# COMPREHENSIVE WILDLIFE CONSERVATION STRATEGY
for the
# COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS

DIVISION OF FISH & WILDLIFE
CNMI

# COMPREHENSIVE WILDLIFE CONSERVATION STRATEGY
for the
# COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS

September 2005

Submitted to:
The National Advisory Acceptance Team
c/o Chris McKay
Assistant Regional Director for Migratory Birds and State Programs
U.S. Fish and Wildlife Service
911 NE 11th Avenue
Portland, OR 97232-4181

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September 27, 2005

National Advisory Acceptance Team
c/o Chris McKay
Assistant Regional Director
for Migratory Birds and State Programs
U.S. Fish and Wildlife Service
911 NE 11th Avenue
Portland, OR 97232-4181

Re: Submission of the Comprehensive Wildlife Conservation Strategy For the Commonwealth of the Northern Mariana Islands

Dear Mr. McKay:

The Commonwealth of the Northern Mariana Islands is pleased to submit its Comprehensive Wildlife Conservation Strategy (CWCS) to the National Advisory Acceptance Team for their approval. Enclosed you will find two hardcopies that are 3-hole punched, and an electronic copy in Adobe Reader format.

The CWCS presented to you here is the culmination of a year-and-a-half's hard work on the part of professional staff of our Division of Fish and Wildlife. Inasmuch as it was developed to satisfy the Eight Elements required by U.S. Congress, we have styled this strategy also to serve our local conservation needs. In one document, we have identified the species in greatest need of conservation, their habitats, priority research needed, and a set of conservation actions to give us conservation direction over the next decade.

Sincerely,

Richard B. Seman
Secretary
CNMI Department of Lands and Natural Resources

cc: (with duplicate electronic copy only)
Genevieve Pullis LaRouce, U.S. Fish and Wildlife Service, Arlington, VA
Paul Hamilton, Director, Division of Fish and Wildlife
Ernest Kosaka, USFWS, Honolulu

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# ABSTRACT

Under the mandate of the U.S. Congress, the Commonwealth of the Northern Mariana Islands (CNMI), Division of Fish and Wildlife (DFW) has joined the 50 states and 5 other territories in presenting its Comprehensive Wildlife Conservation Strategy (CWCS). A "road map" or guide to help the reader find information on each of the Eight Elements required by the CWCS is given in Chapter 1.

The CNMI consists of an archipelago of fourteen islands in the mid-Pacific, far from any continental land mass (Chapter 2). The assemblage of native terrestrial wildlife in the Mariana Islands is characterized by a high degree of endemism, occupying a variety of terrestrial habitats (Chapter 4). Working with professional biologists on staff at DFW and other experts in their fields, researching the available literature, and soliciting the public opinion, the authors of this CWCS have identified the species of special conservation need for the CNMI (Chapter 3). Information on these species of special conservation need is presented in two parts: terrestrial species (Chapter 5) and marine species (Chapter 8). For each species, a profile is presented which is intended to address five of the Eight Elements. Each profile describes the following attributes: common name, scientific name, Chamorro name, Carolinean name, listing status, reasons for selecting the species for special conservation, unique characteristics, distribution, abundance, location and condition of habitats, problems adversely affecting the species and its habitats, priority research, conservation actions, and monitoring. Conservation actions for terrestrial species are fully described in Chapter 6, whereas conservation actions for marine species are described within each marine species profile (Chapter 8). Literature sources for terrestrial habitats and terrestrial species are separately listed in Chapter 7, whereas literature citations for marine species and their habitats are given within each marine species profile in Chapter 8.

Fulfillment of the remaining three elements is presented in Chapters 9 and 10. The participation of the public and of government agencies was sought in the development of this CWCS (Chapter 9). Coordination with agencies, and procedures to review the CWCS are presented in Chapter 10.

# LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| **BBS** | breeding bird surveys |
| **BTS** | Brown Treesnake |
| **CNMI** | Commonwealth of the Northern Mariana Islands |
| **CWCP** | Comprehensive Wildlife Conservation Plan (used synonymously with CWCS) |
| **CWCS** | Comprehensive Wildlife Conservation Strategy (used synonymously with CWCP) |
| **DFW** | Division of Fish and Wildlife, of the CNMI Department of Lands and Natural Resources |
| **ESA** | Endangered Species Act of 1973 |
| **FDM** | Farallon de Medinilla |
| **ha** | hectare (an area equivalent to 10,000 square meters) |
| **INRMP** | Integrated Natural Resources Management Plan, of the U.S. Navy, for military lease areas on Tinian and FDM |
| **IUCN** | International Union for the Conservation of Nature and Natural Resources; also, The World Conservation Union |
| **m** | meter |
| **MLA** | Military Lease Area; lands within the CNMI legally leased to the United States under the Leaseback and Disposal Agreement between the Commonwealth of the Northern Mariana Islands and the United States of America made pursuant to the Covenant to Establish a Commonwealth of the Northern Mariana Islands in Political Union with the United States of America |
| **MPLA** | Marianas Public Lands Authority |
| **n.d.** | no date |
| **n.p.** | no publisher |
| **SWG** | State Wildlife Grant |
| **SWW** | Shorebird, wader and waterbird |
| **U.S.** | United States |
| **USFWS** | United States Fish and Wildlife Service |

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# Chapter 1:

# WHERE WE START




DIVISION OF FISH & WILDLIFE
CNMI







# Chapter 1: WHERE WE START

## Mandate to prepare a Comprehensive Wildlife Conservation Strategy

The Division of Fish and Wildlife (DFW) of the Commonwealth of the Northern Mariana Islands (CNMI), Department of Lands and Natural Resources (DLNR), is the lead agency responsible for studying, conserving and managing fish and wildlife resources. Since the 1980s, DFW has utilized traditional federal grants to fulfill this responsibility, made available through the Pittman-Robertson Wildlife Restoration Act of 1937, and the Dingell-Johnson Sportfish Restoration Act of 1950. These traditional programs are funded by hunter and angler license fees and excise taxes. In recent years, other grant programs, such as Section 6 funding under the Endangered Species Act, have supplemented DFW's efforts.

The State Wildlife Grant Program, initiated by the U.S. Congress in 2001, provides funding by congressional appropriation to every state and territory to support conservation aimed at preventing wildlife from becoming endangered. This new program is intended to be focused on species of special conservation need: species that are not fished or hunted, species that are declining but are not afforded protection status, species that are common but facing threats, species that are "falling through the cracks" of the states' and territories' conservation efforts.

The U.S. Congress required each state and territory to write a Comprehensive Wildlife Conservation Strategy, to be completed by October 2005. This document is the CWCS for the Commonwealth of the Northern Mariana Islands, prepared to fulfill that mandate.

## The Eight Elements

Congress identified eight required elements to be addressed in each state's Comprehensive Wildlife Conservation Strategy. Congress also directed that the strategies must identify and be focused on "species in greatest need of conservation", yet address the "full array of wildlife" and wildlife-related issues. The strategies must address each of the following eight elements.

1. **Information on the distribution and abundance of species of wildlife**, including low and declining populations as the State fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the State's wildlife.
2. **Descriptions of locations and relative condition of key habitats and community types** essential to conservation of species identified in Element 1.
3. **Descriptions of problems which may adversely affect species identified in Element 1 or their habitats, and priority research and survey efforts** needed to identify factors which may assist in restoration and improved conservation of these species and habitats.
4. **Descriptions of conservation actions** proposed to conserve the identified species and habitats and priorities for implementing such actions.

5. **Proposed plans for monitoring** species identified in Element 1 and their habitats, for monitoring the effectiveness of the conservation actions proposed in Element 4, and for adapting these conservation actions to respond appropriately to new information or changing conditions.
6. **Descriptions of procedures to review the strategy** at intervals not to exceed ten years.
7. Plans for **coordinating the development, implementation, review, and revision of the plan with Federal, State, and local agencies and Indian tribes** that manage significant land and water areas within the State or administer programs that significantly affect the conservation of identified species and habitats.
8. Congress also affirmed through this legislation that **broad public participation** is an essential element of developing and implementing these plans, the projects that are carried out while these plans are developed, and the Species in Greatest Need of Conservation that Congress has indicated such programs and projects are intended to emphasize.

## Road Map to the Eight Elements in this CWCS

The Comprehensive Wildlife Conservation Strategy for the CNMI was designed to address each of the Eight Elements required by Congress. The National Advisory Acceptance Team, the body reviewing this CWCS for Congressional approval, has requested that a "road map" be provided to guide reviewers to each of the Eight Elements. Such a guide follows. To find specific page numbers for chapters and headings listed in this guide, the reader can consult the Table of Contents at the beginning of this document.

| For Element: | As it applies to: | Go to Chapter: | Under the heading(s): |
|---|---|---|---|
| | Species in greatest need of conservation – terrestrial species | 3 | "Terrestrial species" and Table 3 |
| | Species in greatest need of conservation – marine species | 3 | "Marine species" and Table 4 |
| | Full array of wildlife – terrestrial wildlife | 3 | "Addressing the full array of terrestrial wildlife" |
| | Full array of wildlife – marine fish and wildlife | 3 | "Addressing the full array of marine fish and wildlife" |
| 1 | Distribution of species of wildlife – terrestrial | 5 | "Distribution of the [species] in the CNMI", under each individual species profile |
| 1 | Abundance of species of wildlife | 5 | "Abundance of the [species] in the CNMI", under each individual species profile |
| 1 | Distribution of species of wildlife – marine | 8 | "Distribution of the [species] in the CNMI", under each individual species profile |
| 1 | Abundance of species of wildlife – marine | 8 | "Abundance of the [species] in the CNMI", under each individual species profile |
| 2 | Locations and relative condition of key habitats – for all terrestrial habitats in the CNMI | 4 | "Characteristics of terrestrial habitats in the CNMI", and<br>"Location and relative condition of key wildlife habitats in the CNMI" |

| For Element: | As it applies to: | Go to Chapter: | Under the heading(s): |
|---|---|---|---|
| 2 | Locations and relative condition of key habitats – species specific, terrestrial | 5 | “Location and relative condition of key habitats for the [species] in the CNMI”, under each individual species profile |
| 2 | Locations and relative condition of key habitats – species specific, marine | 8 | “Location and relative condition of key habitats for the [species] in the CNMI”, under each individual species profile |
| 3 | Problems which may adversely affect species or their habitats – habitats of terrestrial species | 4 | “Problems which adversely affect terrestrial habitats” |
| 3 | Problems which may adversely affect species or their habitats – terrestrial species | 5 | “Problems which adversely affect the [species] in the CNMI”, under each individual species profile |
| 3 | Problems which may adversely affect species or their habitats – marine species and their habitats | 8 | “Problems which adversely affect the [species] in the CNMI”, under each individual species profile |
| 3 | Priority research and survey efforts – terrestrial habitats | 4 | “Priority research and survey efforts needed for improved conservation of terrestrial habitats” |
| 3 | Priority research and survey efforts – terrestrial species | 5 | “Priority research and survey efforts”, under each individual species profile |
| 3 | Priority research and survey efforts – marine species and their habitats | 8 | “Priority research and survey efforts”, under each individual species profile |
| 4 | Conservation actions – listing for terrestrial habitats | 4 | “Conservation actions for terrestrial habitats” |
| 4 | Conservation actions – listing for terrestrial species | 5 | “Conservation actions”, under each individual species profile |
| 4 | Conservation actions – full descriptions for terrestrial habitats and terrestrial species, and priorities for implementing such actions | 6 | Entire Chapter 6 |
| 4 | Conservation actions – full descriptions for marine species and priorities for implementing such actions | 8 | “Conservation actions”, under each individual species profile |
| 5 | Monitoring – terrestrial habitats | 4 | “Monitoring of terrestrial habitats in the CNMI” |
| 5 | Monitoring – terrestrial species | 5 | “Monitoring”, under each individual species profile |
| 5 | Monitoring – marine species | 8 | “Monitoring”, under each individual species profile |
| 5 | Monitoring – effectiveness of conservation actions | 10 | “Monitoring the effectiveness of conservation actions” |
| 5 | Monitoring – adapting actions to new information and changing conditions | 10 | “Adapting conservation actions to respond appropriately to new information or changing conditions” |
| 6 | Procedures to review the strategy | 10 | “A procedure to review and revise the CNMI’s Comprehensive Wildlife Conservation Strategy” |
| 7 | Coordination with federal, state, and local agencies – development of CWCS | 10 | “Agency participation in the development of the CWCS” |

| For Element: | As it applies to: | Go to Chapter: | Under the heading(s): |
|---|---|---|---|
| 7 | Coordination with federal, state, and local agencies – implementation, review and revision of CWCS | 10 | "Agency participation in the implementation, review and revision of the CWCS" |
| 8 | Public participation | 9 | The entire Chapter 9 addresses how the public participated in the development of the CWCS for the CNMI, including: developing a list of stakeholders; getting public input on the list of species of special conservation need, problems and conservation actions; and recommendations for future public participation |

## Data Gathering Approach

Numerous resources were tapped to compile the data needed to satisfy the Eight Elements for CNMI's Comprehensive Wildlife Conservation Strategy.

- Consultation with experts – A number of scientists who are experts in their fields were consulted to provide literature, data, and photographs, to offer their professional opinions, and to review drafts.
- Literature review – Information was gleaned from a thorough review of available literature, both published and unpublished.
- Analysis of known data – Examination of recently obtained data helped to determine population trends for some species.
- Opinions offered by the public – During the public participation phase of the development of this CWCS, opinions were offered about reasons for decline of some species, species were proposed to be added to the list of species of special conservation need, and suggestions were made for conservation actions. This local information was helpful, because it usually does not appear in the literature. Insight into what the public thinks is important was also gained.
- Non-governmental organizations (NGOs) -- NGOs which have assisted in the preparation of CWCS documents for other states do not have any presence in the CNMI. For example, The Nature Conservancy and Partners in Flight do not cover these islands in their databases. During the public participation phase of development of the CWCS for the CNMI, local NGOs were contacted and invited to participate.

## Authorship and Acknowledgements

This Comprehensive Wildlife Conservation Strategy document was researched, developed and written over a period of a year and a half by three individuals. Gayle M. Berger, Natural Resources Planner for the CNMI Division of Fish and Wildlife, wrote Chapters 1 through 7, and Chapter 10. John Gourley of Micronesian Environmental Services wrote Chapter 8, Marine Species Profiles, under an independent contract. Greg Schroer of Resources Northwest wrote Chapter 9, Public Participation, under an independent contract. Gayle Berger compiled the final document. All costs for production of this document were paid out of the State Wildlife Grant made to the CNMI Division of Fish and Wildlife through U.S. Fish and Wildlife Service Federal Aid.

Completion of a project of this magnitude would not have been possible without help from numerous people. Wildlife biologists, wildlife technicians, fisheries biologists and fisheries technicians on staff with the CNMI Division of Fish and Wildlife provided information based on their field observations, unpublished data and professional opinions. Appreciation is extended to Laura Williams, Shelly Kremer, Nate Hawley and Ben Camacho of the Wildlife Section; to Michael Trianni, Michael Tenorio and Larry Ilo of the Fisheries Section; and to Kate Moots, formerly of the Fisheries Section and now working independently.

Experts from other CNMI environmental agencies reviewed drafts, provided literature and made suggestions. Appreciation is extended to John Starmer and Erica Cochrane of the CNMI Coastal Resources Management Office; to Peter Houk of the Division of Environmental Quality; to Henry Hofschneider of DLNR; and to John San Nicolas of Tinian DLNR.

