Innovative Technical Solutions, Inc. and LFR Levine Fricke. August 2003.
- Abraham et al. 2004 Abraham, T., M. Beger, D. Burdick, E. Cochrane, P. Craig, G. Didonato, D. Fenner, A. Green, Y. Golbuu, J. Gutierrez, M. Hasurmai, C. Hawkins, P. Houk, D. Idip, D. Jacobson, E. Josph, T. Keju, J. Kuardei, S. Palik, L. Penland, S. Pinca, K. Rikim, J. Starmer, M. Trianni, S. Victor, and L. Whylen. 2004. Status of the coral reefs in Micronesia and American Samoa. Edited by R. Kelty, and J. Kuardei. Pages 381-409 in C. Wilkinson, ed. *Status of Coral Reefs of the World: 2004*. Townsville, Queensland: Australian Institute of Marine Science.
- AECOS and Wil Chee 2009 AECOS, Inc. and Wil Chee Planning, Inc. (AECOS and Wil Chee). 2009. *Wetlands Inventory Report, U.S. Navy Properties on Guam and Tinian*. September 2009.
- AFSC 2011 Air Force Safety Center (AFSC). 2011. Web_alt_11. Available Online <<http://www.afsc.af.mil/shared/media/document/AFD-080130-043.pdf>>. Accessed July 25, 2011.
- Andersen AFB 1995 Andersen Air Force Base (AFB). 1995. *Andersen Air Force Base Marine Resources Preserve Baseline Survey of Marine Resources*. Prepared by University of Guam Marine Laboratory.
- Andersen AFB 2003 Andersen AFB. 2003. *Integrated Natural Resources Management Plan (INRMP) Department of the Air Force, 36th Air Base Wing, Civil Engineer Squadron*. 2003.
- Andersen AFB 2006 Andersen AFB. 2006. *Architectural Compatibility and Base Design Standards, Andersen Air Force Base, Guam*. Prepared by MWH. January 2006.
- Andersen AFB 2008 Andersen AFB. 2008. *Green Sea Turtle (Chelonia mydas) Management Plan for Andersen Air Force Base, Guam*. Prepared for Andersen Air Force Base and Air Force Center for Environmental Excellence by engineering-environmental Management, May 2007. 52 pp.
- Andersen AFB undated Andersen Air Force Base (Andersen AFB). Undated. *Andersen AFB Marine Resources Preserve Proposed Document*. Unpublished Document. Provided by N. Mitton on July 9, 2008.
- APHIS 2011 U.S. Department of Agriculture Animal and Plant Health Inspection Service (APHIS). 2011. *About APHIS*. Available online <http://www.aphis.usda.gov/about_aphis/>. Accessed July 2011.
- Baker 1951 Baker, R.H. 1951. *The Avifauna of Micronesia, its Origin, Evolution and Distribution*. University of Kansas Publications, Museum of Natural History. University of Kansas, Lawrence, Kansas. 359 pp.

- Bauman 1996 Bauman, S. 1996. Diversity and decline of land snails on Rota, Mariana Islands. *American Malacological Bulletin*, Vol. 12(1/2): 13-27.
- Belt Collins Hawaii Ltd. 2002 Belt Collins Hawaii Ltd. 2002. Economic Analysis of Proposed Critical Habitat for Three Endangered Species on Guam and Rota.
- Benton et al. 2008 Benton, N. J., D. Ripley, and F. Powledge, eds. 2008. *Conserving Biodiversity on Military Lands: A Guide for Natural Resources Managers*. 2008 edition. Available online <<http://www.dodbiodiversity.org>>. Arlington, Virginia: NatureServe. 2008.
- Best and Lockyer 2002 Best, P.B. and C.H. Lockyer. 2002. Reproduction, growth and migrations of sei whales *Balaenoptera borealis* off the west coast of South Africa in the 1960s. *South African Journal of Marine Science* 24: 111–133.
- BioSystems Analysis, Inc. 1989 Biosystems Analysis, Inc. 1989. Natural Resources Survey for the U.S. Public Works Center, Guam (PWC). Prepared for Commander, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, Hi. 8 Chapters.
- Brooke 2008 Brooke, A. 2008. Mariana Fruit Bat Surveys on Navy Properties, Guam, 2008.
- Brown et al. 2011 Brown, V.A., A. Brooke, J.A. Fordyce, and G.F. McCracken. 2011. Genetic analysis of populations of the threatened bat *Pteropus mariannus*. *Conservation Genetics*. Online publication date: February 18, 2011
- Burdick et al. 2008 Burdick, D. V. Brown, J. Asher, M. Gawel, L. Goldman, A. Hall, J. Kenyon, T. Leberer, E. Lundblad, J. McIlwain, J. Miller, D. Minton, M. Nadon, N. Pioppi, L. Raymundo, B. Richards, R. Schroeder, P. Schupp, E. Smith, and B. Zgliczynski. 2008. The state of coral reef ecosystems of Guam. In: *The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States: 2008*. National Oceanic and Atmospheric Administration In Cooperation with Partners from Federal, Territorial and Commonwealth Agencies and the Pacific Freely Associated States. Pages 465–509.
- Bureau of Statistics and Plans 2008 Bureau of Statistics and Plans. 2008. Personal Communication via e-mail, David Burdick 22 December. Information concerning Guam Land Use Plans. Provided 1966 Guam Land Use Plan digitized zoning GIS files-draft pending approval by Department of Land Management.
- Burtenshaw et al. 2004 Burtenshaw, J.C., E.M. Oleson, J.A. Hildebrand, M.A. McDonald, R.K. Andrew, B.M. Howe, and J.A. Mercer. 2004. Acoustic and satellite remote sensing of blue whale seasonality and habitat in the Northeast Pacific. *Deep-Sea Research II* 51: 967–986.
- Campora and Lee 2009 Campora, C. and S. Lee. 2009. Survey for the Mariana eight spot butterfly, *Hypolimnas octocula marianensis* (Lepidoptera: Nymphalidae), in the Pagat Route 15 area of Yigo Village, Guam. A report. August 2009.

- Chirichetti et al. 1993 Chirichetti, A. M., B. Kerr, J. Davidson, Dutka-Gianelli, and C. Dayton. 1993. Anderson Air Force Marine Resources Preserve, Baseline Survey of Marine Resources. First Survey: May–August 1963. 61 pp.
- Christy et al. 2007 Christy M.T., C.S. Clark, D.E. Gee II, D. Vice, D.S. Vice, M.P. Warner, C.L. Tyrrell, G.H. Rodda, and J.A. Savidge. 2007. Recent Records of Alien anurans on the Pacific Island of Guam. *Pacific Science* 61(4): 469–483. Christy, M.T., J.A. Savidge, and G.H. Rodda. 2007. Multiple pathways for invasion of anurans on a Pacific island. *Diversity and Distributions*. Pages 1–10.
- Clapham et al. 2004 Clapham, P.J., C. Good, S.E. Quinn, R.R. Reeves, J.E. Scarff, and R.L. Brownell, Jr. 2004. Distribution of North Pacific right whales (*Eubalaena japonica*) as shown by 19th and 20th century whaling catch and sighting records. *Journal of Cetacean Research and Management* 6(1): 1–6.
- Colvin et al. 2005 Colvin, B.A., M.A. Fall, L.E. Fitzgerald, and L.L. Loope. 2005. Review of Brown Tree Snake Problems and Control Programs. Report for the U.S. Dept. of Int., Office of Insular Affairs. 67 pp.
- COMNAV Mariana 2001 Commander, U.S. Naval Forces Mariana Islands (COMNAV Mariana). 2001. Final Integrated Natural Resources Management Plan for Navy Lands, Guam. Plan Duration 18 November 2001 thru 17 November 2006. November 2001.
- Conry 1988 Conry, P.J. 1988. Management of feral and exotic game species on Guam. *Transactions of the Western Section of the Wildlife Society* 24: 26–30.
- Cowie 1992 Cowie, R.H. 1992. Evolution and extinction of Partulidae, endemic Pacific island land snails. *Philosophical Trans. Royal Soc. London B* 335: 167–191.
- Cowie 2000 Cowie, R.H. 2000. Non-indigenous land and freshwater molluscs in the islands of the Pacific: Conservation impacts and threats.
- Cowie and Cook 2001 Cowie, R.H., and R.P. Cook. 2001. Extinction or survival: Partulid tree snails in American Samoa. *Biodiversity and Conservation* 10: 143–159.
- Cox et al. 1992 Cox, P., T. Elmqvist, E. Pierson, and W. Rainey. 1992. Flying Foxes as pollinators and seed dispersers in Pacific island ecosystems. Pages 18–23 in Wilson, D. E., and G. L. Graham, eds. *Pacific island flying foxes: proceedings of an international conservation conference*. U.S. Fish and Wildlife Service Biological Report 90 (23).
- Crampton 1925 Crampton, H.E. 1925. Studies on the variation, distribution, and evolution of the genus *Partula*. The species of the Mariana Islands, Guam and Saipan. Carnegie Inst. Wash. Publ. 228A. vii + 116pp., 14 pl.
- Croll et al. 1998 Croll, D.A., B.R. Tershy, R.P. Hewitt, D.A. Demer, P.C. Fiedler, S.E. Smith, W. Armstrong, J.M. Popp, T. Kiekhefer, V.R. Lopez, J. Urban, and D. Gendron. 1998. An integrated approach to the foraging ecology of marine birds and mammals. *Deep-Sea Research II* 45: 1353–1371.