A number of experts outside of the CNMI provided literature (both published and unpublished) and photographs, reviewed drafts, clarified conclusions, and offered professional opinions. Barry Smith of the University of Guam, Marine Biology Laboratory was very helpful in developing conservation actions regarding endemic land snails. Dr. Rangaswamy Muniappan at the University of Guam, College of Agriculture and Life Science clarified how biological controls are being used to combat the spread of scarlet gourd (*Coccinia grandis*). Scott Vogt of the U.S. Navy was consulted regarding wildlife on Navy-leased lands on Tinian and FDM. A great deal of gratitude is extended to Fred Amidon and Curt Kessler of the U.S. Fish and Wildlife Service, who provided literature, answered endless questions, and gave generous doses of moral support when it seemed this project would never come to an end.

Several individuals were especially helpful in gathering public comments. We appreciate the efforts of Stan Taisacan and Shelwyn Taisacan of Rota, Henry Cabrera of Tinian and John Castro of Saipan.

Finally, thanks goes to Paul Hamilton, Director of the Division of Fish and Wildlife, and to Richard Seman, Secretary of the CNMI Department of Lands and Natural Resources, for their generous encouragement and support.

# Chapter 2:

# THE ISLANDS

# Chapter 2: THE ISLANDS

## **Location**

The Northern Mariana Islands consist of an archipelago of 15 islands in the mid-Pacific Ocean. The island chain spans a distance of 675 km, from Guam, the largest and most populous island in the south, to Uracas, a tiny, unpopulated volcanic island in the north. The Marianas Trench parallels the archipelago to the east. (See Figure 1.) The Marianas are a part of Micronesia, a scattering of hundreds of tiny islands throughout the mid-Pacific Ocean, far from the mainland. Flight time from Saipan to Japan, the nearest continental landfall, is more than three hours, a distance of nearly 1,500 miles.

I can see for miles and miles.
I can see for miles and miles.
I can see for miles and miles and miles and miles and miles.
Oh, yeah.
-- The Who

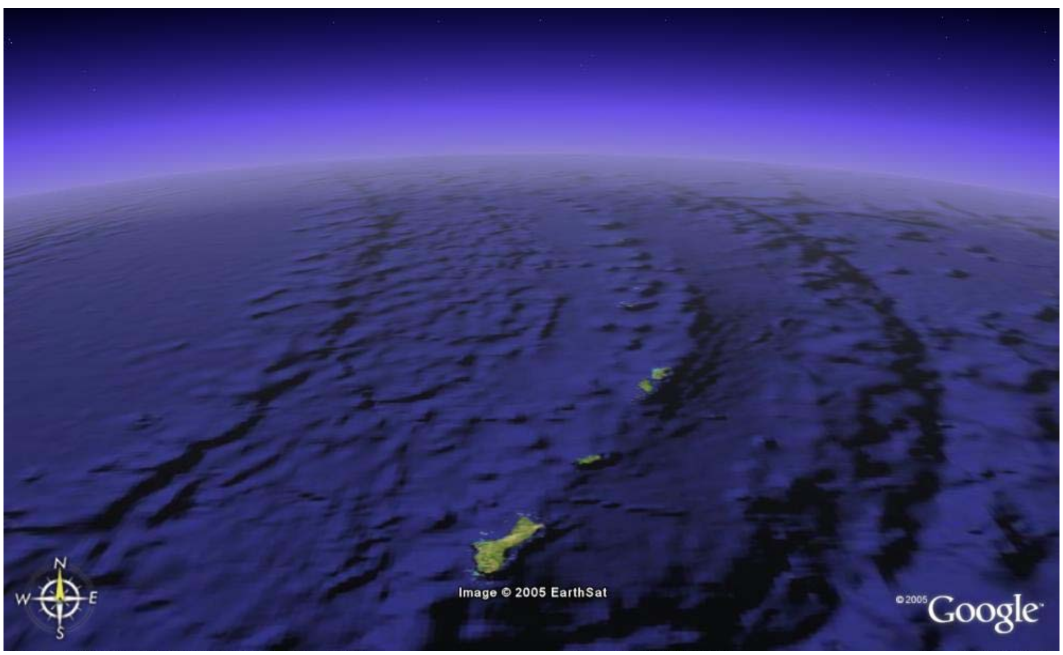


Figure 1. Tilted satellite mosaic image, showing the Northern Mariana Islands archipelago.
Guam is the largest island in the foreground, followed upward by Rota, Tinian and Saipan. The smaller northern islands are barely discernable as a second arc initiating to the northwest of Saipan. The Marianas Trench is visible in this image. Image taken from Google Earth.

## **Political Status**

The Northern Mariana Islands are separated into two different political jurisdictions. The island of Guam is a U.S. territory. The other 14 islands of the archipelago became the Commonwealth of the Northern Mariana Islands (CNMI) in 1976 through The Covenant to Establish a Commonwealth of the Northern Mariana Islands in Political Union with the

United States of America (hereinafter, “Covenant”). The CNMI is generally thought of as a territory of the United States, although its relationship through the Covenant is a unique one. This Comprehensive Wildlife Conservation Strategy document pertains to the CNMI, and not to Guam.

**Geology**

The Northern Mariana Islands archipelago consists of two geologically different arcs. The “southern islands” of Guam, Rota, Tinian, Aguiguan, Saipan and Farallon de Medinilla form an arc of islands constructed of raised limestone with reef flats along shore lines. The “northern islands” of Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, Maug and Uracas form a second arc of volcanic islands, offset to the northwest of the southern islands (Asakura et al. 1994). (See Figure 2.)

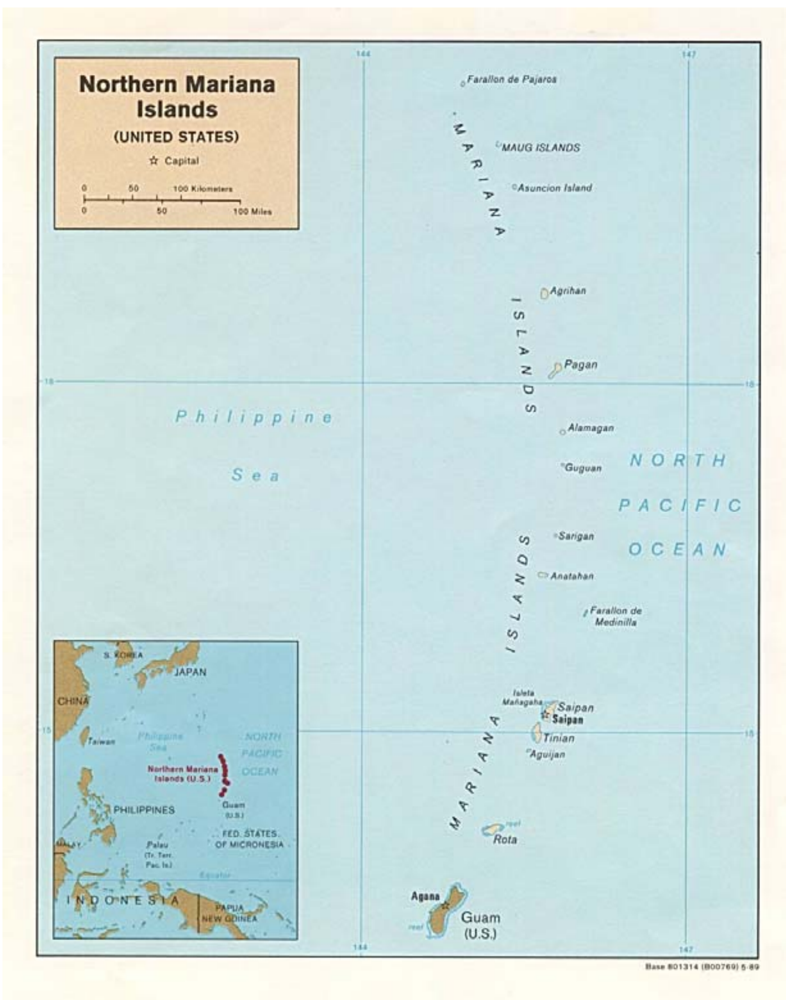


Figure 2. Map of the Northern Mariana Islands.
Map taken from http://www.gesource.ac.uk/worldguide/html/981_map.html

The southern islands are volcanic in origin, but are nearly all covered with uplifted limestone from ancient coral reefs. The limestone creates a flat, “layer-cake” topography with numerous caves, both above and below sea level. The southern islands have the oldest and most developed reefs in the Mariana Islands. Reefs are generally most developed on the western (leeward) sides of the islands (NOAA National Marine Fisheries Service 2005).

The geologically younger northern islands are primarily made up of very recent (4,000 year old) volcanic materials (*ibid.*).

Some of the volcanoes on the northern islands are presently active: Pagan's large eruption in 1981 prompted the evacuation of the island; Anatahan erupted violently with ash plumes starting in May of 2003 and has not stopped since (Global Volcanism Program 2005). The extent of reefs around the northern islands is varied. In general, the younger, more northerly Mariana Islands have sparse, low diversity coral reef communities. Around only a few of the northern banks and islands (e.g. Maug, Guguan, and Stingray Shoals), diverse coral communities with as many as 60 coral species have been observed (NOAA National Marine Fisheries Service 2005).

## Climate

The Mariana Islands enjoys a tropical climate. Temperatures are warm, ranging from 84° to 90° F. (29° to 32° C.) during the day and 70° to 75° F. (21° to 24° C.) at night. The average annual wind velocity is 10.5 miles per hour. Annual rainfall averages 78 to 102 inches (200 to 260 cm). Relative humidity is approximately 65 to 75 percent in the afternoons and 85 to 100 percent during the evenings (Helber Hastert and Fee 2003). Two seasons vary with respect to wind condition and amount of rainfall. The "wet season" lasts from approximately August through December, when tropical storms and typhoons are likely to occur. During the "dry season", from about January through July, winds die down and rainfall is limited. The CNMI experiences numerous typhoons, some of them with devastating effects on forested wildlife habitat. (In fact, this chapter is being drafted during Typhoon Nabi, with wind gusts up to 100 mph, and with thanks to a long-life laptop battery.)

## Features of individual islands

Features of individual islands within the CNMI, including island size, location, land form and human population, are given in Table 1. The size of islands in the Mariana archipelago generally becomes smaller from south to north. Landforms vary from uplifted limestone terraces in the south to steep-sided, young volcanoes in the north. Most of the CNMI's population resides on Saipan, with smaller numbers of people residing on Rota and Tinian; a few families live on Alamagan, Pagan and Agrihan. All of these features have influenced the distribution of wildlife species of special conservation need in the CNMI.

## Conservation areas

Several areas have been set aside for the conservation of terrestrial wildlife and marine species in the CNMI. These conservation areas have been established through various legal means: the CNMI Constitution, CNMI public laws and local laws, by agreement between government agencies, and by regulation. Table 2 gives the name, location, type and purpose, and enabling legislation for each of the conservation areas in the CNMI. Conservation areas for the islands of Rota and Saipan are depicted in Figures 3 and 4.

Table 1. Features of islands in the CNMI.
Island sizes, latitude / longitude, and land form for the southern islands are taken from Engbring et al. 1986 and U.S. Fish and Wildlife Service 2005a. Data for Farallon de Medinilla is taken from Helber Hastert & Fee 2003. Island sizes, latitude / longitude, and land form for the northern islands are taken from Asakura et al. 1994, U.S. Fish and Wildlife Service 2005a and Gourley 2005. Human population figures for the southern islands come from the 2000 Census; for the northern islands from estimates provided by Saipan and Northern Islands Mayor's Office in 2005.

| ISLAND | SIZE (area; dimensions) | LATITUDE, LONGITUDE | LAND FORM | HUMAN POPULATION |
|---|---|---|---|---|
| Rota | 95.7 sq. km; 20 km long, 6 km wide | 14° 10' N, 145° 12' E | Uplifted limestone mesa at 450 m elevation forms the Sabana, dropping off in steep cliffs to north, west and south, and more gently to broad plain at 150 m on northeast side. | 3,283 |
| Aguiguan | 7.0 sq. km; 5 km long, 1.5 km wide | 14° 51' N, 145° 34' E | Several well-defined limestone plateaus or shelves, the highest at 150 m elevation. Steep scarps about 30 m high surround entire island making boat access extremely difficult. Naftan Rock is an islet 1 km off southwest coast of Aguiguan. | Uninhabited |
| Tinian | 101.8 sq. km; 20 km long, 8 km wide | 15° N, 145° 38' E | Low, level terrain, broken by a few relatively gentle cliffs. Highest point is 178 m. Coastline is rocky and rugged and unprotected from wave action except at harbor on southwest coast which is protected by a reef system. Rich soils. | 3,540 |
| Saipan | 122.9 sq. km; 22 km long, 3-10 km wide | 15° 12' N, 145° 45' E | Rugged limestone ridge topped by Mt. Tapochao (436 m) extends through centerline of northern ¾ of the island. Three major, low-lying plateaus extend from base of ridge. Soils derived from limestone with volcanic pockets. Northeast and south shorelines consist of steep cliffs broken by pocket beaches. Nearly entire western coast is extensive sand beach, protected by barrier reef. Mañagaha Island is coral islet on the reef on western side; Bird Island and Forbidden Island are eroded limestone islets on the eastern side. | 62,392 |
| Farallon de Medinilla | 0.8 sq. km; 2.8 km long, 0.45 km wide | 16° 01' N, 146° 04' E | Uplifted limestone plateau with highest elevation at 25 m. Perimeter characterized by steep eroding cliffs as high as 25 m from surrounding ocean. | Uninhabited |
| Anatahan | 32.3 sq. km; 4 km long, 9.5 km wide | 16° 22' N, 145° 40' E | Volcanic island formed by two coalescing volcanoes with a 2.5 x 5 km, east-west trending summit depression formed by overlapping summit craters. Highest elevation is 788 m. Currently volcanically very active, with ash plumes and frequent earthquakes. Ash plume on April 6, 2005 reached 50,000 ft. | Uninhabited |

| ISLAND | SIZE (area; dimensions) | LATITUDE, LONGITUDE | LAND FORM | HUMAN POPULATION |
|---|---|---|---|---|
| Sarigan | 5.0 sq. km; 3 km in diameter | 16° 42' N, 145° 47' E | Extinct volcano; no historically recorded volcanic activity. Highest elevation 549 m. Roughly triangular in shape. Irregular shoreline with steep cliffs created by old lava flows. | Uninhabited |
| Guguan | 4.0 sq. km; roughly 2 km in diameter | 17° 19' N, 145° 51' E | Island comprised of barren active volcano on northern side and old, eroded but vegetated cone on southern side. Maximum elevation is 301 m. Most of shoreline is steep cliffs. Eruptions recorded for 1882 and 1884. | Uninhabited |
| Alamagan | 11.2 sq. km; roughly 3.5 km in diameter | 17° 35' N, 145° 51' E | Alamagan is the emergent summit of a large stratovolcano with a roughly 350 m deep summit crater east of the center of the island. A 1.6 by 1 km graben cuts the southwest flank. Highest elevation is 744 m. Most of recent eruptions (within the last 1,000 years) have been violently explosive; thick pyroclastic flow deposits cover most of the island. Fumerolic activity continues. | 20 to 25 |
| Pagan | 47.7 sq. km; roughly 11 km long, 1 to 3.5 km wide | 18° 06' N, 145° 46' E | Largest of the northern islands, and the only northern island with a fringing coral reef. Raised reef limestone and limestone conglomerate shores are found at the north, along the east and at the west. Island consists of two volcanic mountains connected by a narrow isthmus. Maximum altitude is 570 m. Recently volcanically active; numerous eruptions have occurred in $19^{th}$ and $20^{th}$ centuries; 1981 eruption resulted in evacuation of the island. | 20 to 30 |
| Agrihan | 47.4 sq. km; roughly 8 km long, 5 km wide | 18° 46' N, 145° 40' E | The highest elevation in the Mariana Islands at 965 m. Elliptical shape. This island is the top of a massive 4,000 m high submarine volcano. Deep radial valleys dissect the flanks of this thickly vegetated stratovolcano. Elongated caldera is 1 x 2 km wide, and is breached to the northwest, from where a prominent lava flow extends to the coast and forms a lava delta. The only historical eruption occurred in 1917. Fumarolic activity observed in 1990. | 10 to 12 |
| Asuncion | 7.4 sq. km; 3.4 km long, 2.6 km wide | 19° 40' N, 145° 24' E | A single, large asymmetrical volcano. Maximum elevation is 891 m. Northeast sides are steeper and terminate in high sea cliffs. Southern and western flanks are mantled by ash deposits that may have originated in historic times. An explosive eruption occurred in 1906; steam from numerous locations in summit crated observed in 1992. | Uninhabited |

| ISLAND | SIZE (area; dimensions) | LATITUDE, LONGITUDE | LAND FORM | HUMAN POPULATION |
|---|---|---|---|---|
| Maug | 2.1 sq. km (for all 3 islets total); each islet less than 1.5 km long and less than 0.5 km wide | 20° 01' N, 145° 13' E | Maug consists of three islets, the remnants of a large stratovolcano enclosing a 2.5 km wide caldera containing a submerged central cone that rises to within 20 m of the sea surface. Elevations: North Maug is 277 m, East Maug is 215 m and West Maug is 178 m. Coral reefs present. No historical eruptions recorded. | Uninhabited |
| Uracas | 2.0 sq. km; roughly 1.25 km in diameter | 20° 32' N, 144° 54' E | Symmetrical, sparsely vegetated volcano. Maximum elevation is 334 m. Summit and flank vents have been continuously active with steaming and minor eruptions since early 1900s. Makhahnas Seamount lies 10 km to the southeast. | Uninhabited |

Table 2. Conservation Areas of the CNMI.

| Conservation Area | Location | Type and Purpose | Enabling Law |
|---|---|---|---|
| Sabana Heights Wildlife Conservation Area | Rota, Sabana plateau | Terrestrial, for wildlife conservation | Rota Local Law 9-1 and regulations promulgated under Public Law 2-51 |
| I Chenchon Park Wildlife Conservation Area and Bird Sanctuary | Rota, cliffs along eastern coast | Terrestrial, for wildlife conservation and especially for sea birds | Rota Local Law 9-1 and regulations promulgated under Public Law 2-51 |
| Sasanhaya Fish Reserve | Rota, from Puña Point to Coral Gardens | Marine, for protection of marine resources | Rota Local Law 9-2 and regulations promulgated under Public Law 2-51 |
| Wedding Cake Mountain Wildlife Conservation Area | Rota, Taipingot Peninsula on southwest end of island | Terrestrial, for protection of all wildlife, plants and soils | Rota Local Law 9-3 and regulations promulgated under Public Law 2-51 |
| Mañagaha Marine Conservation Area | Saipan lagoon, islet of Mañagaha and surrounding waters | Terrestrial and marine, no-take zone for all natural resources; certain recreational, educational and cultural practices allowed by regulation | CNMI Constitution, Article XIV, Section 2 and CNMI Public Law 12-12 |
| Saipan Upland Mitigation Bank | Saipan, upland areas of Marpi region on north end of island, encompassing the Marpi Commonwealth Forest | Terrestrial, to provide "credits" for sale to developers as a mitigation measure for the take of Nightingale Reed Warblers; and for preservation of wildlife | CNMI Public Law 10-84; Saipan Upland Mitigation Bank Agreement between CNMI and USFWS; and regulations promulgated under Public Law 2-51 |
| Bird Island Wildlife Preserve | Saipan, lands on Saipan island to the west of Bird Island | Terrestrial, for preservation of wildlife | CNMI Public Law 10-84 |
| Bird Island Sanctuary | Saipan, lands and waters surrounding and including Bird Island | Terrestrial and marine, no-take zone for all natural resources; natural laboratory for educational purposes | CNMI Public Law 12-46 |
| Kagman Wildlife Conservation Area | Saipan, lands on eastern side of Kagman Peninsula | Terrestrial, for preservation of wildlife | CNMI Public Law 10-84 |
| Forbidden Island Sanctuary | Saipan, lands and waters surrounding and including Forbidden Island | Terrestrial and marine, no-take zone for all natural resources; natural laboratory for educational purposes | CNMI Public Law 12-46 |

| Conservation Area | Location | Type and Purpose | Enabling Law |
|---|---|---|---|
| Sea Cucumber Sanctuary | Two locations on Saipan, at Lau Lau Bay and at Bird Island. (The latter area is encompassed by Bird Island Sanctuary.) | Marine, for protection of sea cucumber species | Regulations promulgated under Public Law 2-51 |
| Trochus Sanctuary | Two locations on Saipan, at Garapan "lighthouse" and at Tank Beach in Kagman. (The latter area is encompassed by Forbidden Island Sanctuary.) | Marine, for protection of Trochus species | Regulations promulgated under Public Law 2-51 |
| Guguan Island | Guguan Island | Terrestrial, to be maintained as an uninhabited place and used only for the preservation and protection of natural resources, including but not limited to bird, wildlife and plant species | CNMI Constitution, Article XIV, Section 2 and CNMI Public Law 14-49 |
| Asuncion Island | Asuncion Island | Terrestrial, to be maintained as an uninhabited place and used only for the preservation and protection of natural resources, including but not limited to bird, wildlife and plant species | CNMI Constitution, Article XIV, Section 2 and CNMI Public Law 14-49 |
| Maug Island | Maug Island | Terrestrial, to be maintained as an uninhabited place and used only for the preservation and protection of natural resources, including but not limited to bird, wildlife and plant species | CNMI Constitution, Article XIV, Section 2 and CNMI Public Law 14-49 |
| Uracas Island | Uracas Island | Terrestrial, to be maintained as an uninhabited place and used only for the preservation and protection of natural resources, including but not limited to bird, wildlife and plant species | CNMI Constitution, Article XIV, Section 2 and CNMI Public Law 14-49 |


Figure 3. Conservation areas for the island of Rota.

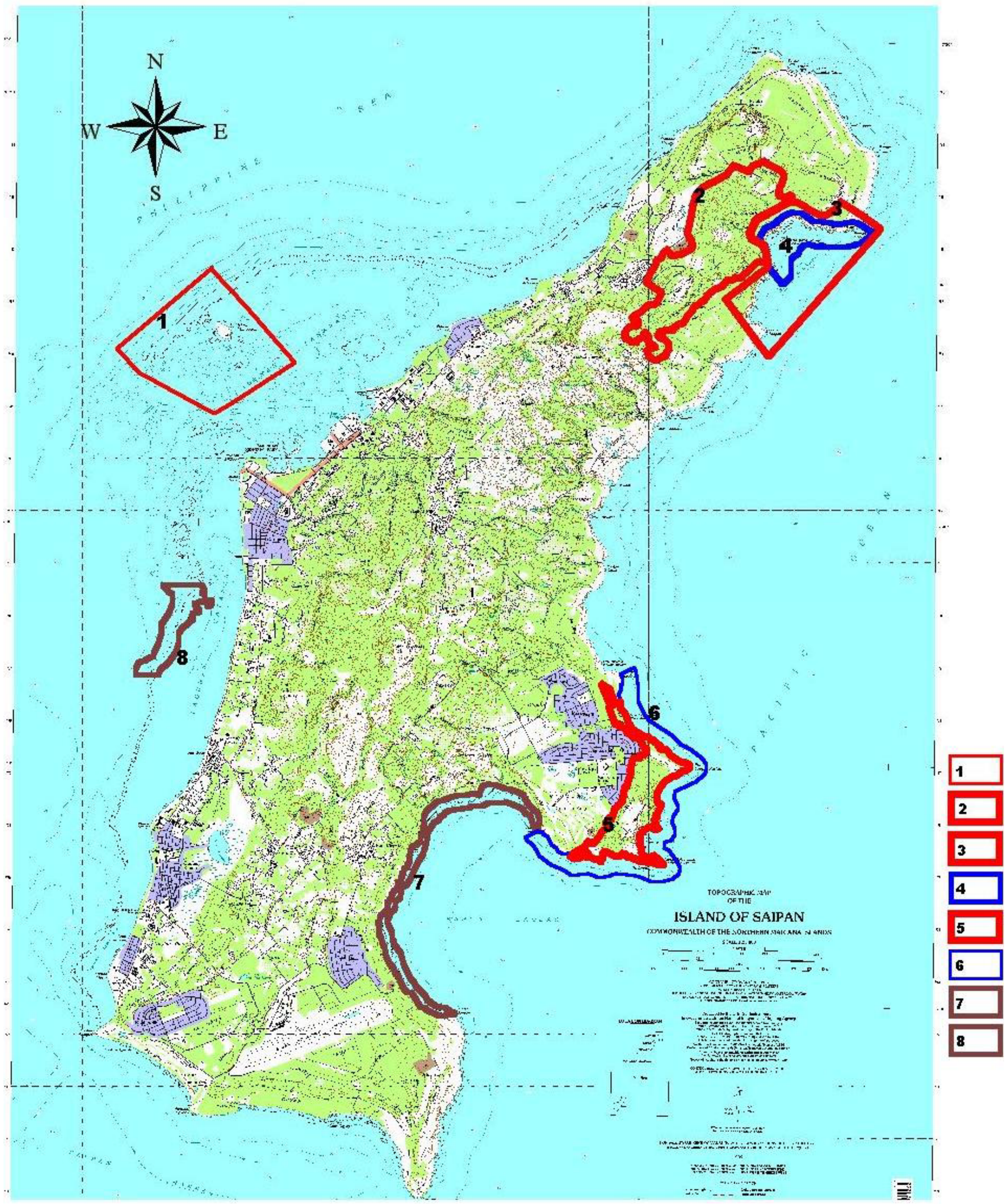


Figure 4. Conservation areas for the island of Saipan.
1 = Mañagaha Marine Conservation Area
2 = Saipan Upland Mitigation Bank
3 = Bird Island Wildlife Preserve (Note: Seaward boundary inaccurate)
4 = Bird Island Sanctuary
5 = Kagman Wildlife Conservation Area
6 = Forbidden Island Sanctuary
7 = Sea Cucumber Sanctuary
8 = Trochus Sanctuary

# Chapter 3:

# SPECIES OF SPECIAL CONSERVATION NEED FOR THE CNMI











# Chapter 3: SPECIES OF SPECIAL CONSERVATION NEED FOR THE CNMI

## Species Selection Process

The CWCS for each state was to identify the species in greatest need of conservation yet address the full array of wildlife and wildlife-related issues. For wildlife of the CNMI, DFW adopted the phrase, "species of special conservation need" for the islands' species in greatest need of conservation. A decision was made early in the planning process to separate terrestrial wildlife from marine fish and wildlife, both because the land and marine environments are so different, and because expertise for terrestrial and marine wildlife could be drawn from two distinct sets of people.

## Terrestrial Species

### Selection criteria for terrestrial species of special conservation need

The DFW Natural Resources Planner and Wildlife Biologists made an initial selection of terrestrial species of special conservation need for the CNMI in April 2004. In selecting terrestrial species of special conservation need, the following criteria were considered:

- All endemic species were selected.
- Native species for which we have little or no life history information were selected.
- Native species which are rare or declining in numbers were selected.
- Native species which have a limited distribution, i.e. which occur on only one, two, three or four islands in the archipelago, were selected.
- Native species for which we do not have funding for research, conservation or management were selected.
- Native species that face threats of extirpation, particularly the threat posed by the Brown Treesnake (*Boiga irregularis*), were selected.

### Refinement of the list of terrestrial species

Revisions to the initial list of terrestrial species of special conservation need were made over the course of several months, as research was conducted, experts were consulted and the public was invited to make suggestions. Few revisions were made to the initial list. The final list of terrestrial species of special conservation need for the CNMI is given in Table 3.

### Addressing the full array of terrestrial wildlife

In selecting terrestrial species of special conservation need, the full array of wildlife occurring in the CNMI was considered. Some wildlife species were not selected, according to the following criteria:

- Native land birds that are common were not selected.
- Migratory seabirds and shorebirds that are widespread in their distribution and that do not face known threats in the CNMI were not selected.

- Native reptiles that are relatively common or for which we have adequate life history information were not selected.
- Terrestrial invertebrates (other than the four species that appear on the list of terrestrial species of special conservation need) were not selected because there is almost no readily available, up-to-date and thorough information on their taxonomy, life history, abundance, or distribution within the CNMI, or on the threats posed to their survival, upon which to make decisions regarding their selection as species of special conservation need.
- Non-native or introduced species were intentionally not selected.

Hearing from the public

During the public participation phase of the development of the CWCS, concerns were raised that populations may be declining for two introduced species: the Philippine turtle dove (*Streptopelia bitorquata*), and deer (*Cervus mariannus*). (See Chapter 9.) Whereas DFW recognizes that the public values these species for hunting opportunities, they were not included as species of special conservation need, because they are introduced and they are regulated as game animals. Deer also cause ecological problems for native species due to overbrowsing, which is adversely impacting native forest regeneration.

The public also expressed concerns about declining populations of Coconut Crab (*Birgus latro*). The U.S. Congress intended that the CWCS focus on wildlife that is not hunted or fished. CNMI's list of terrestrial species of special conservation need does include the Coconut Crab, a game animal. The Coconut Crab was selected for many reasons, detailed the Coconut Crab species profile found in Chapter 5.

## Marine Species

Selection criteria for marine species of special conservation need

The DFW Natural Resources Planner, Fisheries Biologists, and the Marine Planning Consultant made an initial selection of marine species of special conservation need for the CNMI in June 2004. In selecting marine species of special conservation need, the following criteria were considered:

- Native species, especially marine invertebrates, for which Dingell-Johnson Sportfish Restoration Grant funds cannot be expended, because this funding is limited to finfish.
- Native marine species for which we have little or no life history information, but are important for social, cultural, economic or subsistence reasons.
- Native marine species which are rare or declining in numbers.
- Native marine species which appear to be overharvested.
- Native marine species which are currently being harvested at unknown levels.
- Native marine species which occur within three miles seaward of the low-water mark on the CNMI's coastlines, this being the current area allowed to the CNMI for enforcement of local laws applicable to fish, wildlife, and coral reef protection by Order Partially Staying Judgment Pursuant to Stipulation of Parties, *CNMI v. USA*, Civil Action CV 99-0028, U.S. District Court for the

District of the Northern Mariana Islands (Judge Alex Munson, January 20, 2004).

- Non-native or introduced marine species were intentionally not selected.

Refinement of the list of marine species

Revisions to the initial list of terrestrial species of special conservation need were made over the course of several months, as research was conducted, experts were consulted and the public was invited to make suggestions. Many additions were made to the initial list, mostly as a result of interest expressed by the public in harvestable marine invertebrates. The final list of marine species of special conservation need for the CNMI is appended as Table 4.

Addressing the full array of marine fish and wildlife

In selecting marine species of special conservation need, it was nearly impossible to consider the full array of marine fish and wildlife occurring in the CNMI. Marine species number in the thousands. Very little research has been published specific to marine species in the CNMI, making it difficult to decide which marine species merit listing as species of special conservation need. Consequently, marine species were selected based on the criteria listed above.

Hearing from the public

The marine environment is of utmost importance to the islanders of the CNMI. Their interest in the waters surrounding their islands was well expressed during the public participation phase of the development of this CWCS. Many of the species appearing on the list of marine species of special concern are there at the suggestion of the public. (Refer to Chapter 9 for more details on the public's input.)