- CRS 2007 CRS Report for Congress. 2007. *Exemptions from Environmental Law for the Department of Defense: Background and Issues for Congress*. Order Code RS22149. Updated 15 May 2007. Available online <<http://www.fas.org/sgp/crs/natsec/RS22149.pdf>> Accessed November 2010.
- Darling and Mori 1993 Darling, J.D., and K. Mori. 1993. Recent observations of humpback whales (*Megaptera novaeangliae*) in Japanese waters off Ogasawara and Okinawa. *Canadian Journal of Zoology* 71: 325–333.
- Davis 1991 Davis, G.W. 1991. Letter to the Air Force Regarding Green Sea Turtle Foraging and Nesting in the Tarague Basin Area. 12 pp.
- Davis undated Davis, G. Undated. Guam turtle history. Mangilao: Guam Division of Aquatic and Wildlife Resources.
- DOD 2005 Department of Defense (DOD). 2005. Implementation of Sikes Act Improvement Amendments: Supplemental Guidance Concerning Leased Lands. May 2005.
- DOD 2011 DOD. 2011. Department of Defense Directive 4715.3, Environmental Conservation Program. 2011.
- DOI 1970 Department of the Interior (DOI). 1970. Conservation of endangered species and other fish or wildlife; list of endangered foreign fish and wildlife. *Federal Register* 35: 18319–18322.
- DoN 2003 Department of the Navy (DoN). 2003. Final Environmental Assessment, Inner Apra Harbor Maintenance Dredging, Guam. Pearl Harbor, Hawai'i: Pacific Division, Naval Facilities Engineering Command.
- DoN 2004 DoN. 2004. Year 2003 assessment of marine and fisheries resources---Farallon de Medinilla, Commonwealth of the Northern Mariana Islands. Final report. Submitted to Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, Hawaii, under contract no. N62742-02-D-1802, DO 002, by the Environmental Company, Honolulu, Hawaii.
- DoN 2005 DoN. 2005. *Marine resources assessment for the Mariana Operating Area*. Prepared for Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, Hawaii under contract number N62470-02-D-9997, CTO 0027. Prepared by Geo-Marine, Inc., Plano, Texas.
- DoN 2007 DoN. 2007. OPNAVINST 5090.1C Navy Environmental and Natural Resources Program Manual. Chapter 2: Funding. October 2007.
- DoN 2010 DoN. 2010. Natural Resource Survey Report in Support of the Environmental Impact Statement for the Marine Corps Relocation Initiative to Various Locations on Guam. Naval Facilities Engineering Command, Pacific. 957 pp.
- DoN 2011 DoN. 2011. OPNAVINST 5090.1C CH-1. Environmental Readiness Program Manual. Chapter 24: Natural Resources Management. 18 July 2011.

- Donnegan et al. 2004 Donnegan, J.A., Butler, S.L., Grabowski, W, Hiserote, B.A., and Limtiaco, D. 2004. Guam's Forest Resources, 2002. Resour. Bull. PNW-RB-243. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 32 pp.
- Dueñas and Associates 1998 Dueñas and Associates. 1998. Report No. 5. Fifth and final report. Wetland delineation and mapping, COMNAV MARIANAS, M.I. (Contract No. N62766-95-D-0006). Prepared for: Julianne T. Duwel. D&A (ES) Rept. No. 99-1(F). 71 pp. (incl. appendices).
- DUSD (I&E) 2002 Deputy Under Secretary of Defense (Installations and Environment) (DUSD [I&E]). 2002. Implementation of the Sikes Act Improvement Act: Updated Guidance, October 10, 2002.
- DUSD (I&E) 2004 DUSD (I&E). 2004. Memorandum providing policy on scope of INRMP review, public comment on INRMP review, and Endangered Species Act consultation on INRMPs, November 1, 2004.
- DUSD (I&E) 2005a DUSD (I&E). 2005. Memorandum providing policy on the applicability of the Sikes Act INRMP requirement for DOD lands leased to a non-DOD party, May 17, 2005.
- DUSD (I&E) 2005b DUSD (I&E). 2005. Best practices for Integrated Natural Resources Management (INRMP) Implementation, August 2005.
- e²M 2008 engineering-environmental Management, Inc. (e²M). 2008. Draft Basewide Vegetation Survey, Mapping, and Report at Andersen Air Force Base, Guam. 24 pp.
- Eckert 1993 Eckert, K.L. 1993. The biology and population status of marine turtles in the North Pacific Ocean. NOAA Technical Memorandum NMFS-SWFSC-186: 1–156.
- Eldredge 2003 Eldredge, L.G. 2003. The marine reptiles and mammals of Guam. *Micronesica* 35-36: 653–660.
- Engbring and Ramsey 1984 Engbring, J. and F.L. Ramsey. 1984. Distribution and abundance of the forest birds of Guam: results of a 1981 survey. U.S. Fish Wildlife Service FWS/OBS-84/20.
- Englis and Naughton 2004 Englis, Jr. A. and Naughton, M. 2004. U.S. Pacific Islands Regional Shorebird Conservation Plan. *U.S. Shorebird Conservation Plan*. U.S. Department of the Interior, Fish and Wildlife Service. Portland, Oregon.
- Esselstyn et al. 2006 Esselstyn, J.A., A. Amar, and D. Janeke. 2006. Impact of Post-typhoon Hunting on Mariana Fruit Bats (*Pteropus mariannus*). *Pacific Science* 60(4): 531–539.
- Fiedler et al. 1998 Fiedler, P.C., S.B. Reilly, R.P. Hewitt, D. Demer, V.A. Philbrick, S. Smith, W. Armstrong, D.A. Croll, B.R. Tershy, and B.R. Mate. 1998. Blue whale habitat and prey in the California Channel Islands. *Deep-Sea Research II* 45: 1781–1801.

- Fosberg 1960 Fosberg, F.R. 1960. The Vegetation of Micronesia. 1. General description of vegetation of the Mariana Islands, and a detailed consideration of the vegetation of Guam. *Bull. Amer. Mus. Nat. Hist.* 119(1): 1–75.
- Fritts and Rodda 1998 Fritts, T.H. and G.H. Rodda. 1998. The role of introduced species in the degradation of island ecosystems: a case history of Guam. *Annual Review of Ecology and Systematics* 29: 113–140.
- Gannier 2000 Gannier, A. 2000. Distribution of cetaceans off the Society Islands (French Polynesia) as obtained from dedicated surveys. *Aquatic Mammals* 26(2): 111–126.
- GDAWR 2005 Guam Department of Agricultural, Division of Aquatic Wildlife Resources (GDAWR). 2005. “Fact Sheet: Birds of Guam.” Last modified March 9, 2005. Available online <<http://www.guamGDAWR.org/learningcenter/factsheets/birds/>>. Accessed April 12, 2011.
- GDAWR 2006a GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy. November 7, 2006.
- GDAWR 2006b GDAWR. 2006. “Fena Lake.” Last modified 1 February 2006. Available online <<http://www.guamGDAWR.org/aquatics/freshwaterm/fena/>>. Accessed April 12, 2011.
- GDAWR 2008a GDAWR. 2008. Biological and Habitat Assessment of Surface Waters on Guam. September 12, 2008.
- GDAWR 2008b GDAWR. 2008. Guam Hunting Regulations. Available online <http://www.guamGDAWR.org/wildlife/hunting/Hunting%20Regs.pdf/file_view>. Accessed May 2, 2011.
- GDAWR 2011 GDAWR. 2011. Annual Report for Wildlife Restoration. 2011.
- GEPA 2006 Guam Environmental Protection Agency (GEPA). 2006. Guam 2006 Integrated Water Quality Monitoring and Assessment Report, Clean Water Act Sections 303(d), 305(b) and 314. Part II. September 2006.
- GHS 2008 Guam Homeland Security (GHS). 2008. Draft 2008 Guam Hazard Mitigation Plan. Prepared by URS. March 2008.
- Gill 2002 Gill, P.C. 2002. A blue whale (*Balaenoptera musculus*) feeding ground in a southern Australian coastal upwelling zone. *Journal of Cetacean Research and Management* 4(2): 179–184.
- Gingerich 2003 Gingerich, S.B. 2003. Hydrologic Resources of Guam. USGS Water-Resources Investigations Report 03-4126. Available online <<http://pubs.usgs.gov/wri/wri034126/>>. Accessed May 25, 2011.

- Gregr and Trites 2001 Gregr, E.J., and A.J. Trites. 2001. Predictions of critical habitat for five whale species in the waters of coastal British Columbia. *Canadian Journal of Fisheries and Aquatic Sciences* 58: 1265–1285.
- Grimm and Farley 2008 Grimm, G. and J. Farley. 2008. Sea Turtle Nesting Activity on Navy Lands, Guam, 2007 – 2008. U.S. Navy, NAVFAC Marianas Environmental, Guam. November 2008. 6 pp
- Gutierrez 2004 Gutierrez, J. 2004. Guam sea turtle recovery annual progress report. Mangilao, Guam: Guam Division of Aquatic and Wildlife Resources.
- GDWR 2012 GDWR 2012. Guam Division of Aquatic and Wildlife Resources. Black Francolin. Available online http://www.guamdwr.org/learningcenter/factsheets/birds/francolin_html. Accessed May 2, 2012.
- Hain et al. 1985 Hain, J., M. Hyman, R. Kenney, and H. Winn. 1985. The role of cetaceans in the shelf-edge region of the northeastern United States. *Marine Fisheries Review* 47(1): 13–17.
- HDR 2012 HDR. 2012. Draft Threatened and Endangered Species and Migratory Birds Monitoring Report. Naval Support Activity Andersen, Guam. January 2012.
- Helber, Hastert and Fee 2005 Helber, Hastert and Fee. 2005. Draft ecological reserve feasibility study, Commander Navy Region Marianas. Prepared for Naval Facilities Engineering Command, Pacific. 2005.
- Herman et al. 1980 Herman, L.M., C.S. Baker, P.H. Forestell, and R.C. Antinaja. 1980. Right whale *Balaena glacialis* sightings near Hawaii: A clue to the wintering grounds? *Marine Ecology Progress Series* 2: 271–275.
- Holm et al. 1977 Holm, L.G., D.L. Plucknett, J.V. Pancho, J.P. Herberger. 1977. *The World's Worst Weeds: Distribution and Biology*. East-West Center/University Press of Hawaii. 609 pp.
- Hopper and Smith 1992 Hopper, D.R. and B.D. Smith. 1992. The status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H. E. Crampton in 1920. *Pacific Sci.* 46: 77–85.
- Horwood 1987 Horwood, J. 1987. *The sei whale: Population biology, ecology & management*. New York, New York: Croom Helm in association with Methuen, Inc.
- IWC 2001 International Whaling Commission (IWC). 2001. Report of the Workshop on the Comprehensive Assessment of Right Whales: a worldwide comparison. *Journal of Cetacean Research and Management*. Right whales: Worldwide status. Special Issue 2: 1–60.
- Janeke 2006 Janeke, D. 2006. Nocturnal movements and habitat use by the Mariana flying fox, *Pteropus mariannus mariannus*, on Guam. M.S. thesis, University of Guam. 103 pp.

- Jefferson et al. 1993 Jefferson, T.A., S. Leatherwood, and M.A. Webber. 1993. FAO species identification guide. Marine mammals of the world. Rome: Food and Agriculture Organization of the United Nations.
- Jenkins 1979 Jenkins, M.L. 1979. Natural history of the Guam Rail. *Condor* 81: 404–408.
- Jenkins 1983 Jenkins, M.L. 1983. The Native Forest Birds of Guam. Ornithological Monographs No. 31. The American Ornithologists' Union, Washington, DC. 1983. 61 pp.
- JGPO 2010 Joint Guam Program Office (JGPO). 2010. Final Environmental Impact Statement Guam and CNMI Military Relocation: Relocating Marines from Okinawa, Visiting Aircraft Carrier Berthing, and Army Air and Missile Defense Task Force. NAVFAC Pacific. July 2010.
- JRM 2011 Joint Regions Marianas. 2011. Joint Region Marianas Ungulate Management Plan and Environmental Assessment. Prepared by Globeteck Group, Guam, June 24, 2011. Pp. 164.
- Karolle 1993 Karolle, B. G. 1993. Atlas of Micronesia, Second Edition. Bess Press, Honolulu, Hawaii. 122 pp.
- Kellman and Tackaberry 1997 Kellman, M. and R. Tackaberry. 1997. Tropical environments: the functioning and management of tropical ecosystems. Routledge. New York, NY. 380 pp.
- Kenney and Winn 1987 Kenney, R.D. and H.E. Winn. 1987. Cetacean biomass densities near submarine canyons compared to adjacent shelf/slope areas. *Continental Shelf Research* 7: 107–114.
- Kenney et al. 1997 Kenney, R.D., G.P. Scott, T.J. Thompson, and H.E. Winn. 1997. Estimates of prey consumption and trophic impacts of cetaceans in the USA northeast continental shelf ecosystem. *Journal of Northwest Atlantic Fisheries Science* 22: 155–171.
- Keystone Center 1996 Keystone Center. 1996. Keystone Center Policy Dialogue on a Department of Defense Biodiversity Management Strategy, Final Report. Keystone, Colorado. January 1996.
- Knutson and Vogt 2002 Knutson, K. and S. Vogt. 2002. Philippine deer and feral pig population sampling on northern Guam. *Journal of Wildlife Management*. 7 pp.
- Kolinski 2001 Kolinski, S.P., D.M. Parker, L.I. Ilo, and J.K. Ruak. 2001. An assessment of the sea turtles and their marine and terrestrial habitats at Saipan, Commonwealth of the Northern Mariana Islands. *Micronesia* 34(1): 55–72.
- Leberer 2003 Leberer, T. 2003. Records of freshwater turtles on Guam, Mariana Islands, *Micronesia* 35-36: 649-652
- Leeuwenberg 1991 Leeuwenberg, A. 1991. A revision of *Tabernaemontana*. I. The Old World species, II. The New World Species. 1994 (Rev Tabern) 2: 271.