Table 3. Terrestrial Species of Special Conservation Need for the Commonwealth of the Northern Mariana Islands.

| **Common name** *Scientific Name* | **Local and Federal Listing and Protection Status** | **Reasons for selecting this species as a Species of Special Conservation Need** |
|---|---|---|
| **Native Forest Birds** | | |
| Golden White-eye *Cleptornis marchei* | ▪ Locally protected [a] | Occurs on only two islands, Aguiguan and Saipan. Not federally listed, so does not qualify for Sec. 6 endangered species funding. Little is known about natural history or habitat requirements. |
| Mariana Crow *Corvus kubaryi* | ▪ Locally protected<br>▪ Locally listed as Threatened or Endangered [b]<br>▪ Federally listed as Endangered [c] | Found only on the islands of Rota and Guam. Dramatic decline in numbers in last 20 years. Section 6 endangered species funding is insufficient. |
| Mariana Fruit Dove *Ptilinopus roseicapilla* | ▪ Locally protected<br>▪ Locally listed as Threatened or Endangered | Occurs only on the four southern islands of the archipelago. Not federally listed, so does not qualify for Sec. 6 endangered species funding. Became rare due to overhunting, although declaration as the official bird of the Commonwealth may have resulted in less hunting pressure in recent years. Extirpated from Guam by the Brown Treesnake. |
| Mariana Swiftlet *Aerodramus vanikorensis bartschi* | ▪ Locally protected<br>▪ Locally listed as Threatened or Endangered<br>▪ Federally listed as Endangered | Occurs only on Saipan and Aguiguan. Locally extinct on Rota and Tinian. Objectives for de-listing in Recovery Plan have not yet been met. |
| Micronesian Megapode *Megapodius laperouse laperouse* | ▪ Locally protected<br>▪ Locally listed as Threatened or Endangered<br>▪ Federally listed as Endangered | Found only in the Mariana Islands. Rare or extirpated on the four southern Mariana Islands. Numbers declining on northern islands due to impacts from feral animals. |
| Nightingale Reed-warbler *Acrocephalus luscinia* | ▪ Locally protected<br>▪ Locally listed as Threatened or Endangered<br>▪ Federally listed as Endangered | Found only on the islands of Saipan and Alamagan, with perhaps a few on Aguiguan. Species for which the Saipan Upland Mitigation Bank was established. |
| Rota Bridled White-eye *Zosterops rotensis* | ▪ Locally protected<br>▪ Locally listed as Threatened or Endangered<br>▪ Federally listed as Endangered | Occurs only on the island of Rota. Numbers have declined by an estimated 89% between 1982 and 1996. Range has become restricted to Sabana Heights. USFWS funding is insufficient for designation of critical habitat. |

| **Common name** *Scientific Name* | **Local and Federal Listing and Protection Status** | **Reasons for selecting this species as a Species of Special Conservation Need** |
|---|---|---|
| Rufous Fantail *Rhipidura rufifrons* | ▪ Locally protected | Occurs only on the four southern islands of the archipelago. Not federally listed, so does not qualify for Sec. 6 endangered species funding. Extirpated from Guam by the Brown Treesnake. Would be easily preyed upon by snakes should they enter the Commonwealth. |
| Saipan Bridled White-eye *Zosterops conspicillatus saypani* | ▪ None | Occurs on only three islands, Aguiguan, Tinian and Saipan. Not federally listed, so does not qualify for Sec. 6 endangered species funding. This subspecies is afforded no protection. The Guam subspecies is already extinct due to the Brown Treesnake. Easily preyed upon by snakes. |
| Tinian Monarch *Monarcha tatatsukasae* | ▪ Locally protected<br>▪ Locally listed as Threatened or Endangered | Found only on the island of Tinian. At risk of extinction if the Brown Treesnake becomes established on Tinian. |
| White-throated Ground Dove *Gallicolumba xanthonura* | ▪ Locally protected | Found only in the Mariana Islands and Yap. Not federally listed, so does not qualify for Sec. 6 endangered species funding. Easily preyed upon. |
| **Freshwater Birds** | | |
| Mariana Common Moorhen *Gallinula chloropus guami* | ▪ Locally protected<br>▪ Locally listed as Threatened or Endangered<br>▪ Federally listed as Endangered | Occurs only on Guam, Rota, Tinian and Saipan. Numbers have been reduced due to wetland habitat loss and predation. |
| **Sea Birds** | | |
| Masked booby *Sula dactylatra* | ▪ Locally protected | The largest known nesting site in the CNMI is on Farallon de Medinilla, subject to heavy bombing pressure by the U.S. Navy. May breed on Naftan Rock off the island of Aguiguan, and on northern islands. Further research on distribution is needed. |
| Wedge-tailed shearwater *Puffinus pacificus* | ▪ None | Based on current knowledge, this bird nests only on Mañagaha Island. More research is required to determine if nesting occurs elsewhere in the archipelago. |
| **Mammals** | | |
| Mariana Fruit Bat *Pteropus mariannus* | ▪ Locally listed as Threatened or Endangered<br>▪ Federally listed as Threatened | Although it is now illegal to hunt fruit bats, they are a traditional food delicacy. Poaching is a known threat. Federally proposed for Threatened status in 1998, and subsequently listed as Threatened effective in February 2005. |

| **Common name** ***Scientific Name*** | **Local and Federal Listing and Protection Status** | **Reasons for selecting this species as a Species of Special Conservation Need** |
|---|---|---|
| Sheath-tailed Bat *Emballonura semicaudata rotensis* | ▪ Locally listed as Threatened or Endangered<br>▪ Candidate species for Federal listing [c] | Occurs only on the island of Aguiguan. Extirpated from Saipan, Rota and Guam. Numbers drastically reduced. Candidate species for listing, so does not qualify for Sec. 6 endangered species funding. |
| **Invertebrates** | | |
| Coconut crab *Birgus latro* | ▪ Game species, regulated by seasons, bag limits, license requirements | No funding available for research. Ecologically important – disperse seeds, carry fruits. Baseline surveys needed throughout the CNMI. |
| Endemic Land Snails:<br>▪ Fragile tree snail *Samoana fragilis*<br>▪ Humped tree snail *Partula gibba*<br>▪ Langford's tree snail *Partula langfordi* | ▪ Candidate species for Federal listing | No funding available for research. Numbers are declining. Need research on distribution. |
| **Reptiles** | | |
| Micronesian Gecko *Perochirus ateles* | ▪ Locally listed as endangered or threatened.<br>▪ Locally protected. | Reported only from Rota and Saipan. Rarer than other geckos, would be subject to extirpation if the Brown Treesnake establishes a population in the CNMI. |
| Rock Gecko *Nactus pelagicus* | ▪ None | Difficult to survey due to unusual habitat and habits. Recorded on Rota, Alamagan, and Anatahan, but may occur on others as well. Subject to predation. Would be subject to extirpation if the Brown Treesnake establishes a population in the CNMI. |
| Tide-pool Skink *Emoia atrocostata* | ▪ None | Occupies a specialized habitat in areas immediately adjacent to salt water. Known to be on five islands, Rota, Aguiguan, Forbidden (an islet off Saipan) Alamagan, and Guguan. Surveys are needed to establish whether this species occurs on other northern islands. |
| Slevin's Skink *Emoia slevini* | ▪ None | Easily confused with Tide-pool Skink and Blue-tailed Skink. Known from a number of islands, but not common in the southern islands of the archipelago. Surveys are needed to study the ecology of this species. |

Notes to table:

a "Locally protected" species are protected under the current Division of Fish and Wildlife Non-Commercial Fishing and Hunting Regulations. Hunting for any of these species is prohibited.

b Species which are "Locally listed as Threatened and Endangered" are protected under local CNMI law, specifically, the Fish, Game and Endangered Species Act, 2 CMC §§ 5101 *et seq*. and under the regulations promulgated thereby.

c Federal listing statuses, under the Endangered Species Act, include: Endangered, Threatened and Candidate.

Table 4. Marine Species of Special Conservation Need for the Commonwealth of the Northern Mariana Islands.

| **Common name**<br>***Scientific Name*** | **Status of Local, Federal or International Protection** | **Reasons for selecting this species as a Species of Special Conservation Need** |
|---|---|---|
| **Marine Mammals** | | |
| Spinner dolphin<br>*Stenella longirostris* | ▪ Locally protected [a]<br>▪ Listed as *Threatened* on 2004 IUCN Red List of Threatened Species | One of the few marine mammals that enter shallow near shore waters and become susceptible to human interactions. |
| **Marine Turtles** | | |
| Green marine turtle<br>*Chelonia mydas* | ▪ Locally protected [a]<br>▪ Locally listed as threatened or endangered [b]<br>▪ Federally listed threatened [c]<br>▪ Listed as an Appendix I species by CITES [d] | Sea turtles are traditional food items. Poaching is a threat to free swimming adults, nesting females and nests by egg robbers. Nesting sites are potentially disturbed by vehicle traffic on beaches. |
| Hawksbill marine turtle<br>*Eretmochelys imbricate* | ▪ Locally protected [a]<br>▪ Locally listed as threatened or endangered [b]<br>▪ Federally listed endangered [c]<br>▪ Listed as an Appendix I species by CITES [d] | Sea turtles are traditional food items. Poaching is a threat to free swimming adults, nesting females and nests by egg robbers. Nesting sites are potentially disturbed by vehicle traffic on beaches. |
| **Marine Fish** | | |
| Lamniformes<br><br>Gray reef shark<br>*Carcharhinus amblyrhynchos* | ▪ As part of the Magnuson-Stevens Act provisions and effective from 13 March 2002, the US prohibits shark finning activities in the US Exclusive Economic Zone and through US ports<br>▪ Listed as *Lower Risk, Near Threatened* on the 2004 IUCN Red List of Threatened Species | Considered a nuisance species by bottom fishers. Occasionally, local fishers will first fish the sharks out of an area before commencing bottom fishing.<br><br>Population levels are unknown |
| Perciformes<br>Labridae (wrasses)<br><br>Napoleon wrasse<br>*Cheilinus undulatus* | ▪ Listed as *Endangered* on 2004 IUCN Red List of Threatened Species<br>▪ Listed as an Appendix II species by CITES [d] | Highly prized local food fish and highly susceptible to spear fishers. Large individuals are rarely observed.<br><br>Anecdotal evidence indicates that population levels have declined substantially around the more populated southern islands. |

| Common name<br>*Scientific Name* | Status of Local, Federal or International Protection | Reasons for selecting this species as a Species of Special Conservation Need |
|---|---|---|
| Perciformes<br>Scaridae (parrotfish)<br><br>Green humphead parrotfish<br>*Bolbometopon muricatum* | ▪ None | Highly prized local food fish and highly susceptible to spear fishers when spawning. Large individuals are rarely observed.<br><br>Anecdotal evidence indicates that population levels have declined substantially around the more populated southern islands. |
| **Marine Invertebrates** | | |
| Decapoda<br>Brachyura<br>Ocypodidae<br><br>Ghost crab<br>*Ocypoda cerathopthalma* | ▪ Regulated species under Section 80.1 of the DFW Non-Commercial Fishing and Hunting Regulations (CNMI 2000) | Currently being harvested at some unknown level for consumption purposes.<br><br>Population levels are unknown.<br><br>Not eligible for funding from existing federal grant programs. |
| Decapoda<br>Brachyura<br>Grapsidae<br><br>Rock Crabs<br>*Grapsus* spp.<br>*Geograpsus* spp.<br>*Metopograpsus* spp.<br>*Pachygrapsus* spp. | ▪ Regulated species under Section 80.1 of the DFW Non-Commercial Fishing and Hunting Regulations (CNMI 2000) | Currently being harvested at some unknown level for consumption purposes.<br><br>Species, population levels and distribution are unknown.<br><br>Not eligible for funding from existing federal grant programs. |
| Decapoda<br>Palinuridae<br><br>spiny lobster<br>*Panulirus pencillatus*<br>*P. versicolor*<br>*P. longipes* | ▪ Regulated species under Section 70.1 of the DFW Non-Commercial Fishing and Hunting Regulations (CNMI 2000) | Highly prized local food and are susceptible to night spear fishers.<br><br>Anecdotal evidence is supported by local fisheries data that population levels are on the decline in certain reef areas of the southern populated islands.<br><br>Species, population levels and distribution are unknown.<br><br>Not eligible for funding from existing federal grant programs. |
| Decapoda<br>Anomura<br>Coenobitidae<br><br>Land Hermit crab<br>*Coenobita spp.* | ▪ None | Anecdotal evidence indicates that population levels are on the decline on the more populated southern islands. Believed to be harvested at some unknown level for consumption purposes.<br><br>Species, population levels and distribution are unknown.<br><br>Not eligible for funding from existing federal grant programs. |

| **Common name**<br>***Scientific Name*** | **Status of Local, Federal or International Protection** | **Reasons for selecting this species as a Species of Special Conservation Need** |
|---|---|---|
| Echinodermata<br>Holothuroidea<br><br>Surf redfish<br>*Actinopyga mauritiana*<br><br>Black teatfish<br>*Holothuria whitmaei* | ▪ Regulated species under Section 60.1 of the DFW Non-Commercial Fishing and Hunting Regulations (CNMI 2000)<br>▪ Two sea cucumber sanctuaries have been established in the CNMI (e.g., Saipan) | Sea cucumbers were overexploited in 1996 and 1997on Saipan and Rota.<br><br>It is not known if the remaining population is sufficient to be self sustaining.<br><br>Not eligible for funding from existing federal grant programs |
| Echinodermata<br>Toxopneustidae<br><br>Sea urchin<br>*Tripneustes gratilla* | ▪ Regulated species under Section 80.1 of the DFW Non-Commercial Fishing and Hunting Regulations (CNMI 2000) | Believed to be over harvested.<br><br>Population levels and distribution are unknown.<br><br>Not eligible for funding from existing federal grant programs |
| Mollusca<br>Bivalvia<br>Tridacnidae (giant clams)<br><br>Fluted giant clam<br>*Tridacna squamosa*<br><br>Elongate giant clam<br>*Tridacna maxima* | ▪ Regulated species under Section 80.1 of the DFW Non-Commercial Fishing and Hunting Regulations (CNMI 2000)<br>▪ Listed as an Appendix II species by CITES [d] | Currently being harvested at some unknown level for consumption purposes. The fluted giant clam is believed collected as curio or souvenir shells.<br><br>Population levels are unknown.<br><br>Not eligible for funding from existing federal grant programs. |
| Mollusca,<br>Bivalvia,<br>Veneidae (clams)<br><br>Pectinate venus<br>*Gafrarium pectinatum* | ▪ Regulated species under Section 80.1 of the DFW Non-Commercial Fishing and Hunting Regulations (CNMI 2000) | Currently being harvested at some unknown level for consumption purposes.<br><br>Population levels and distribution are unknown.<br><br>Not eligible for funding from existing federal grant programs. |
| Mollusca,<br>Gastropoda,<br>Strombidae<br><br>Common spider conch<br>*Lambis lambis* | ▪ Regulated species under Sections 80.1 and 80.3of the DFW Non-Commercial Fishing and Hunting Regulations (CNMI 2000) | Currently being harvested at some unknown level for consumption purposes.<br><br>Population levels are unknown. Anecdotal evidence indicates historically abundant.<br><br>Not eligible for funding from existing federal grant programs. |
| Mollusca,<br>Gastropoda,<br>Cassidae<br><br>horned helmet shell<br>*Cassis cornuta* | ▪ Regulated species under Sections 80.1 and 80.3 of the DFW Non-Commercial Fishing and Hunting Regulations (CNMI 2000) | Believed collected as curio or souvenir shells.<br><br>Population levels are unknown.<br><br>Not eligible for funding from existing federal grant programs. |

| **Common name** *Scientific Name* | **Status of Local, Federal or International Protection** | **Reasons for selecting this species as a Species of Special Conservation Need** |
|---|---|---|
| Mollusca, Gastropoda, Turbinidae<br><br>Tapestry turban shell *Turbo petholatus*<br><br>Rough turban *Turbo setosus*<br><br>Silver-mouth turban *Turbo argyrostoma* | ▪ Regulated species under Section 80.1 of the DFW Non-Commercial Fishing and Hunting Regulations (CNMI 2000) | Currently being harvested at some unknown level for consumption purposes.<br><br>Population levels are unknown.<br><br>Not eligible for funding from existing federal grant programs. |
| Mollusca, Gastropoda, Cymatiidae<br><br>Triton's trumpet shell *Charonia tritonis* | ▪ Regulated species under Sections 80.1 and 80.3 of the DFW Non-Commercial Fishing and Hunting Regulations (CNMI 2000) | Believed collected as curio or souvenir shells.<br><br>Population levels are unknown.<br><br>Not eligible for funding from existing federal grant programs. |
| Octopoda Octopodidae<br><br>Octopus *Octopus cyanea* | ▪ Regulated species under Section 80.1 of the DFW Non-Commercial Fishing and Hunting Regulations (CNMI 2000) | Currently being harvested at some unknown level for consumption purposes.<br><br>Population levels are unknown.<br><br>Not eligible for funding from existing federal grant programs. |

Notes to table:

a "Locally protected" species are protected under the current Division of Fish and Wildlife Non-Commercial Fishing and Hunting Regulations. Hunting for any of these species is prohibited.

b Species which are "Locally listed as Threatened and Endangered" are protected under local CNMI law, specifically, the Fish, Game and Endangered Species Act, 2 CMC §§ 5101 *et seq*. and under the regulations promulgated thereby.

c Federal listing statuses, under the Endangered Species Act, include: Endangered, Threatened and Candidate.

d CITES is the acronym for The Convention on International Trade in Endangered Species of Wild Fauna and Flora. An International Convention, of which the United States is a member, where member parties agree to monitor international tradeof plant and wildlife species that are in need of protection. CITES associated regulations are only implemented when international trade occurs between two countries where each country is a party or when one of the countries is a party.