- McDonald and Jenson 2003 McDonald, M.Q. and J.W. Jenson. 2003. Chloride History and Trends of Water Production Wells In the Northern Guam Lens Aquifer. Water and Environmental Research Institute Technical Report No. 98. June 2003.
- Meijer et al. 1983 Meijer, A, M. Reagan, H. Ellis, M. Shafiqullah, J. Sutter, P. Damon, and S. Kling. 1983. Chronology of volcanic events in the eastern Philippine Sea. In Hayes, D.E. (Ed.), The tectonic and geologic evolution of southeast Asian seas and islands: Part 2: American Geophysical Union, Geophysical Monograph 27, Washington, DC, pages 349–359.
- Meinzer 1930 Meinzer, O.E. 1930. Ground water in the Hawaiian Islands. In: Stearns, H.T. and W.O. Clark, Geology and water resources of the Kau District, Hawaii: U.S. Geological Survey Water-Supply Paper 616, pages 1–28.
- Michael 2004 Michael, M. 2004. Incidental observations of dolphins, whales, and turtles during scuba diving excursions off Rota. Unpublished sighting data. Received 10 December 2004 from Mr. Mark Michael, Dive Rota, Commonwealth of the Northern Mariana Islands.
- Mink 1974 Mink, J.F. 1974. Groundwater resources of Guam: Occurrence and development, report to the Public Utility Agency, Guam, variously paged.
- Minton et al. 2009 Minton D, Foster K, Kessler C, Suhkraj N, Brown V, Kolinski S, Dugger K, Schils T, Flores T, Tenorio M, Trianni M, Houk P, Iguel J, Starmer J. 2009. *Marine Resource Survey of Tinian, Commonwealth of the Northern Mariana Islands* (Volume 1). Headquarters United States Marine Corps Technical Report, 55 pp.
- Mizroch et al. 1999 Mizroch, S.A., D.W. Rice, D. Zwiefelhofer, J. Waite, and W.L. Perryman. 1999. Distribution and movements of fin whales (*Balaenoptera physalus*) in the Pacific Ocean. Page 127 in: Abstracts, Thirteenth Biennial Conference on the Biology of Marine Mammals. 28 November–3 December 1999. Wailea, Maui.
- Moore 2007 Moore, A. 2007. Assessment of Rhinoceros Beetle Infestation on Guam. University of Guam. 28 October 2007. Updated October 31, 2007.
- Moore 2011 Moore, A. 2011. Guam Coconut Rhinoceros Beetle. Final Report for USDA FS Grant 08-DG-11052021-146. University of Guam Cooperative Extension Service. March 13, 2011.
- Morton 1996 Morton, J.M. 1996. Final Report – Effects of Aircraft Overflights on Endangered Manriana Crows and Mariana Fruit Bats at Andersen Air Force Base, Guam. Prepared by USFWS, Pacific Islands EcoRegion, Honolulu, HI for Department of the Navy, Naval Facilities engineering Command Pacific, Honolulu, HI. July 1996.
- Morton and Amidon 1996 Morton, J.M. and Amidon, F.A. Development of field techniques for studying and restoring the Vanikoro Swiftlet (*Aerodramus vanikorensis bartschi*) on Guam. U.S. Fish and Wildlife Service, Pacific Islands EcoRegion, Dededo, GU. 34 pp.

- Morton and Wiles 2002 Morton, J.M. and G.J. Wiles. 2002. Observations of Mariana Fruit Bats (*Pteropus mariannus*) in the upper Talofofu watershed on southern Guam. *Micronesica* 34(2): 155–163.
- Morton et al. 1999 Morton, J.M., S. Plentovich, and T. Sharp. 1999. Reproduction and juvenile dispersal of Mariana Crows (*Corvus kubaryi*) on Rota 1996-1999. Unpublished report submitted to the U.S. Fish and Wildlife Service, Honolulu, Hawai'i.
- Nafus 1992 Nafus, D.M. 1992. Impact of intentionally and accidentally introduced biological control agents on unintended hosts, *Hypolimnas anomala* and *H. Bolina* (Lepidoptera: Nymphalidae) on Guam. *Pac. Sci.* 46: 394.
- NAVFAC ESC SDS 2010 Naval Facilities Engineering Service Center (NAVFAC ESC). 2010. Final Deliverable for CNIC's INRMP Based Response to the Proposed Listing of 82 Species of Coral. Prepared by NAVFAC ESC. September 17, 2010.
- NAVFAC Pacific 2008 Naval Facilities Engineering Command, Pacific (NAVFAC Pacific). 2008. Guam Water Utility Study Report for Proposed USMC Relocation. Prepared by Earth Tech and TEC, Inc. Joint Venture. July 2008.
- NAVFAC Pacific 2010a NAVFAC Pacific. 2010. Preliminary Wetland Identification for Various Locations on Guam in Support of the Guam Military Buildup EIS. Pearl Harbor, HI.
- NAVFAC Pacific 2010b NAVFAC Pacific. 2010. Natural Resource Survey Report in Support of the Environmental Impact Statement for the Marine Corps Relocation Initiative to Various Locations on Guam. Final. December 23, 2010.
- NAVFAC Pacific 2010c NAVFAC Pacific. 2010. Draft Wetland Delineation Report San Luis Ponds, Naval Base Guam. Prepared for NAVFAC Pacific by HDR. January 2010.
- NMFS 1991 National Marine Fisheries Service (NMFS). 1991. Recovery Plan for the humpback whale (*Megaptera novaeangliae*). Prepared by the Humpback Whale Recovery Team for the National Marine Fisheries Service, Silver Spring, MD. 105 pp.
- NMFS 1998 NMFS. 1998. Designated critical habitat; green and hawksbill sea turtles. *Federal Register* 63: 46693–46701.
- NMFS 2008 NMFS. 2008. Final Rule for Fisheries in the Western Pacific; Pelagic Fisheries; Squid Jig Fisheries. *Federal Register* 73 (226): 70600–70603. November 21, 2008.
- NMFS 2010a NMFS. 2010. Endangered Species Act – Section 7 Consultation. Biological Opinion. August 25, 2010.
- NMFS 2010b NMFS. 2010. Recovery plan for the fin whale (*Balaenoptera physalus*). National Marine Fisheries Service, Silver Spring, MD. 121 pp.
- NMFS 2010c NMFS. 2010. Final Recovery Plan for the sperm whale (*Physeter macrocephalus*). National Marine Fisheries Service, Silver Spring, MD. 165 pp.

- NMFS and USFWS 1998a National Marine Fisheries Service and the U.S. Fish and Wildlife Service (NMFS and USFWS). 1998. Recovery Plan for the U.S. Pacific populations of the Green Turtle (*Chelonia mydas*). National Marine Fisheries Service, Silver Spring, MD. 84 pp.
- NMFS and USFWS 1998b NMFS and USFWS. 1998. Recovery plan for U.S. Pacific populations of the leatherback turtle (*Dermochelys coriacea*). National Marine Fisheries Service, Silver Spring, MD. 66 pp.
- NMFS and USFWS 1998c NMFS and USFWS. 1998. Recovery plan for U.S. Pacific populations of hawksbill turtle (*Eretmochelys imbricate*). National Marine Fisheries Service, Silver Spring, MD. 83pp.
- NMFS and USFWS 2007 NMFS and USFWS. 2007. Hawksbill Sea Turtle (*Eretmochelys imbricata*). 5-Year Review. 93 pp. Available online http://www.nmfs.noaa.gov/pr/pdfs/species/hawksbill_5yearreview.pdf
- NMFS and USFWS 2010 NMFS and USFWS. 2010. Endangered and threatened species; proposed listing of nine distinct population segments of loggerhead sea turtles as endangered or threatened. *Federal Register* 75: 12598–12656.
- NOAA 2006 National Oceanic and Atmospheric Administration (NOAA). 2006. Tidal Stations Locations and Ranges. Available online <<http://coops.nos.noaa.gov/tides06/tab2wc3.html>>. Accessed February 1, 2011.
- NOAA 2011a NOAA. 2011. About NOAA. Available online <<http://www.noaa.gov/about-noaa.html>>. Accessed April 2011.
- NOAA 2011b NOAA. 2011. About National Marine Fisheries Service. Available online <<http://www.nmfs.noaa.gov/>>. Accessed April 2011.
- Notarbartolo-di-Sciara et al. 2003 Notarbartolo-di-Sciara, G., M. Zanardelli, M. Jahoda, S. Panigada, and S. Airoldi. 2003. The fin whale *Balaenoptera physalus* (L. 1758) in the Mediterranean Sea. *Mammal Review* 33(2): 105–150.
- NRCS 1988 Natural Resources Conservation Service (NRCS). 1988. Soil Survey of Territory of Guam. U.S. Department of Agriculture, Natural Resources Conservation Service (formerly Soil Conservation Service). May 1988. Washington. DC. 166 pp.
- NRCS 2010 NRCS. 2010. Pacific Islands Area Official Soil Survey Information: Soils Data for Guam. Available online <http://www.pia.nrcs.usda.gov/soils_id_reports.asp>. Accessed January 2010.
- NRCS 2011 NRCS. 2011. About NRCS. Available online <<http://www.nrcs.usda.gov/about/>>. Accessed March 2011.
- NRLM 2007 Navy Research Laboratory Monterey (NRLM). 2007. Typhoon Havens Handbook for the Western Pacific and Indian Oceans. NRL/PU/7543-96-0025. Available online <http://www.nrlmry.navy.mil/port_studies/thh-nc/Ostart.htm>. Accessed May 2011.

- Omura et al. 1969 Omura, H., S. Ohsumi, T. Nemoto, K. Nasu, and T. Kasuya. 1969. Black right whales in the North Pacific. *Scientific Reports of the Whales Research Institute* 21: 1–78.
- PACAF 2006 Pacific Air Forces (PACAF). 2006. Final Environmental Impact Statement: Establishment and Operation of an Intelligence, Surveillance, Reconnaissance (ISR), and Strike Capability, Andersen Air Force Base, Guam. November 2006.
- Parsons 2006 Parsons. 2006. Field studies survey report for vegetation community mapping, Andersen AFB. Andersen Air Force Base, Yigo, GU.
- Paulay et al. 1997 Paulay, G., L. Kirkendale, G. Lamber, and J. Starmer. 1997. The Biodiversity of Apra Harbor: Significant Areas and Introduced Species, with Focus on Sponges, Echinoderms and Ascidiars. Prepared for U.S. Department of Defense, COMNAVMARIANAS, University of Guam Marine Laboratory, Mangilao, Guam.
- Paulay et al. 2001 Paulay G, L. Kirkendale, C. Meyer, P. Houk, T. Rongo, and R. Chang. 2001. Marine Biodiversity Resource Survey and Baseline Reef Monitoring Survey of the Southern Orote Peninsula and North Agat Bay Area. Prepared for the U.S. Navy by the URS Corporation and Dames and Moore. 111 pp.
- Paulay et al. 2002 Paulay, G., L. Kirkendale, G. Lambert, and C. Meyer. 2002. Anthropogenic Biotic Interchange in a Coral Reef Ecosystem: a Case Study from Guam. *Pacific Science* 56: 403–422.
- Payne et al. 1986 Payne, P.M., J.R. Nicolas, L. O'Brien, and K.D. Powers. 1986. Distribution of the humpback whale, *Megaptera novaeangliae* on Georges Bank and in the Gulf of Maine in relation to densities of the sand eel *Ammodytes americanus*. *Fisheries Bulletin, U.S.* 84: 271–277.
- PCR Environmental 2007 PCR Environmental, Inc. 2007. Guam Submerged Lands Management Plan, U.S. Navy Region Mariana. Prepared for: Commander, Navy Region Mariana. September 2007.
- Perez 1972 Perez, G. 1972. Observations of Guam bats. *Micronesica* 8: 141–149.
- Perry et al. 1999 Perry, S.L., D.P. DeMaster, and G.K. Silber. 1999. The great whales: History and status of six species listed as endangered under the U.S. Endangered Species Act of 1973. *Marine Fisheries Review* 61: 1–74.
- Pickard and Emery 1982 Pickard, G.L. and W.J. Emery. 1982. Descriptive physical oceanography: An introduction. 4th ed. Oxford, United Kingdom: Pergamon Press.
- Polovina et al. 2000 Polovina, J.J., D.R. Kobayashi, D.M. Ellis, M.P. Seki, and G.H. Balazs. 2000. Turtles on the edge: movement of loggerhead turtles (*Caretta caretta*) along oceanic fronts in the central North Pacific, 1997–1998. *Fisheries Oceanography* 9: 71–82.

- Polovina et al. 2001 Polovina, J.J., E. Howell, D.R. Kobayashi, and M.P. Seki. 2001. The transition zone chlorophyll front, a dynamic global feature defining migration and forage habitat for marine resources. *Progress in Oceanography* 49: 469–483.
- Polovina et al. 2004 Polovina, J.J., G.H. Balazs, E.A. Howell, D.M. Parker, M.P. Seki, and P.H. Dutton. 2004. Forage and migration habitat of loggerhead (*Caretta caretta*) and olive ridley (*Lepidochelys olivacea*) sea turtles in the central North Pacific Ocean. *Fisheries Oceanography* 13(1): 36–51.
- Porter et al. 2005 Porter, V., T. Leberer, M. Gawel, J. Gutierrez, D. Burdick, V. Torres, and E. Lujan. 2005. The state of coral reef ecosystems of Guam. In: J. Waddell (ed.), *The state of coral reef ecosystems of the United States and Pacific freely Associated States*: NOAA Technical Memorandum NOS NCCOS 11, pp. 442-487. NOAA/NCCOS Center for Coastal Monitoring and Assessment’s Biogeography Team. Silver Spring, MD.
- Ramey 2001 Ramey, V. 2001. “Hydrilla.” University of Florida IFAS Extension. Center for Aquatic and Invasive Plants. Available online <<http://plants.ifas.ufl.edu/node/183>>. Accessed May 2011.
- Randall 2005 Randall, J.E. 2005. *Reef and Shore Fishes of the South Pacific: New Caledonia to Tahiti and the Pitcairn Islands*. University of Hawaii Press. 707 pp.
- Raulerson and Rinehart 1991 Raulerson, L. and Rinehart, A. 1991. *Trees and Shrubs of the Northern Mariana Islands*. Coastal Resources Management, Office of the Governor, Commonwealth of the Northern Mariana Islands. Saipan, Northern Mariana Islands.
- Raulerson and Rinehart 1992 Raulerson, L. and Rinehart, A. 1992. *Ferns and Orchids of the Mariana Islands*. Lynn Raulerson and Agnes Rinehart, P.O. Box 428, Agana, Guam.
- Reagan and Meijer 1984 Reagan, M.K., and Meijer, A. 1984. Geology and geochemistry of early arc-volcanic rocks from Guam: *Geological Society of America Bulletin*, v. 95, pp. 701–713.
- Reeves and Kenney 2003 Reeves, R.R., and R.D. Kenney. 2003. Baleen whales: Right whales and allies. Pages 425-463 in G.A. Feldhamer, B.C. Thompson, and J.A. Chapman, eds. *Wild mammals of North America: Biology, management, and conservation*. 2d ed. Baltimore, Maryland: Johns Hopkins University Press.
- Reeves et al. 2002 Reeves, R.R., B.S. Stewart, P.J. Clapham, and J.A. Powell. 2002. *National Audubon Society Guide to Marine Mammals of the World*. New York: Alfred A. Knopf.
- Reilly and Thayer 1990 Reilly, S. and V.G. Thayer. 1990. Blue whale (*Balaenoptera musculus*) distribution in the eastern tropical Pacific. *Marine Mammal Science* 6(4): 265–277.