# Chapter 4:

# TERRESTRIAL HABITATS OF THE CNMI

# Chapter 4: TERRESTRIAL HABITATS OF THE CNMI

**Data Sources**

Information concerning terrestrial habitats in the Commonwealth of the Northern Mariana Islands is scattered among various scientific reports. The currently available information on terrestrial habitat types is contained in the reports of various researchers, and is described in Table 5.

**Characteristics of terrestrial habitats in the CNMI**

Habitats that support wildlife species in the CNMI are described as follows.

Native forest

The native forest habitat is characterized by a closed canopy of broadleaf trees with an understory of younger trees, vines, ferns and orchids (Vogt and Williams 2004, Stone 1970). Native genera for the southern islands include, but are not limited to: *Ficus, Elaeocarpus, Mammea, Guamia, Cynometra, Aglaia, Premna, Pisonia, Orchrosia, Neisosperma, Intsia, Melanolepis, Eugenia, Pandanas, Arctocarpus, Hernandia* and others (Engbring et al. 1986). Native tree species that are important in the northern islands include: *Aglaia mariannensis, Pandanas tectorius, Terminalia catappa, Trema orientalis, Morinda citrifolia, Erythrina variegata var. orientalis*, among others (Fosberg et al. 1979, Cruz et al. 2000c, Vogt and Williams 2004). The quantitative composition of native tree species has not been studied.

While walking through the native forest, one notices the darkness and dampness caused by the closed canopy of the overstory. (See Figure 5.) Trees are tall compared to other habitat types, and may reach heights to 45 feet (14 meters), with some individual trees reaching 75 feet (23 meters) in height (Falunruw et al. 1989). Native tree species exhibit adaptations to the environment of the Mariana Islands. They can grow with roots wrapped around craggy limestone pillars and outcroppings. (See Figure 6.) *Pisonia grandis* grows multiple trunks, the weaker ones breaking off during typhoons, and new stems regrowing repeatedly (Falunruw et al. 1989). (See Figure 7). Blow-down of large trees is a common occurrence after typhoons. (See Figure 8).

On the southern islands of Rota, Aguiguan, Tinian and Saipan, this habitat type is often referred to as the limestone forest, owing to its growth on a limestone substrate, sometimes on steep cliff faces. On the northern islands, native forests grow on a volcanic substrate. Irrespective of the nature of the substrate, native forest is the most important habitat for species of special conservation need throughout the archipelago. Native forest birds including the Mariana Fruit Dove, Mariana Crow, Rota Bridled White-eye, Golden White-eye, White-throated Ground Dove and Rufous Fantail are found at their highest densities in the native forest.

Figure 5. The closed canopy of the native forest causes darkness and dampness.
Photo credit: Gayle Berger

Figure 6. Tree roots growing over limestone substrate.
Photo credit: Gayle Berger

Figure 7. Some tree species grow multiple trunks, an adaptation to typhoons.
Photo credit: Gayle Berger

Figure 8. Large trees are often blown over in a typhoon.
Photo credit: Gayle Berger

Secondary forest

Where native forest has been removed or disturbed, secondary vegetation will succeed. Secondary forests occur in areas that were formerly cleared for cultivated fields and coconut groves, World War II installations, and other developments (Vogt and Williams 2004, Engbring et al. 1986). This type is typically brushy and weedy, the upper canopy reaching from 2 to 20 meters in height, and the understory dense. Small grassy openings are scattered amongst the trees and shrubs. Secondary forests often consist of a combination of introduced plant species, with a few native species mixed in. (See Figure 9.) There are native tree species that favor these conditions such as *Ochrosia mariannensis* and *Melanolepis multiglandulosa* (Vogt and Williams 2004). Species composition varies considerably throughout the archipelago. Dominant trees include the genera *Leucaena, Acacia, Albizzia, Cocos* and *Delonix* (Engbring et al. 1986).

Figure 9. Secondary forests consist of a mix of introduced and native species. They are dense and brushy.
Photo credit: Gayle Berger

Secondary forests are important to a number of native forest birds, notably the Nightingale Reed-Warbler and Saipan Bridled White-eye, among others (Vogt and Williams 2004).

Tangantangan forest

A special type of secondary forest consists of nearly pure stands of tangantangan (*Leucaena leucocephala*), an introduced tree species. Tangantangan has been in the Mariana Islands since the early 1900s, and became widespread around the middle of the century. When sugar cane farming by the Japanese was stopped, tangantangan colonized the empty fields (Vogt and Williams 2004). Tangantangan was apparently intentionally aerially seeded by the U.S. Navy after World War II, to prevent erosion in areas formerly used by the Japanese for growing sugar cane and in areas cleared by war-time activities (Engbring et al. 1986). The islands of Saipan and Tinian are covered with vast, monospecific thickets of tangantangan; the islands of Rota and Aguiguan have a few isolated stands of this species (*ibid.*). These medium-sized trees may reach a height of 10 meters (33 feet) (Vogt and Williams 2004). The understory is open. Tangantangan leaflets are tiny. (See Figure 10.) Trees of the genera *Albizzia, Delonix, Acacia* and *Casuarina* are often associated with tangantangan (Engbring et al. 1986). Some bird species have adapted well to this introduced habitat type, notably the Nightingale Reed-Warbler on Saipan and the Tinian Monarch on Tinian (Vogt and Williams 2004).

Figure 10. Tangantangan leaflets are tiny.
Photo credit: Gayle Berger

Agricultural forest

This habitat type occurs where people have planted tropical food trees. Common genera include *Cocos, Artocarpus, Citrus, Mangifera, Papaya, Pithecellobium, Persea,* and *Muntingia*. On the southern islands of Rota, Aguiguan and Tinian, agricultural forests are scattered in patches. On Saipan, agricultural forests are more extensive, and situated near urban centers (Engbring et al. 1986). Agricultural forests consisting mostly of coconut plantations are found on Anatahan, Sarigan, Alamagan, Pagan and Agrihan

(Cruz et al. 2000f, 2000e, 2000d, 2000g, 2000h). (See Figures 11 and 12.) Agricultural forests may be currently tended, or have been abandoned. Many native forest birds can be found in the agricultural forest, but at lower densities than in the native forest.

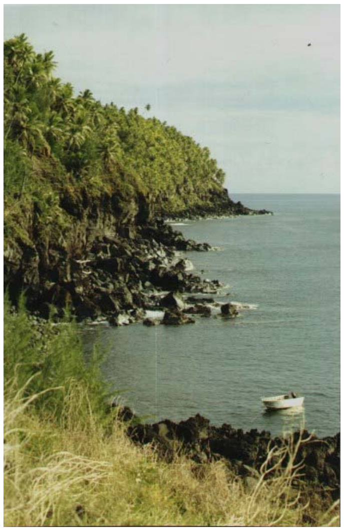

Figure 11. Coconut plantations hug the coast at Alamagan.
Photo credit: Laura Williams

Figure 12. Coconut plantations occur at lower elevations at Agrihan.
Photo credit: Laura Williams

Grassland and Savanna

Grasslands consist of open fields dominated by grasses. Savannas consist of grasslands with widely-spaced trees. Both types may include small thickets of native or introduced vegetation scattered throughout. Common ground cover in savannas includes the genera *Miscanthus, Pennesetum, Panicum, Mimosa, Momordica, Eupatoruim, Dicranopteris, Bidens, Spathoglottis, Lantana,* and *Nephrolepis*. The Sabana capping the island of Rota and the hillsides surrounding Mt. Tapochao on Saipan are examples of savannas. (See Figure 13.) Grasslands and savannas are important foraging habitat for the Mariana Swiftlet, an endemic, endangered bird (Engbring et al. 1986; Vogt and Williams 2004).

Wetlands

Wetlands consist of vegetation that is permanently or periodically immersed in water. (See Figures 14 and 15.) In the CNMI, wetlands are limited in extent, although some artificial wetlands have been created to increase wildlife habitat. Genera that are common in freshwater wetlands include *Acrostichum, Phragmites, Scirpus, Cyperus,* and *Hibiscus* (Engbring et al. 1986). Fresh water, brackish water and artificial wetlands are important habitat for the endangered Mariana Moorhen and the Nightingale Reed-Warbler (Vogt and Williams 2004).

Mangrove wetlands are marine forests with specialized roots that are periodically inundated by the sea. Mangrove wetlands are found only on Saipan, and are limited to very small patches (Falunruw et al., 1989). (See Figure 16.) Vogt and Williams (2004) refer to this special type as an endangered habitat. Common plants in the mangrove forest are *Bruguiera gymnorhiza, Heritiera littoralis,* and *Xylocarpus moluccensis* (Falunruw et al., 1989). Mangrove wetlands support several bird species, bats, and mangrove crabs, and serve as fish nurseries (Vogt and Williams 2004).

Figure 13. Savanna on the south flanks of Mt. Tapochao, Saipan. Photo credit: Laura Williams

Figure 14. Lake Susupe wetland on Saipan. Photo credit: Laura Williams

Figure 15. Flores Pond, Saipan. Photo credit: Shelly Kremer

Figure 16. Mangrove forest, Saipan. Photo credit: Shelly Kremer

Strand

The strand is located immediately adjacent to the coastline, consisting of a narrow belt of halophytic (salt-tolerant) vegetation. The substrate varies from flat, sandy beaches to jumbled boulders giving way to rocky cliffs. Plants occupying the strand habitat are adapted to windy, salty and drought conditions by having fuzzy, hairy, waxy or succulent leaves (Vogt and Williams 2004). This habitat is important for the Tide-pool skink and for many forest birds and shore birds.

Limestone caves and crevices

The southern islands of the CNMI are formed from a limestone substrate. Erosion through chemical processes has formed a number of limestone caves and crevices within cliff faces of these islands. These caves and crevices are important habitats for the Mariana Swiftlet and the Sheath-tailed Bat.

Urban

Wildlife habitats are found in urban and residential settings on the populated southern islands. Native and non-native trees, shrubs and tall grasses grow in the spaces between buildings, providing habitat for forest birds, reptiles and invertebrates. Among species of special conservation need, Saipan bridled white-eyes, Golden white-eyes, Rufous fantails, Mariana fruit doves, White-throated ground doves, and Tinian Monarchs can be seen or heard in the urban habitat.

**Location and relative condition of key wildlife habitats in the CNMI**

Important wildlife habitats vary in plant species composition, extent and condition. Habitat condition has been affected by man-induced changes and natural phenomenon, as described below, by island.

Rota

Most of Rota was forested prior to the arrival of people over 4,000 years ago (Engbring et al. 1986). Land clearing began when the island was first colonized by Chamorros, but proceeded on a much larger scale during the Japanese administration (1914-1944) with sugar cane farming on flat lands and phosphate mining on the Sabana plateau (Amidon 2000). Although Rota was spared invasion during World War II, it was heavily bombed (Engbring et al. 1986). By the end of the war, approximately 25% of Rota was covered in well-developed forest divided into small parcels or located at the base of cliffs (Amidon 2000).

Falanruw et al. (1989) classified Rota's vegetation types based on 1976 aerial photography and found 62% in forest, 13% in secondary vegetation, 5% in agroforest and 20% in non-forest. How this distribution among habitat types has changed in the intervening three decades has not been quantitatively documented. The Rota Resort was constructed in 1992, and includes an 18-hole golf course (Worthington 1998). The Agricultural Homestead Project Area consists of 278 ha within the Dugi, Gampapa, As Niebes and I Chenchon regions of eastern Rota (Schroer 2005b). Due to these developments that have occurred since the vegetation classification of Falanruw et al. (1989), native and secondary forest coverage in Rota is now probably less than 60% (Amidon 2000).

The native forest on Rota consists of two types, divided by elevation. At low elevations, forests are drier because of low levels of rainfall during the dry season. At higher elevations, predominantly wet forests develop due to the persistent accumulation of clouds over the Sabana and higher levels of rainfall (Amidon 2000). This "cloud forest" type is unique in the Marianas to Rota.

Engbring et al. (1986) found Rota's habitats to be in an altered condition owing to its history of agricultural development. Native forest is restricted to the slopes leading up to the Sabana, too steep to be farmed. Areas of the eastern plateau and coastal shelves that were formerly farmed have regenerated with native species in a scrubby secondary forest. Where grazing by cattle or browsing by deer occurs, this secondary forest is open; otherwise the openings are heavily overgrown with grasses, vines and shrubs. The

Sabana plateau is characterized by grasslands, native forest and secondary forest, which are degraded in quality for wildlife habitat.

The majority of high elevation forests along the upper plateau of Rota have not been threatened by development or clearing because of their rugged topography (Amidon 2000). However, these high elevation areas have been exposed to the force of numerous typhoons, resulting in damage to the cloud forests of the Sabana (*ibid.*). Supertyphoon Roy in January 1988 hit Rota with winds exceeding 150 mph, causing complete defoliation of almost all forests, half of the trees downed and all of the trees with broken limbs. The wet forests of the upper cliffline were drastically altered and had not recovered completely by the time Supertyphoon Paka hit Rota in December 1997 (*ibid.*). Since then, Rota has twice been hit by supertyphoons, Pongsona in December 2002, and Chaba in August 2004. Clearing of land on the Sabana has been limited, but may have accelerated degradation of mature native forests on the Sabana by typhoons, because fragmentation of the forest increases the forest edge and exposes more of the forest to typhoon-force winds (U.S. Fish and Wildlife Service 2004a). It appears that large areas of mature native forest are being converted into *Pandanas tectorius* thickets as canopy trees are damaged and die off (Amidon 2005b). Browsing by deer (*Cervus mariannus*) may be impacting natural regeneration of native forests in the Sabana (*ibid.*), and may also be exacerbating the effects of supertyphoons (DFW personnel, pers. comm., August 2005).