- Rice 1989 Rice, D.W. 1989. Sperm whale-*Physeter macrocephalus* (Linnaeus, 1758). Pages 177-234 in S.H. Ridgway and R. Harrison, eds. Handbook of Marine Mammals. Volume 4: River dolphins and the larger toothed whales. San Diego, California: Academic Press.
- Riegl et al. 2008 Riegl, B.M., S.J. Purkis, P. Houk, G. Cabrera, and R. Dodge. 2008. *Chapter 18: Geologic setting and geomorphology of coral reefs in the Mariana Islands (Guam and Commonwealth of the Northern Mariana Islands)*. Pages 691-718 in B.M. Riegl and RE Dodge (eds.), Coral Reefs of the USA. Coral Reefs of the World 1. Springer Science and Business Media B.V.
- RISC 2012 Regional Invasive Species Council (RISC) Report. 2012. 17th MCES March 14-15.
- Ritter and Savidge 1999 Ritter, M.W. and J.A. Savidge. 1999. A Predictive Model of Wetland Habitat Use on Guam by Endangered Mariana Common Moorhens. *The Condor* 101: 282–287. 1999.
- Rowntree et al. 1980 Rowntree, V., J. Darling, G. Siber, and M. Ferrari. 1980. Rare sighting of a right whale (*Eubalaena glacialis*) in Hawaii. *Canadian Journal of Zoology* 58: 309–312.
- Sagun et al. 2005 Sagun, V.G., N.B. Ramoso, Jr., and B.H. Mejino. 2005. New records on the distribution of loggerhead turtles (*Caretta caretta*) in the Philippines. *Marine Turtle Newsletter* 107: 12.
- Salden and Mickelsen 1999 Salden, D.R. and J. Mickelsen. 1999. Rare sighting of a North Pacific right whale (*Eubalaena glacialis*) in Hawai'i. *Pacific Science* 53(4): 341–345.
- Sampson 1986 Sampson, C. 1986. The *Hypolimnias octocula* complex, with notes on *H. inopinata* (Lepidoptera: Nymphalidae). *Tyo to Ga* 37: 15–43.
- Scarff 1986 Scarff, J.E. 1986. Historic and present distribution of the right whale (*Eubalaena glacialis*) in the eastern North Pacific south of 50°N and east of 180°W. *Reports of the International Whaling Commission. Special Issue* 10: 43–63.
- Schilling et al. 1992 Schilling, M.R., I.Seipt, M.T.Weinrich, S.E. Frokock, A.E. Kuhlberg, and P.J. Clapham. 1992. Behavior of individually-identified sei whales *Balaenoptera borealis* during an episodic influx into the southern Gulf of Main in 1986. *Fishery Bulletin* 90: 749–755.
- Schreiner and Nafus 1986 Schreiner, I. H. and D. Nafus. 1986. Accidental Introductions of Insect Pests to Guam, 1945-1985. *Proceedings, Hawaiian Entomological Society* 27: 45–52.
- Schreiner and Nafus 1996 Schreiner, I.H. and D.M. Nafus. 1996. Survey of rare butterflies in the Mariana Islands. Preliminary report to USFWS. 10 pp.
- Schreiner and Nafus 1997 Schreiner, I.H. and D.M. Nafus. 1997. *Butterflies of Micronesia*. University of Guam Press.

- Seale 1901 Seale, A. 1901. Report of a mission to Guam. Occasional Papers Bernice P. Bishop Museum, 1:17-128.
- Sheeline 1991 Sheeline, L. 1991. Cultural significance of Pacific fruit bats (*Pteropus* spp.) to the Chamorro people of Guam: conservation implications. Report to World Wildlife Fund/TRAFFIC USA. 97pp.
- Shilton and Whittaker 2009 Shilton, L.A. and R.J. Whittaker. 2009. The Role of Pteropodid Bats in Reestablishing Tropical Forests on Krakatau. In T.H. Fleming and P.A. Racey (Eds), *Island Bats*(117-216). Chicago IL, University of Chicago Press,.
- Smith 2004 Smith, S.H. 2004. Ecological assessment of the marine community in the vicinity of Kilo Wharf, Apra Harbor Guam. Naval Facilities Engineering Command Technical Report, 35 pp.
- Smith 2006 Smith, S.H. 2006. Marine ecological reconnaissance of selected shoal areas within Apra Harbor, Guam. Naval Facilities Engineering Command Technical Report, 19 pp.
- Smith 2007 Smith, S.H. 2007. Ecological Assessment of Stony Corals and Associated Organisms in the Eastern Portions of Apra Harbor, Guam. Naval Facilities Engineering Command Technical Report, 46 pp.
- Smith and Hopper 1994 Smith, B.D., and D.R. Hopper. 1994. The Partulidae of the Mariana Islands: Continued threats and declines. Hawaiian Shell News 42(6): 10–11.
- Smith and Marx 2006 Smith S.H., and D.E. Marx. 2006. Assessment of Stony Corals between Orote Point and Sumay Cove Apra Harbor, Guam. Naval Facilities Engineering Command Technical Report, 31 pp.
- Smith and Marx 2009 Smith, S.H. and D.E. Marx. 2009. Assessment of Stony Corals between Orote Point and Sumay Cove Apra Harbor, Guam. Naval Facilities Engineering Command Technical Report, 31 pp.
- Smith et al. 2008 Smith, B.D, R. Cooper-Nurse, and A. Gawel. 2008. Survey of Endangered Tree Snails on Navy-Owned Land in Guam. Prepared for the U.S. Navy by Marine Laboratory, University of Guam, Mangilao. Draft.
- SRS-Parsons 2007 SRS-Parsons. 2007. Marine Mammal and Sea Turtle Survey and Density Estimates for Guam and the Commonwealth of the Northern Mariana Islands. Prepared for Naval Facilities Engineering Command Pacific.
- Stone 1970 Stone, B.C. 1970. The Flora of Guam. A Manual for the Identification of the Vascular Plants of the Island. Micronesica Vol. 6. 659 pp.
- SWCA 2008 SWCA Environmental Consultants (SWCA). 2008. The Effects of Flight Operations on Endangered Mariana Fruit Bats and Mariana Crows: A Monitoring Program for Andersen AFB, Guam. Prepared by: SWCA Environmental Consultants. May 2008.

- SWCA 2010a SWCA. 2010. Orote Peninsula Ecological Reserve Area General Management Plan, Naval Base Guam. Prepared for: Naval Facilities Engineering Command, Mariana, NAVFACMAR. August 2010.
- SWCA 2010b SWCA. 2010. Haputo Ecological Reserve Area General Management Plan, Naval Base Guam. Prepared for: Naval Facilities Engineering Command, Mariana, NAVFACMAR. August 2010.
- SWCA 2012 SWCA. 2012. Draft Report: Mariana Fruit Bat and Mariana Crow Noise Study and Demographic Survey, Andersen AFB, Guam. January 2012.
- Sweezy 1942 Sweezy, O. H. 1942. Insects of Guam I, Lepidoptera (Butterflies of Guam). Bulletin B. P. Bishop Museum. 172: 31–38.
- Taitano 1991 Taitano, Z.Y. 1991. 3 whales sighted off Alupang cove. Press Release: Pacific Daily News, p. 8. February 13, 1991.
- Takano and Haig 2004 Takano, L.L. and S.M. Haig. 2004. Distribution and Abundance of the Mariana Subspecies of the Common Moorhen. *Waterbirds* 27(2): 245–250.
- Tate 1934 Tate, G.H.H. 1934. Bats from the Pacific Islands including a new fruit bat from Guam. *American Museum Novitates* No. 713.
- Tennent 2006 Tennent, W. J. 2006. A checklist of the butterflies of Melanesia, Micronesia, Polynesia and some adjacent areas. *Zootaxa* 1178. Magnolia Press, Auckland New Zealand, 209 pp.
- Townsend 1935 Townsend, C.H. 1935. The distribution of certain whales as shown by logbook records of American whalships. *Zoologica* 19(1): 1–50.
- Tracey et al. 1964 Tracey, J.I., Jr., S.O. Schlanger, J.T. Stark, D.B. Doan, and H.G. May. 1964. General geology of Guam: U.S. Geological Survey Professional Paper 403-A, 104 p., 3 pp.
- U.S. Navy 2006 U.S. Navy. 2006. Integrated Natural Resources Management Plan Guidance for Navy Installations How To Prepare, Implement, and Revise Integrated Natural Resources Management Plans (INRMP). April 10, 2006.
- U.S. Navy 2008 U.S. Navy. 2008. Sustaining our Environment, Protecting our Freedom. April 2008.
- U.S. Navy 2009 U.S. Navy. 2009. Interim Final Integrated Natural Resources Management Plan, Plan Years 2009 – 2014, Navy Base Guam. 2009.
- U.S. Navy 2010a U.S. Navy. 2010. Update of Integrated Natural Resources Management Plans for Navy Leased Lands on Tinian and Farallon de Medinilla, Plan Years 2010 – 2015. May 29, 2010.
- U.S. Navy 2010b U.S. Navy. 2010. Final Mariana Islands Range Complex Environmental Impact Statement/Overseas Environmental Impact Statement. 3 Volumes. Prepared for Commander, U.S. Pacific Fleet, Honolulu, Hawai'i. May 2010.

- U.S. Navy, U.S. Marine Corps, and U.S. Coast Guard 2007 U.S. Navy, U.S. Marine Corps and U.S. Coast Guard. 2007. A Cooperative Strategy for 21st Century Seapower. October 2007.
- UFL 2012 University of Florida Institute of Food and Agricultural Sciences. 2012. Featured Creatures: Little Fire Ant. Available online <http://entnemdept.ufl.edu/creatures/urban/ants/little_fire_ant.htm> . Accessed May 2012.
- UNEP-WCMC undated United Nations Environment Programme, World Conservation Monitoring Centre (UNEP-WCMC). Undated. "Naval Station Marsh." Protected Areas and World Heritage Programme.
- UOG 2007 University of Guam (UOG). 2007. Survey of *Tabernaemontana rotensis* on Andersen Air Force Base. Prepared for Andersen AFB. February 2007.
- USAF 1997 USAF. 1997. Dobbins ARB Oplan 91. Headquarters 94th Airlift Wing.
- USAF 2009 USAF. 2009. Final Integrated Natural Resources Management Plan and Environmental Assessment for Andersen Air Force Base, Guam. July 2009.
- USDA-WS 2011 U.S. Department of Agriculture –Wildlife Services (USDA-WS). 2011. About APHIS. Available online <http://www-mirror.aphis.usda.gov/about_aphis/programs_offices/wildlife_services/>. Accessed March 2011.
- USEPA 2004 U.S. Environmental Protection Agency (USEPA). 2004. Endangered and Threatened Wildlife and Plants; Review of Species That Are Candidates or Proposed for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions. Available online <<http://www.epa.gov/EPA-SPECIES/2004/May/Day-04/e9893.htm>>. Accessed July 2008.
- USEPA 2011 USEPA. 2006. About EPA. Available online <<http://www.epa.gov/epahome/aboutepa.htm>>. Accessed March 2011.
- USFWS 1984 U.S. Fish and Wildlife Service (USFWS). 1984. Endangered and threatened wildlife and plants; determination of endangered status for seven birds and two bats of Guam and the Northern Mariana Islands. Final rule. *Federal Register* 49: 33881–33885. August 27, 1984.
- USFWS 1990a USFWS. 1990. *Native forest birds of Guam and Rota of the Commonwealth of the Northern Mariana Islands Recovery Plan*. Portland, OR: U.S. Fish and Wildlife Service. 86 pp.
- USFWS 1990b USFWS. 1990. *Guam Mariana Fruit Bat and Little Mariana Fruit Bat Recovery Plan*. U.S. Fish and Wildlife Service, Portland, Oregon. 63 pp.

- USFWS 1991a USFWS. 1991. Endangered and threatened wildlife and plants; proposed designation of Critical Habitat for the little Mariana fruit bat, Mariana fruit bat, Guam broadbill, Mariana crow, Guam Micronesian kingfisher, and Guam bridled white-eye. *Federal Register* 56: 27485–27493.
- USFWS 1991b USFWS. 1991. Recovery Plan for the Mariana Islands Population of the Vanikoro Swiftlet, *Aerodramus vanikorensis bartschi*. U.S. Fish and Wildlife Service, Portland, OR. 49 pp.
- USFWS 1992 USFWS. 1992. *Recovery Plan for the Mariana Common Moorhen (Gallinula chloropus guami)*. U.S. Fish and Wildlife Service Region one, Portland, Oregon. September 1992.
- USFWS 1994a USFWS. 1994. Endangered and threatened wildlife and plants; withdrawal of proposed rule to designate critical habitat for the little Mariana fruit bat, Mariana fruit bat, Guam broadbill, Mariana crow, Guam Micronesian kingfisher, and Guam bridled white-eye. *Federal Register* 59: 15696–15700.
- USFWS 1994b USFWS. 1994. Endangered and threatened wildlife and plants; animal candidate review for listing as endangered or threatened species. *Federal Register* 59: 58982–59028.
- USFWS 1994c USFWS. 1994. Recovery plan for *Serianthes nelsonii*. U.S. Fish and Wildlife Service, Portland, OR. 60 pp.
- USFWS 1997 USFWS. 1997. Endangered and threatened wildlife and plants; review of plant and animal taxa that are candidate or proposed for listing as endangered or threatened, annual notice of findings on recycled petitions, and annual description of progress on listing actions. *Federal Register* 62: 49398–49411.
- USFWS 2000 USFWS. 2000. Endangered and threatened wildlife and plants; Proposed endangered status for three plants from the Mariana Islands and Guam. *Federal Register* 65: 35025–35033.
- USFWS 2002a USFWS. 2002. “Endangered and Threatened Wildlife and Plants; Determinations of Prudency for Two mammal and Four Bird Species in Guam and the Commonwealth of the Northern Mariana Islands and Proposed Designations of Critical Habitat for One Mammal and Two Bird Species.” *Federal Register* 67 (199): 63738–63772. October 15, 2002. Proposed Rules.
- USFWS 2002b USFWS. 2002. Endangered and threatened wildlife and plants; proposed rule to remove the Mariana mallard and the Guam broadbill from the Federal List of Endangered and Threatened Wildlife. *Federal Register* 67: 3675–3679.
- USFWS 2004a USFWS. 2004. Endangered and threatened wildlife and plants; Designation of critical habitat for the Mariana fruit bat and Guam Micronesian kingfisher on Guam and the Mariana crow on Guam and in the Commonwealth of the Northern Mariana Islands; Final Rule. *Federal Register* 69: 62944–62990.

- USFWS 2004b USFWS. 2004. Endangered and threatened wildlife and plants: Determination of endangered status and prudency determination for designation of critical habitat for two plant species from the Commonwealth of the Northern Mariana Islands. *Federal Register* 69: 18499–18507.
- USFWS 2005a USFWS. 2005. Endangered and threatened wildlife and plants; Mariana fruit bat (*Pteropus mariannus mariannus*): reclassification from endangered to threatened in the Territory of Guam and listing as threatened in the Commonwealth of the Northern Mariana Islands. *Federal Register* 70: 1190–1210. January 6, 2005.
- USFWS 2005b USFWS. 2005. Draft Revised Recovery Plan for the Aga or Mariana Crow, *Corvus kubaryi*. Portland, Oregon. x + 147 pp.
- USFWS 2008 USFWS. 2008. Threatened and Endangered Species System for Guam. Available online
<http://ecos.fws.gov/tess_public/pub/stateListingAndOccurrence.jsp?state=GU>. Accessed 16 July 2008.
- USFWS 2009a USFWS. 2009. U.S. Fish and Wildlife Service National Wetlands Inventory: Pacific Trust Islands (Guam and Saipan). Available online
<http://wetlandsfws.er.usgs.gov/imf/imf.jsp?site=NWI_PacTrust>. Accessed 4 May 2011.
- USFWS 2009b USFWS. 2009. Mariana Common Moorhen (*Gallinula chloropus guami*), 5-Year Review, Summary and Evaluation. U.S. Fish and Wildlife Services, Pacific Islands Fish and Wildlife Office, Honolulu, HI.
- USFWS 2010a USFWS. 2010. Endangered Species in the Pacific Islands; Mariana Crow, *Corvus kubaryi*, Aga. Available online
<<http://www.fws.gov/pacificislands/fauna/marianacrow.html>>. Accessed May 2011.
- USFWS 2010b USFWS. 2010. Species Assessment and Listing Priority Assignment Form, *Hypolimnas octocula marianensis*. Available online
<<http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?sPCODE=I0R7>>. Accessed May 2011.
- USFWS 2010c USFWS. 2010. Species Assessment and Listing Priority Assignment Form, *Vagrans egestina*. Available online
<<http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?sPCODE=I0R8>>. Accessed May 2011.
- USFWS 2010d USFWS. 2010. Species Assessment and Listing Priority Assignment Form, *Partula gibba*. Available online
<<http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?sPCODE=G0AC>>. Accessed May 2011.