Aguiguan

As with the forests on other southern islands of the archipelago, the forests of Aguiguan have been dramatically altered. During the 1930s, the Japanese cleared native forests to plant sugar cane and pineapple on the limestone terraces. Engbring et al. (1986) found the abandoned fields overgrown with weeds, primarily *Chromolaena odorata*. Although the native forest covered nearly half of the island, it was limited to steep scarps and shelves rimming the high plateau, and was scrubby and open in character. Engbring et al. (1986) found bird habitat type extents, based on aerial photography (date of photography not reported) of 47% in native forest, 4% in secondary forest, small but unmeasured patches of tangantangan forest, and 43% in open fields.

Cruz et al. (2003d) found little change two decades later. They observed the western half of the island covered in secondary forest or tangantangan forest. Native forest on Aguiguan was species poor with a practically bare understory and low seedling recruitment, due to browsing by feral goats. The most disturbed areas are now dominated by *Lantana camara*, a thorny introduced plant with no known wildlife or economic value (Cruz et al. 2000b). *Lantana* is becoming more widespread and is invading the upper reaches of the island and in the open field regions (*ibid.*).

Tinian

Drastic alterations to the native vegetation have occurred over the years on the island of Tinian. Prior to the beginning of the twentieth century, Tinian harbored much native forest, although the original composition of the forest is unknown (U.S. Fish and Wildlife Service 1996). Man-induced disturbances may have started with the burning of large areas, clearing of forest for agriculture and introduction of exotic animals and plants by the indigenous Chamorros over 4,000 years ago (Engbring et al. 1986). Although Tinian was probably uninhabited during the Spanish administration, wild cattle, pigs and feral junglefowl were abundant (*ibid.*). In the mid-1700s, the forest appeared parklike and open, undoubtedly rendered by the thousands of introduced ungulates (*ibid.*). During the Japanese era, from 1914 to 1944, nearly the entire island of Tinian was deforested and replaced with sugar cane fields, except for the craggy, forested cliffs and ridges with shallow soils (Lusk et al. 2000a). During World War II, all vegetation on Tinian was virtually leveled, and only tiny pockets of native vegetation remained (Engbring et al. 1986). After the war, vast areas where sugar cane had formerly grown were overgrown with tangantangan (*Leucaena leucocephala*) (*ibid.*). Cattle grazing and agriculture increased during the 1980s, resulting in a mosaic of forest habitats within a matrix of grasslands, pastures and cultivated fields (*ibid.*). Vegetation density has increased since the 1980s due to less grazing pressure by cattle (Lusk et al. 2000a).

Falanruw et al. (1989) classified Tinian's vegetation types based on 1976 aerial photography and found less than 7% in native forest, 17% in other forest (introduced and *Casuarina*), 54% in secondary vegetation (mostly tangantangan), 1% in agroforest and 21% in non-forest. Engbring et al. (1986) found slightly different bird habitat type extents, based on aerial photography (date of photography not reported): less than 5% in native forest, 19% in secondary forest, 38% in tangantangan forest, 31% in open fields, 0.1% in marsh and less than 7% in other types excluded from their forest bird study. This data represents the most recent habitat extent information available for the island of Tinian; it is not known how this distribution has changed in the intervening three decades.

Tinian's native forest is discontinuous and limited in extent to patches at cliff lines and escarpments around the Kastiyo, Piña and Carolinas plateaus on the southeast side of Tinian, and a narrow corridor on the escarpment that connects Mt. Lasso with Maga in the center part of the island (U.S. Fish and Wildlife Service 1996). Cruz et al. (2000a) did not find Tinian Monarchs as abundant as expected in the native limestone forest, which may be explained by a possible degradation in native forest habitat quality occurring over time.

Tangantangan forests dominate most of the level and moderately sloping areas, in extensive, homogeneous stands which cover a great portion of the island of Tinian. Tinian Monarchs have adapted well to tangantangan forests, though they are found in much higher densities in native forest (Helber Haster & Fee 2003, Engbring et al. 1986, U.S. Fish and Wildlife Service 1996).

Tinian's wetlands are formed by impermeable clay that impounds water. The largest is Lake Hagoi, 15.5 ha in area and situated in the northern part of the island within the Tinian MLA. Water levels at Lake Hagoi drop during periods of drought, but this wetland has not been observed to be completely dry. Lake Hagoi is an important wetland for Mariana Moorhens. Other wetlands in Tinian are smaller and ephemeral because they are not large enough to sustain periods of low rainfall; among these are Mahalang and

Bateha within the MLA. Makpo Swamp in the southern part of Tinian once had open water, but it became heavily overgrown by woody vegetation after municipal groundwater pumping altered water levels, and this area is no longer considered a wetland (Helber Haster & Fee 2003, Engbring et al. 1986).

Saipan

Saipan shares a similar vegetation alteration history to that of Tinian and Aguiguan. A summary of Saipan's history, taken from Engbring et al. (1986) is as follows. Saipan is thought to have been forested before being settled by people. Before the arrival of Europeans, the native Chamorros likely cleared land by cutting vegetation and using fire, probably converting large areas of forest to grasslands. A variety of plants and animals were introduced, including rats (*Rattus spp.*) and the red junglefowl (*Gallus gallus*). With the arrival of the Spanish, the Chamorros were decimated by disease and war, and Saipan was likely left uninhabited. During the Spanish era (1521 to 1899), ungulates were introduced to Saipan, including goats, cattle, pigs and deer. These animals became feral and greatly modified the vegetation composition. During the German administration (1899-1914), Chamorros and Carolinians settled on Saipan and an active coconut planting program ensued. During the Japanese administration (1914-1944), sugar cane fields replaced much of Saipan's native forests, leaving forests only on rocky ridges and cliffs that were unsuited for sugar cane production. World War II brought tens of thousands of people to Saipan, and virtually all of the vegetation on the island of Saipan was leveled, leaving only tiny pockets of forest. After the war, fields on Saipan formerly cultivated by the Japanese were re-seeded with tangantangan by the U.S. military.

Post-war development on Saipan has included rapid expansion of tourism (including golf courses); residential, commercial and industrial development along the western shore, and in Kagman; and agriculture on a large project in Kagman and on scattered private farms.

Engbring et al. (1986) observed most of Saipan to be covered with mixed second-growth forests, grassy savannas and dense thickets of tangantangan. Their cover estimates, based on aerial photography (of unknown date), are: less than 5% in native forest, 32% in secondary vegetation, 28% in tangantangan, 9% in agriforest, 13% in open field and 1% in marsh, with the remaining 12% in other types not included in their bird study. Island-wide quantitative data on the changes in this habitat type distribution since Engbring's study are not available.

Today, Saipan's native forest is limited to steep limestone escarpments. The most extensive and best developed native forest on Saipan is in the Marpi region. Most of the island's native forests fall within the boundaries of established conservation areas, including the Saipan Upland Mitigation Bank, the Bird Island Wildlife Preserve, the Kagman Wildlife Conservation Area, and terrestrial portions of the Bird Island and Forbidden Island Sanctuaries. Secondary forests and tangantangan thickets are distributed throughout the island of Saipan. Unlike at Tinian, where tangantangan forms mostly monospecific stands, on Saipan tangantangan and secondary forest species mix with native species, forming a forest mosaic (Cruz et al. 2003b). For example, vegetation in the Saipan Upland Mitigation Bank area is comprised of 41.5% tangantangan forest, 30% native limestone forest, 13.5% introduced forest, 8% grass fields and 7% *Lantana camara* (an invasive weed) (Cruz and Williams 2003).

Condition of native, secondary and tangantangan forests on Saipan is good for supporting robust forest bird populations, especially in the conservation areas where surveys have been conducted (Cruz et al. 2003b, Cruz et al. 2003c, Cruz and Williams 2003). Where microenvironments provide enough shade and moisture, native tree species may start to appear in the seedling and sapling layers of secondary forests dominated by tangantangan, indicating that native tree species may increase in extent over time (Craig 1993). However, a dire threat to forest habitats on Saipan is being posed by the scarlet gourd vine (see discussion below).

Agriforests (notably coconut and betelnut plantations) are clustered around residential areas at Susupe and Garapan, or on agricultural homesteads scattered throughout the island. Grasslands cover much of the hillsides flanking Mt. Tapochao. Wetlands, including artificial wetlands, are located primarily on the southern part of Saipan and along the western coast, in flat areas. Lake Susupe is the largest wetland, with about 18 ha of open water surrounded by 518 ha of surrounding marsh vegetation (Engbring et al. 1986). Lake Susupe along with numerous smaller wetlands provide important habitat for the Nightingale Reed-Warbler and the Mariana Common Moorhen. Saipan supports the only mangrove forest in the CNMI, in a very small area near the seaport on the western side of the island.

<u>Farallon de Medinilla</u>

Farallon de Medinilla is characterized by unvegetated, steep vertical cliffs capped by a flat terrace covered in low-lying shrubs and grass. (See Figure 17.) Due to its small size (83 ha) and xeric conditions, FDM does not now support any forest habitat (Helber Hastert and Fee 2003). However, photos taken from the Micronesian Area Research Center prior to 1944 indicate that there once was a large forest on the island. The crowns of *Pisonia grandis* can be identified. Micronesian megapodes, a forest dwelling species, were known to exist on FDM. The habitat was modified considerably after World War II as the military began to utilize the island for bombing practice. The United States Navy has funded programs throughout the rest of the archipelago to mitigate for the take of Farallon de Medinilla (L. Williams, pers. comm., September 2005).

Figure 17. Farallon de Medinilla. Photo credit: U.S. Navy at http://ww2.pstripes.osd.mil/01/sep01/ed090701b.html

Currently, habitat condition at FDM cannot be studied on the ground, due to the presence of unexploded ordnance. The cliffline ecosystem provides important habitat for colonies of ground-nesting seabirds, notably for Red-footed Boobies, Masked Boobies, Brown Boobies and Great Frigatebirds (Helber Hastert and Fee 2003).

Anatahan

In 2000, Anatahan's habitat types were roughly estimated by Cruz et al. (2000f) to be 2,280 ha (68%) in open areas, 750 ha (23%) in native and ravine forest, and 300 ha (9%) mixed native, coconut and agroforest.

Figure 18. Anatahan volcano spewing ash, June 2005.
Photo credit: Curt Kessler

Anatahan's vegetation has undergone drastic changes due to destruction caused by feral animals during the last 50 years. Anatahan was described in 1984 as a large, heavily forested island with a band of swordgrass running along the top of the southern ridge. In 1988, the ravines of Anatahan were described as being well forested, with degradation by feral animals not yet severe (Cruz et al. 2000f). But, in 2000, Cruz et al. (*ibid.*) attributed large numbers of feral goats and pigs as being responsible for incredible and perhaps irrecoverable damage on Anatahan. On May 10, 2003, Anatahan's eastern volcano started to erupt, sending steam, ash and rocks over the majority of the island (Cruz et al. 2003a). The volcano continues to erupt to this day. (See Figure 18.) The effect of volcanic ash fall on the condition of wildlife habitats has not been quantified because the danger of landing on the island precludes taking vegetation surveys, but most certainly, drastic changes to key wildlife habitats have occurred, as exhibited by "before and after" photos; (compare Figures 19 and 20; Figures 21 and 22).

Figure 19. "Golf Course" camp at Anatahan, July 2000.
Photo credit: L. Williams

Figure 20. "Golf Course" camp at Anatahan covered in volcanic ash, June 2005.
Photo credit: C. Kessler

Figure 21. Transect #2 on Anatahan, showing ravine forest, July 2000.
Photo credit: L. Williams

Figure 22. Slopes of Anatahan covered in volcanic ash, June 2005.
Photo credit: C. Kessler

Figure 23. Quickbird II satellite image of Sarigan, acquired Jan. 13, 2004, provided by U.S. Forest Service

Sarigan

Sarigan's steep eastern and southern slopes are sparsely vegetated with grasses and ferns, whereas the western and northern slopes are more gentle and support native forest and coconut forest (Fancy et al. 1999). (See Figure 23.) Native forest is common in ravines and was estimated by Fancy et al. (*ibid.*) to cover 29 ha of the island, comprising 18% of the forest area of Sarigan. Coconut plantations cover 133 ha of the island, comprising 82% of the forest area. Under the German administration, prisoners planted 17,200 coconut palms (*Cocos nucifera*) before 1904 (*ibid.*).

Sarigan's forests have been severely degraded by feral goats and pigs. In 1997, little palatable vegetation was found in the understory of the coconut forest by Fancy et al. (1999). Feral animals were removed through a campaign conducted during 1998, utilizing shooting from a helicopter and on the ground (Kessler 2002). Numbers of plant species, frequency of individual plant species and ground cover increased dramatically within a year after feral animal removal. Although it is encouraging to see this plant succession, invasive vines, especially *Operculina ventricosa*, were observed in July 2000 to be spreading at an alarming rate over most of the low grasslands and covering seedlings (Cruz et al. 2000e).

<u>Guguan</u>

Habitats on Guguan are diverse. The northern, central and western parts of the island are characterized by recent lava flows being vegetated by grasses, shrubs and small trees. The southern part of the island is bounded by high cliffs and is heavily vegetated with dense native forest. (See Figure 24.) Guguan's native plant species that are important to wildlife for foraging and habitat were found to be the most frequent and in the greatest density when compared to other northern islands surveyed in 2000. Even though Guguan is evidently recovering from recent volcanic activity, this pristine island's ecosystems are much healthier than on the other northern islands (Cruz et al. 2000c).

Figure 24. The island of Guguan.
Photo credit: Cruz et al. 2000c

<u>Alamagan</u>

Alamagan's highlands are dominated by swordgrass, a savannah type that supports little wildlife. Coastal areas of the island are dominated by coconut forests. Most forest bird species are densely packed into native forest zones, limited to coastal areas and ravines. Out of a total land area of 1,120 ha, Alamagan's important wildlife habitats are estimated to cover 230 ha in native forest, 120 ha in coconut forest, and 150 ha in edge habitat. The quality of native forest habitat is being degraded by feral animals, which are eliminating the majority of tree seedlings and hastening erosion. The low abundance and density of native plant species on Alamagan is cause for concern, however, the destruction of forest on Alamagan is not as severe as has been observed on Anatahan or Pagan (Cruz et al. 2000d).

<u>Pagan</u>

Gross estimates of forest area cover on Pagan made by Cruz et al. (2000g) were 900 ha (19%) in native/coconut forest, 820 ha (17%) in *Casuarina equisetifolia* forest, and 3,050 ha (64%) in lava/open/forest interface. Three tree species were most abundant and in the greatest densities: *Cocos nucifera* (coconut), *Casurarina equisetifolia*, and *Jatropha curcas*, all introduced species. The seedling understory was completely absent, due to browsing by feral animals. Some unique native forest pockets were found, but forest fragmentation is occurring, and introduced forest species dominate Pagan's landscape. Native forest is disappearing, erosion of topsoil is occurring. Wildlife habitat is in poor condition and will worsen if forest restoration efforts are not undertaken immediately (Cruz et al. 2000g).

Agrihan

Agrihan's volcano, at 965 m, is the highest point in Micronesia. The island consists of a continuous series of steep, narrow ridges and ravines, with volcanic dikes occasionally running into the sea. This steep terrain separates populations of feral goats and pigs into different sectors, and limits the movement of the few people who live on Agrihan. Much of the southern part of the island is covered in swordgrass savannah, while mixed coconut and native forests dominate the northern half. Gross estimates of important habitat extent on Agrihan are 250 ha in agroforest, 800 ha in coconut forest, and 1,250 ha mixed secondary forest; forest types are estimated to cover 30% to 40% of the island. Tree species of the highest relative density are tangantangan (*Leucaena leucocephala*), coconut (*Cocos nucifera*) and *Hibiscus tiliaceus*, followed by other food trees. The widespread occurrence of coconut trees is probably attributed to copra production carried out during the German administration, and to support the small village where people have lived since the late 1800s. The U.S. Military is reported to have broadcast tangantangan (Cruz et al. 2000h).