- USFWS 2010e USFWS. 2010. Species Assessment and Listing Priority Assignment Form, *Partula radiolata*. Available online <<http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?scode=G0A8>>. Accessed March 2011.
- USGS 1992 U.S. Geological Survey (USGS) 1992. Geologic Map and Sections of Guam, Mariana Islands. 1:50,000. Plate I, Professional Paper 403A.
- USGS 2008 USGS. 2008. Extinctions and Loss of Species from Guam: Lizards. Available online <<http://www.fort.usgs.gov/resources/education/bts/impacts/herps.asp>>. Accessed June 2008.
- USGS 2010 USGS. 2010. Population Assessment of the Mariana Fruit Bat (*Pteropus mariannus mariannus*) on Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, and Maug; 15 June to 10 July 2010. July 2010.
- USGS 2012 USGS. 2012. Extinctions and Loss of Species from Guam: Birds. Available online <<http://www.fort.usgs.gov/resources/education/bts/impacts/birds.asp#gotohere2>>. Accessed May 2012.
- Vogt and Williams 2004 Vogt, S.R. and L.L. Williams. 2004. Common Flora and Fauna of the Mariana Islands. Laura L. Williams and Scott R. Vogt, Commonwealth of the Northern Mariana Islands, 158 pp.
- Ward et al. 1965 Ward, P.E., S.H. Hoffard, and D.A. Davis. 1965. Hydrology of Guam: U.S. Geological Survey Professional Paper 403-H, 28 p., 1 pl.
- Waring and Finn 1995 Waring, G.T. and J.T. Finn. 1995. Cetacean trophic interactions off the northeast USA inferred from spatial and temporal co-distribution patterns. Unpublished meeting document. ICES D.M. 1995/N:7: 1–44. Copenhagen, Denmark: International Council for the Exploration of the Sea.
- Waring et al. 2001 Waring, G.T., T. Hamazaki, D. Sheehan, G. Wood, and S. Baker. 2001. Characterization of beaked whale (*Ziphiidae*) and sperm whale (*Physeter macrocephalus*) summer habitat in shelf-edge and deeper waters off the northeast U.S. Marine Mammal Science 17(4): 703–717.
- Western Pacific Regional Fishery Management Council 1998 Western Pacific Regional Fishery Management Council (WPRFMC). 1998. Magnuson-Stevens Act Definitions and Required Provisions. Western Pacific Regional Fishery Management Council, Honolulu, HI. 1998.
- Wheeler 1979 Wheeler, M.E. 1979. The Mariana fruit bat: Management history, current status and future plans. *California-Nevada Wildlife Transactions* 1979: 149–165.
- Wheeler and Aguon 1978 Wheeler, M.E. and Aguon, C.F., 1978. The current status and distribution of the Marianas fruit bat on Guam. Aquatic and Wildlife Resources Division Technical Report No. 1. Guam Department of Agriculture, Division of Aquatic and Wildlife Resources, Mangilao, Guam, USA.

- Whittaker and Jones 1994 Whittaker R.J. and S.H. Jones. 1994. The role of frugivorous bats and birds in the rebuilding of a tropical forest ecosystem, Krakatau, Indonesia. *Journal of Biogeography* 21(3): 245–258.
- Wiles 1987a Wiles, G.J. 1987. Current research and future management of Mariana fruit bats (Chiroptera: Pteropodidae) on Guam. *Australian Mammalogy* 10: 93–95.
- Wiles 1987b Wiles, G.J. 1987. The status of fruit bats on Guam. *Pacific Science* 41: 148–157.
- Wiles 1987c Wiles, G.J. 1987. Natural history, biology, and habitat protection for the Mariana fruit bats. Pp. 124-135 *In* Aquatic and Wildlife Resources Division annual report, fiscal year 1987 Ed by G.R. Grimm and L.L. Mariano. Guam Department of Agriculture, Division of Aquatic and Wildlife resources, Mangilao, Guam, USA.
- Wiles 1989 Wiles, G.J. 1989. Natural History, Biology, and Habitat Protection for the Mariana Fruit Bats. Pp. 59-71 *In* Division of Aquatic and Wildlife Resources annual report, fiscal year 1989 Ed by C.F. Aguon, G.J. Wiles, and L.L. Mariano. Guam Division of Aquatic and Wildlife Resources. Mangilao, Guam, USA.
- Wiles 1990 Wiles, G.J. 1990. Natural history, biology, and habitat protection for Marianas fruit bats. Pp. 136-144 *In* Division of Aquatic and Wildlife Resources annual report, fiscal year 1990 Ed by R.D. Andersen, G.W. Davis, L.L. Mariano, T.J. Pitlik and G.J. Wiles. Guam Division of Aquatic and Wildlife Resources. Mangilao, Guam, USA.
- Wiles 1992 Wiles, G.J. 1992. Assessment of damage to Guam’s natural resources from Typhoon Omar. Appendix B *In*: Survey and Inventory of Non-Game Birds. Job Progress Report Research Project Segment, Federal Aid to Fish and Wildlife Restoration Project No. FW-2R-29. Guam Division of Aquatic and Wildlife Resources, Guam Department of Agriculture.
- Wiles 1998 Wiles, G.J. 1998. Current Status, Distribution, and Natural History of Mariana Fruit Bats. *In* G.W. Davis, T.J. Pitlik, and G.J. Wiles (Eds), Division of Aquatic and Wildlife Resources Annual Report FY 1998 (Pp. 117-123). Guam Department of Agriculture, Mangilao, Guam.
- Wiles 2005 Wiles, G.J. 2005. Decline of a population of wild seeded breadfruit (*Artocarpus marianensis*) on Guam, Mariana Islands. *Pacific Science* 59: 509–522.
- Wiles and Brooke 2009 Wiles, G.J., and A.P. Brooke 2009. Conservation threats to bats in the tropical Pacific islands and insular Southeast Asia. *In* Island bats: evolution, ecology, and conservation. Eds T. H. Fleming and P. A. Racey Univ Chicago Press. Pp 405-549. 2009.
- Wiles and Glass 1990 Wiles, G. J. and P.O. Glass. 1990. Interisland movements of the fruit bat (*Pteropus mariannus*) in the Mariana islands. *Atoll Research Bulletin* 343: 1–6.
- Wiles and Ritter 1993 Wiles, G.J. and M.W. Ritter. 1993. Guam, *In*: A Directory of Wetlands in Oceania, D.A. Scott, ed. International Waterfowl and Wetlands Research Bureau (IWRB), Slimbridge, U.K. and AWB, Kuala Lumpur, Malaysia.

- Wiles et al. 1989 Wiles, G.J., A.B. Amerson, Jr., and R.E. Beck, Jr. 1989. Notes on the herpetofauna of Tinian, Mariana Islands. *Micronesica* 22(1): 107–118.
- Wiles et al. 1990 Wiles, G.J., G.H. Rodda, T.H. Fritts, and E.M. Taisacan. 1990. Abundance and habitat use of reptiles on Rota, Mariana Islands. *Micronesica* 23(2): 153–166.
- Wiles et al. 1995 Wiles, G.J., C.F. Aguon, G.W. Davis, and D.J. Grout. 1995. The status and distribution of endangered animals and plants in northern Guam. *Micronesica* 28: 31–49.
- Wiles et al. 1999 Wiles, G.J., D.W. Buden, and D.J. Worthington. 1999. History of introduction, population status and management of Philippine deer (*Cervus mariannus*) on Micronesian islands. *Mammalia* 63: 193–215
- Wiles et al. 2003 Wiles, G., J. Bart, R.E. Beck, Jr., and C.F. Aguon. 2003. Impacts of the brown tree snake: patterns of decline and species persistence in Guam’s avifauna. *Conservation Biology* 17: 1350–1360.
- WPRFMC 2005 WPRFMC. 2005. *Fishery Ecosystem Plan for Pacific Remote Island Areas*. Honolulu, Hawaii: Western Pacific Fishery Management Council.
- WPRFMC 2009 WPRFMC. 2009. *Fishery Ecosystem Plan for Pacific Pelagic Fisheries of the Western Pacific Region*. Honolulu, Hawaii: Western Pacific Regional Fishery Management Council.
- Yochem and
Leatherwood 1985 Yochem, P.K., and S. Leatherwood. 1985. Blue whale *Balaenoptera musculus*. Pages 193-240 in S.H. Ridgway and R. Harrison, eds. *Handbook of marine mammals*. Volume 3: The sirenians and baleen whales. San Diego, California: Academic Press.