The 2000 expedition to the northern islands was hampered by an incoming typhoon from completing vegetation surveys around the entire island of Agrihan. Transects were set up in close proximity to the village, purposely in areas that were being proposed for homestead development. Consequently, Cruz et al. (2000h) reported on the coastal area of Agrihan that has received substantial human and feral animal impact for many years. Native tree species important to wildlife were detected, but they were not relatively abundant. Feral animals were few, their numbers probably kept low by hunting by the island residents. The impact of feral animals on the quality of habitat on the remaining, less accessible part of the island is unknown, and needs to be surveyed.

Asuncion

Figure 25. Southwest upper slopes of Asuncion, unvegetated due to 1906 lava flows.
Photo credit: Dick Moore, U.S. G.S.

The habitat types of remote Asuncion Island are rarely studied. Falunruw (1989) mapped vegetation types using 1969 aerial photography, circumnavigations in 1972 and 1975, and an overflight of the island in 1975. She reported 12% in barren areas (landslides, bluffs, 1906 lava flow and the caldera), 45% in sparse or low growth, and 43% in thickets, forests and coconuts. (See Figure 25.) Of the northern islands free of goats, cattle and pigs, "Asuncion provides the largest area of sheltered habitat for the native, endemic, and endangered fauna present in this chain of islands frequently affected by violent typhoons"

(Falunruw 1989). Asuncion has not been visited recently; a field expedition to survey the wildlife and vegetation resources has been funded under the State Wildlife Grant and will be carried out in 2006 or 2007.

Maug

Maug's three islets, the remains of the crater wall of a sunken volcano, rise steeply from the ocean. Some coconut (*Cocos nucifera*) has been planted on the north islet. Most of the other parts of the islets are covered in grasslands and shrubs. Native forest of limited extent occurs in some gullies. There are no feral goats, cattle or pigs on Maug (Ohba 1994). The DFW expedition to the northern islands in 2000 was unable to visit Maug, so there is no recent information about the condition of key wildlife habitats.

Uracas

Most of Uracas is unvegetated. Low-lying shrubs are distributed in patches on gentle slopes. No humans nor domestic animals occur on Uracas. Large seabird nest colonies are found within the vegetated areas (Ohba 1994). The DFW expedition to the northern islands in 2000 did not visit Uracas, so there is no recent information about habitat condition.

## Problems which adversely affect terrestrial habitats

Loss of forested habitats through land development

Despite a lagging local economy, clearing of land for various developments on the southern islands of Rota, Tinian and Saipan continues. With a growing local populace, there is a demand for village and agricultural homesteads. One proposed homestead development in the Carolinas and Kastiyu region is situated in or proximate to the only remaining native limestone forest on Tinian. Large developments such as golf courses that result in the clearing of forested areas are required to mitigate for the taking of any federally endangered species; the Saipan Upland Mitigation Bank was specifically established for this purpose, to protect the Nightingale Reed-Warbler. Proposals for large developments have curtailed in recent years due to the economic downturn in the Mariana Islands. Recently, DFW's attention has also been focused on smaller operations for clearing of tangantangan forest on Saipan, for construction of buildings, development of farm plots, or harvest for charcoal.

Damage to native forest understory by feral ungulates

Goats, cattle, pigs and deer were brought to the Marianas during the Spanish era, from 1521 to 1899 (Engbring et al. 1986). These animals became feral and greatly modified the vegetation composition on most of the islands. The current presence of feral animals that damage forested habitats is given in Table 6. Feral ungulates eat native plants, with the result that the forest understory becomes devoid of native tree species. Regeneration of the native forest is not occurring. Unpalatable, weedy species move in and replace native species. Rooting, especially by pigs, results in soil erosion. Ultimately, the forest will die out. Forest damage is especially drastic on the islands of Aguiguan, Anatahan and Pagan, whereas Alamagan is "at a crossroads" for preserving remaining habitat (Cruz et al. 2000b, 2000d, 2000f, 2000g). Feral animals on Sarigan have been eradicated, and tree seedlings are starting to show up in the understory (Cruz et al. 2000e). The degradation of forested habitat on the Sabana of Rota is not well studied or understood, but it is thought that deer browsing is a leading cause (L. Williams, pers. comm., April 2005).

Natural phenomena

Typhoons can result in complete defoliation, broken limbs and downed trees in forests. Although the forests of the CNMI are adapted to this kind of disturbance, recovery may take many years. Damage by typhoons is exacerbated if forests are fragmented or already in poor condition.

Many of the Mariana Islands are volcanically active. The 1981 eruption on Pagan changed the face of the island; Anatahan's volcano continues to spew ash over the landscape today.

Invasive plants

Invasive plants can choke out native vegetation and prevent it from becoming established after disturbance. *Operculina ventricosa*, a vine, has spread on Sarigan following feral animal eradication; it remains to be seen if this is one successional stage that will yield to native tree species becoming established in the future (Cruz et al. 2000e). *Lantana camara* is an aggressive, thorny weed that spreads under the forest canopy after overbrowsing by goats or cows, and is problematic on Aguiguan, Tinian and Saipan (Cruz et al. 2003d; Cruz and Williams 2003; L. Williams, pers. comm., August 2005). The chain-of-love vine (*Antigonon leptopus*) is a smothering vine that climbs over the tree canopy. It is becoming prevalent on Saipan (S. Kremer, pers. comm., August 2005), and is also a problem on Rota, Tinian, Pagan and Agrihan (U.S. Forest Service 2004). The wood rose (*Merremia tuberosa*) is another smothering vine that is problematic on Rota, Tinian and Saipan (U.S. Forest Service 2004).

The most rapidly spreading invasive plant at Saipan is the scarlet gourd, *Coccinia grandis*. This aggressive vine climbs over trees, smothering the canopy, choking out sunlight and eventually killing the forest. In the span of less than a decade, *C. grandis* has spread to all parts of the island, especially in urban and agricultural areas, and is approaching the outskirts of Saipan's terrestrial conservation areas. (See Figure 26.) It is estimated that over 15,000 acres on Saipan and 5 acres on Rota are infested with scarlet gourd, and the infestation continues to spread (U.S. Department of Agriculture 2004). Biological control efforts to defoliate the vines through the introduction of leaf-boring weevils are not keeping up with the rapid growth of this pest.

Figure 26. *Coccinia grandis* in the Marpi region of north Saipan. Left: Scarlet gourd vines have killed these trees. Center: Scarlet gourd vines (broad leaves with white flowers) climbing over tangantangan branches. Right: Scarlet gourd vines advance over the canopy of native forest, some of the only remaining native forest on the island of Saipan. Photo credit: Gayle Berger

Tangantangan could be argued to be an introduced plant that interrupts plant succession to climax native forest after disturbance. Craig (1993), however, found that native tree species can successfully recolonize disturbed sites under a tangantangan overstory given certain ecological conditions. Tangantangan forests are valuable habitats for many species, including the endangered Nightingale Reed-warbler on Saipan and the Tinian Monarch on Tinian.

## Priority research and survey efforts needed for improved conservation of terrestrial habitats

### Geographic Information System for Wildlife

There is currently no centralized, geographic database that could be used by wildlife biologists, planners and managers to determine trends in the amount of vegetation cover, detect wildlife population fluctuations, track the extent of invasive species, or monitor the effectiveness of conservation areas. The limited data on habitat extent and condition for the CNMI is based on outdated aerial photos. There is a need to develop a Geographic Information System (GIS) for the CNMI, geared toward wildlife conservation and management, and based upon recent data. DFW does not currently have the hardware, software or expertise to develop such a GIS and will need to contract out these services.

### Study of deer densities and effects of overbrowsing on the Sabana of Rota

High densities of deer on the Sabana of Rota are suspected to be preventing forest regeneration due to overbrowsing. A study is needed to determine current densities of deer and to ascertain the extent of habitat damage caused by deer. Exclosure plots could be established to examine forest regeneration in the absence of deer.

Study of dynamics of goat population and effects on vegetation on Aguiguan

DFW's last study of the vegetation of Aguiguan, conducted in 2002, found that the native forest suffers from extreme browsing damage from high densities of goats (Cruz et al. 2003d). In 2005, a special hunting season was opened in January by the Resident Director of the Tinian DLNR, and was closed in July after 500 goats had been harvested (J. San Nicolas, pers. comm., August 2005). Goat densities on Aguiguan will fluctuate with hunting pressure. A study is needed to monitor how goat densities fluctuate through time in response to varying hunting pressure, and to assess if forest regeneration is occurring.

Suitability of habitats on Sarigan and other northern islands to receive translocated forest birds

Native forest birds on the southern islands of the archipelago are under the threat of extirpation by the Brown Treesnake (*Boiga irregularis*). In response to this threat, DFW and other agencies have proposed translocation of these birds to the northern islands. Before translocations can be initiated, however, studies are needed to update vegetation information from the baseline to determine if habitats are sufficient for translocated birds. Sarigan has been cleared of feral animals, and it appears that forests there have started to recover (Cruz et al. 2000e). Sarigan is a good candidate to be the first island to receive forest birds from the southern islands, in response to the likelihood of their extirpation by entry of the Brown Treesnake to the CNMI.

Baseline vegetation study of Asuncion

During the northern islands expedition in 2000, DFW's field crew was turned back at Agrihan by foul weather. They were unable to visit the last forested island in the archipelago, Asuncion. A project has been approved under State Wildlife Grant funding for a field trip to Asuncion, to gather baseline vegetation and wildlife data. The trip is planned for 2006 or 2007, depending on whether a Coast Guard certified vessel charter can be contracted.

**Conservation actions for terrestrial habitats**

Conservation actions to conserve terrestrial habitats are listed below, by habitat type. A detailed description and priority rank for each conservation action is given in Chapter 6.

Native forest

| |
|---|
| Implement the Rota Agricultural Homestead Habitat Conservation Plan |
| Conserve habitat for endangered bird species on Rota through an island-wide habitat conservation plan |
| Decrease deer numbers on the Sabana of Rota |
| Cull goats from the island of Aguiguan |
| Conserve remnant native limestone forest on Tinian by establishing a conservation area |
| Eradicate scarlet gourd (*Coccinia grandis*) from Saipan |
| Prevent further introductions of invasive species to the southern islands |

| |
|---|
| Conserve remaining forest and wetland habitats on the southern islands through avoidance and mitigation conditions placed on land development proposals |
| Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition |
| Improve management of terrestrial conservation areas in the southern islands |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Reforest disturbed areas with native tree species on the southern islands |
| Assess the suitability of Sarigan Island to receive translocated birds and monitor forest succession and wildlife population trends on Sarigan following the eradication of feral ungulates |
| Establish a fenced nature reserve on the southern peninsula of Pagan |
| Remove feral ungulates from the northern islands of Anatahan, Alamagan, Pagan and Agrihan |
| Prevent the introduction of invasive species to the northern islands |

<u>Secondary forest</u>

| |
|---|
| Implement the Rota Agricultural Homestead Habitat Conservation Plan |
| Conserve habitat for endangered bird species on Rota through an island-wide habitat conservation plan |
| Decrease deer numbers on the Sabana of Rota |
| Cull goats from the island of Aguiguan |
| Eradicate scarlet gourd (*Coccinia grandis*) from Saipan |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on the southern islands through avoidance and mitigation conditions placed on land development proposals |
| Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition |
| Improve management of terrestrial conservation areas in the southern islands |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Reforest disturbed areas with native tree species on the southern islands |
| Assess the suitability of Sarigan Island to receive translocated birds and monitor forest succession and wildlife population trends on Sarigan following the eradication of feral ungulates |
| Establish a fenced nature reserve on the southern peninsula of Pagan |
| Remove feral ungulates from the northern islands of Anatahan, Alamagan, Pagan and Agrihan |
| Prevent the introduction of invasive species to the northern islands |

Tangantangan forest

| |
|---|
| Eradicate scarlet gourd (*Coccinia grandis*) from Saipan |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on the southern islands through avoidance and mitigation conditions placed on land development proposals |
| Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition |
| Improve management of terrestrial conservation areas in the southern islands |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Reforest disturbed areas with native tree species on the southern islands |

Agricultural forest

| |
|---|
| Eradicate scarlet gourd (*Coccinia grandis*) from Saipan |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on the southern islands through avoidance and mitigation conditions placed on land development proposals |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Reforest disturbed areas with native tree species on the southern islands |
| Assess the suitability of Sarigan Island to receive translocated birds and monitor forest succession and wildlife population trends on Sarigan following the eradication of feral ungulates |
| Establish a fenced nature reserve on the southern peninsula of Pagan |
| Remove feral ungulates from the northern islands of Anatahan, Alamagan, Pagan and Agrihan |
| Prevent the introduction of invasive species to the northern islands |

Grassland and Savanna

| |
|---|
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on the southern islands through avoidance and mitigation conditions placed on land development proposals |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Reforest disturbed areas with native tree species on the southern islands |
| Assess the suitability of Sarigan Island to receive translocated birds and monitor forest succession and wildlife population trends on Sarigan following the eradication of feral ungulates |

Wetlands

| |
|---|
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on the southern islands through avoidance and mitigation conditions placed on land development proposals |
| Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition |
| Develop island-wide habitat conservation plans for all islands in the archipelago |

Strand

| |
|---|
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on the southern islands through avoidance and mitigation conditions placed on land development proposals |
| Improve management of terrestrial conservation areas in the southern islands |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Prevent the introduction of invasive species to the northern islands |

Limestone caves and crevices

| |
|---|
| Protect limestone caves on Rota, Aguiguan, Tinian and Saipan from disturbance by people |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on the southern islands through avoidance and mitigation conditions placed on land development proposals |
| Develop island-wide habitat conservation plans for all islands in the archipelago |

## Monitoring of terrestrial habitats in the CNMI

Monitoring of habitats in the CNMI is challenging. Although land area is small when compared to other states, access to the remote islands for field work is difficult and expensive. A systematic geographic information system for storing and analyzing habitat attributes is lacking. DFW currently monitors habitats through baseline vegetation studies and permanent vegetation plots.

Baseline vegetation studies

Baseline vegetation studies were undertaken for six of the northern islands during an expedition in 2000 – Guguan, Alamagan, Sarigan, Anatahan, Pagan, and Agrihan – as reported in Cruz et al. (2000c, 2000d, 2000e, 2000f, 2000g, 2000h). In the same year, baseline vegetation studies were undertaken in the southern islands as follows: for

Aguiguan (Cruz et al. 2000b); for conservation areas on Saipan (Cruz et al. 2003b, 2003c; Cruz and Williams 2003); and for the proposed conservation area on Tinian (Cruz et al. 2000a). DFW plans to re-visit the northern islands within the next five years to monitor vegetation trends from the baselines. No baseline vegetation information is available for Asuncion; a field trip to Asuncion is planned for 2006 or 2007 for this purpose.

Permanent vegetation plots

Permanent vegetation plots have been established to monitor habitats on three islands – Saipan, Anatahan and Sarigan.

Saipan

Eighty-nine permanent vegetation plots were established in 1999 throughout the Saipan Upland Mitigation Bank conservation area. The plots were surveyed for tree and shrub species, circumference, tree height, and canopy cover. Data were analyzed for basal area, frequency, density, relative density, and importance. Each plot was assigned a habitat designation similar to that used by Falunruw et al. (1989). Details of this baseline survey of the habitats of the Saipan Upland Mitigation Bank conservation area are given in Cruz and Williams (2003). These plots will be monitored in the future to determine how disturbed areas covered in *Lantana camara* are changing, whether native forest species continue to replace introduced tree and shrub species, how habitat type composition changes affect the abundance of different endangered and native bird species, and to detect other ecological changes.

Anatahan

After baseline information was collected for Anatahan in 2000 (Cruz et al. 2000f), a project was initiated to remove feral goats and pigs. In May 2002, two vegetation surveys were conducted: a point-center quarter survey to establish forest species diversity, and a baseline survey of long-term vegetation plots (with fenced and unfenced plots) to monitor habitat recovery with the removal of feral animals. The vegetation plots established in May 2002 were reassessed in November 2002 to evaluate the impact of removal on vegetative recovery (Cruz et al. 2003a). The Anatahan volcano started to erupt in May 2003, making return visits to the island for field work impossible for the time being. Shooting of feral animals continues from a helicopter on a monthly basis (volcano permitting).

Sarigan

Three different vegetation studies have been conducted on the island of Sarigan. One study was conducted simultaneously with forest bird surveys, on stations along transects. The vegetation was surveyed using a modified point-centered quarter method. Data was analyzed for ground and canopy cover, species absolute frequency, relative density and diameter size classes (Cruz et al. 2000e). Vegetation data on these plots along transects will again be gathered during a field trip scheduled for 2006.

A second study is vegetation monitoring of 13 permanent plots established prior to feral animal eradication in 1997. These plots were established in 1996 along a transect running up a ridgeline and across habitat types. The plots have been surveyed four times to date -- in February 1997 before feral goats and pigs were eradicated from the island, in August 1998, in July 1999, and in July 2000. Data were analyzed for species richness, frequency, canopy and ground cover and average tree diameter for each year. Pictures were taken all years at each station (*ibid.*). These permanent plots will again be checked during the field trip scheduled for 2006.

The third study was a vegetation succession study. Seedlings and mature trees were measured along a transect running between two forest fragments and through a field that was likely forested at one time, using a modified line intersect method. Measurements were taken of tree height, distance of trees from the transect, and herbaceous ground cover. Soil core samples were taken, air dried, and later watered to determine species of seedlings that would sprout. This study may be repeated during the field trip scheduled for 2006.

Table 5. Recent Data Sources for Terrestrial Habitat Types Currently Available for the CNMI.

| Author | Survey Method and Product | Islands Surveyed | Advantages of Using This Source | Disadvantages of Using This Source |
|---|---|---|---|---|
| Falanruw et al. (1989) | Interpretation of black and white aerial photography taken in 1976. The classification scheme was simplified to vegetation types that could be identified on black and white aerial photography without intensive ground checking. A series of maps was produced showing polygons identified with vegetation type codes. Tables and bar charts show estimated areas for each type by island and land class. | Saipan, Tinian and Rota | ▪ The map series provides 100% coverage of vegetation types.<br>▪ The bar graphs and tables give a good overall picture of the extent of important wildlife habitat on each island. | ▪ Data and maps are based on 1976 photography, now almost three decades old; vegetation types have probably changed since then.<br>▪ The map data is not available in digital form, and if used in a GIS, would have to be digitized.<br>▪ Plant species composition under the canopy is not shown. |
| Falanruw (1989) | Examination of aerial and ground photographs taken between 1944 and 1975 to construct a generalized vegetation type map of the island of Asuncion. Rough estimates of area by type using dot grid. Description of each type includes typical plant species, where type is found, probable successional events. | Asuncion | ▪ The map provides 100% coverage of general vegetation types.<br>▪ This information will be helpful in planning the 2005 field surveys to Asuncion. | ▪ Vegetation typing is based on aerial photos that are from 36 to 61 years old; vegetation types have probably changed since then.<br>▪ The vegetation types are very general, and do not depict plant species composition under the canopy. |

| Author | Survey Method and Product | Islands Surveyed | Advantages of Using This Source | Disadvantages of Using This Source |
|---|---|---|---|---|
| Engbring et al. (1986) | Apparently adopted vegetation type mapping eventually published by Falanruw et al. (1989). Descriptions of ten habitat types important for forest birds, including dominant tree species and extent of cover on each island. | Saipan, Tinian, Aguiguan and Rota | ▪ Forest bird densities were computed from the vegetation type data.<br>▪ This study is considered a baseline for forest bird population and density estimates for these inhabited islands. | ▪ It is not clear how the vegetation types were determined for Aguiguan.<br>▪ No date of aerial photography is given, but it is at least as old as 1982, over two decades ago. Vegetation types have probably changed since then, especially on these inhabited islands. |
| Craig (1992a) | Plotless point-quarter sampling technique (after Cottam and Curtis 1956) on points along transects through native forest at Marpi, Saipan. Characterization of species composition, relative species importance, tree basal area, and tree density. | Saipan | ▪ Detailed description of a remnant native forest in northern Saipan, growing on limestone substrate.<br>▪ Comparison with other native forest stands on Tinian, Rota and Guam through literature accounts.<br>▪ Forest composition remains native despite centuries of disruption, suggesting that native forest is resistant to invasion by alien species. | ▪ Findings may not apply to northern islands, which have a volcanic substrate and less human disturbance.<br>▪ Study area is described, but not mapped, making it difficult to eventually input the data to GIS. |
| Craig (1993) | Measure of basal area by tree species and vertical strata in ten plots in an area disturbed 45 years ago, at Marpi, Saipan. Characterization of densities of introduced and native species among strata. Suggestion that native species might increase their presence in the canopy. | Saipan | ▪ The only plant succession study performed on disturbed forest for southern islands.<br>▪ Management recommendations made for reestablishing native forest in disturbed areas. | ▪ Findings may not apply to northern islands, which have a volcanic substrate and less human disturbance.<br>▪ Study area is described, but not mapped, making it difficult to eventually input the data to GIS, or to repeat the study for trend analysis. |

| Author | Survey Method and Product | Islands Surveyed | Advantages of Using This Source | Disadvantages of Using This Source |
|---|---|---|---|---|
| Ohba (1994) | Braun-Blanquet surveys within samples of characteristic floristic assemblages of all terrestrial plant communities. Detailed listing of 39 different plant communities, 15 of them new associations. | Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, Maug, Uracas | ▪ Detailed plant communities are described and species composition is documented in Braun-Blanquet matricies.<br>▪ This is the first thorough study of plant species composition for the northern islands. | ▪ Geographic extent of plant communities is not mapped. |
| Mueller-Dombois and Fosberg (1998) | Review of published literature coupled with brief island visits by the authors or other researchers. Detailed descriptions of vegetation of the Northern Mariana Islands. | All of the Mariana Islands | ▪ Vegetation types are described for Micronesia.<br>▪ Characteristics of vegetation and historical changes are described for each of the Mariana Islands. | ▪ Descriptions are based on literature that is out of date, illustrating the paucity of current information.<br>▪ No maps of vegetation types are given for the Mariana Islands. |
| DFW Technical Report Series (Cruz et al. 2000a, 2000b, 2000c, 2000d, 2000e, 2000f, 2000g, 2000h, 2003a, 2003b, 2003d; Cruz and Williams 2003) | Ground surveys using modified point-center quarter method (after Mueller-Dombois and Ellenberg 1974) at stations along transects. Tables and graphs showing attributes by plant species, such as: importance values, relative density, absolute frequency, DBH size classes, native vs. non-native distribution, ground cover, and canopy cover. | Tinian, Aguiguan, Saipan, Guguan, Alamagan, Sarigan, Anatahan, Pagan and Agrihan | ▪ Data are recently taken.<br>▪ Data, graphs and tables give a picture of forest species composition and cover extent, from understory to canopy.<br>▪ Relationship of forest habitat types to wildlife species abundance is explained.<br>▪ Covers all of the southern islands in the archipelago, with the exception of Rota.<br>▪ Covers all of the forested northern islands in the archipelago, with the exception of Asuncion. | ▪ No maps of habitat types were produced from this recent study.<br>▪ Data are based on transects, and may not represent island-wide forest conditions.<br>▪ Since the vegetation surveys were performed, the Anatahan volcano has violently erupted, spreading ash. The current state of wildlife habitats is unknown. |

| Author | Survey Method and Product | Islands Surveyed | Advantages of Using This Source | Disadvantages of Using This Source |
|---|---|---|---|---|
| Vogt and Williams (2004) | Handbook of flora and fauna, featuring a section on common habitats, including name of habitat, description and photograph. | All islands | ▪ Very recent publication<br>▪ Easily read and understood<br>▪ Photographs portray typical habitat types. | ▪ As the book is meant to be a field guide for identification purposes, detailed scientific data on habitat type extent or species composition is lacking. |

Table 6. Current presence of problematic feral ungulates in the CNMI.

| Animal<br>**Island** | **Deer**<br>**(*Cervus unicolor*)** | **Pigs**<br>**(*Sus scofra*)** | **Goats**<br>**(*Capra hircus*)** | **Cattle**<br>**(*Bos taurus*)** |
|---|---|---|---|---|
| Rota | Present | | | |
| Aguiguan | | | Present | |
| Anatahan | | Eradication program ongoing | Eradication program ongoing | |
| Sarigan | | Removed 1998 | Removed 1999 | |
| Alamagan | | Present | Present | Present |
| Pagan | | Present | Present | Present |
| Agrihan | | Present | Present | Present |

# Chapter 5:

# PROFILES OF TERRESTRIAL SPECIES











# Chapter 5: PROFILES OF TERRESTRIAL SPECIES

**How to use the profiles**
Detailed information on each of the 24 terrestrial species of special conservation need is presented in the series of profiles in this chapter. Profiles are presented in the same order in which the species of special conservation need are listed in Table 3. The layout of the profiles was designed to address Elements 1 through 5 for each species. Underlined headings were used to facilitate easy recognition of the Elements.

**Finding the Elements**
For purposes of providing the reader a link between the headings in the profiles to the Elements, a generic list of headings is given here, with the Element number indicated in parentheses and in blue type.

## SPECIES TITLE

**Common Name**
**Scientific Name**
**Chamorro Name**
**Carolinian Name**
**Listing Status**
**Reasons for selecting the [species] as a species of special conservation need**
**Unique characteristics**
**Distribution of the [species] in the CNMI** (Element 1)
**Abundance of the [species] in the CNMI** (Element 1)
**Location and relative condition of key habitats for the [species] in the CNMI** (Element 2)
**Problems which adversely affect the [species] and its habitats** (Element 3)
**Priority research and survey efforts** (Element 3)
**Conservation actions** (Element 4)
**Monitoring** (Element 5)

**Literature Cited**
Full citations for all literature cited within these profiles for terrestrial species is given in Chapter 7. This approach of collecting all citations across all terrestrial species into a separate chapter was intended to reduce the volume of this document. Because almost all sources applied to several species, there would have been considerable redundancy in listing them at the end of each species profile.

**Species Distribution**
The species of special conservation need for the CNMI include 11 native forest birds, 1 freshwater bird, 2 seabirds, 2 mammals, 4 invertebrates, and 4 reptiles. Even though each profile details the distribution of each species, a summary would be useful in demonstrating the high degree of endemism and the restricted distribution to just a few islands of many of these species. Table 7 provides just such a summary.

## A note about forest bird abundance estimates

Throughout the species profiles for native forest birds that follow, estimates of abundance are reported from Engbring et al.'s (1986) *Micronesian Forest Bird Survey, 1982: Saipan, Tinian, Agiguan, and Rota*. They used the variable circular plot method to survey forest birds. The method consists of marking stations along transects in the study area and conducting counts at each station. During each count all birds heard of seen and their lateral distance from the observer are recorded. The data are analyzed by determining an effective detection distance (or area) for each species, and ultimately calculating densities. In calculating densities, adjustment factors are incorporated for each observer and for habitat types. Population sizes are calculated by multiplying densities by the study area size (Engbring et al. 1986).

In 1996 on Tinian and in 1997 on Saipan, the transects surveyed by Engbring et al. (1986) were resurveyed, and data was collected on all forest bird species (F. Amidon, pers. comm., September 2005). However, population estimates and densities were only calculated for two species, the Tinian Monarch (*Monarcha takatsukasae*) on Tinian (Lusk et al. 2000a), and the Nightingale Reed-warbler (*Acrocephalus luscinia*) on Saipan (U.S. Fish and Wildlife Service 1998b). It is hoped that the 1996 and 1997 data will soon be analyzed for the other forest bird species as well (F. Amidon, pers. comm., September 2005).

In 2004 on Rota, Amar et al. (2004) resurveyed the same transects as Engbring et al. (1986), and noted alarming decreases in abundance indicators for eight forest bird species. Statistical analysis methods may have differed from Engbring's. These findings are still under review and, for purposes of this document, should be considered preliminary (L. Williams, pers. comm., September 2005).

The variable circular plot methods used by Engbring et al. (1986) have set a baseline standard for conducting bird surveys in the CNMI. For example, all the island-wide surveys, surveys in the northern islands, in the Saipan Upland Mitigation Bank, the BBS Survey, and the bird surveys in all of the conservation areas have utilized VCP methodology. The analysis method used by Engbring to determine population densities and abundance may not be the same as those used in other, more recent surveys. These statistical issues are currently being addressed so that accurate temporal population estimates can be determined.

Table 7. Current known distribution of terrestrial species of special conservation need among the islands of the CNMI. Key: E = endemic; N = native; R = resident native, breeding; U = suspected but not verified, or unknown.

| **Island**<br>**Common name**<br>***Scientific Name*** | **Rota** | **Aguiguan** | **Tinian** | **Saipan** | **FDM** | **Anatahan** | **Sarigan** | **Guguan** | **Alamagan** | **Pagan** | **Agrihan** | **Asuncion** | **Maug** | **Uracas** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Native Forest Birds** | | | | | | | | | | | | | | |
| Golden White-eye *Cleptornis marchei* | | E | | E | | | | | | | | | | |
| Mariana Crow *Corvus kubaryi* | E | | | | | | | | | | | | | |
| Mariana Fruit Dove *Ptilinopus roseicapilla* | E | E | E | E | | | | | | | | | | |
| Mariana Swiftlet *Aerodramus vanikorensis bartschi* | | E | | E | | | | | | | | | | |
| Micronesian Megapode *Megapodius laperouse laperouse* | | E | U | E | E | E | E | E | E | E | E | U | E | U |
| Nightingale Reed-warbler *Acrocephalus luscinia* | | U | | E | | | | | E | | | | | |
| Rota Bridled White-eye *Zosterops rotensis* | E | | | | | | | | | | | | | |
| Rufous Fantail *Rhipidura rufifrons* | E | E | E | E | | | | | | | | | | |
| Saipan Bridled White-eye *Zosterops conspicillatus saypani* | | E | E | E | | | | | | | | | | |
| Tinian Monarch *Monarcha tatatsukasae* | | | E | | | | | | | | | | | |
| White-throated Ground Dove *Gallicolumba xanthonura* | E | E | E | E | E | E | E | E | E | E | E | E | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Freshwater Birds** | | | | | | | | | | | | | | |
| Mariana Common Moorhen *Gallinula chloropus guami* | E | | E | E | | | | | | | | | | |
| **Sea Birds** | | | | | | | | | | | | | | |
| Masked booby *Sula dactylatra* | | U | | | R | | | R | | | | | R | R |
| Wedge-tailed shearwater *Puffinus pacificus* | | U | | R | | | | | | | U | U | U | |
| **Mammals** | | | | | | | | | | | | | | |
| Mariana Fruit Bat *Pteropus mariannus* | E | E | E | E | E | E | E | E | E | E | E | E | E | |
| Sheath-tailed Bat *Emballonura semicaudata rotensis* | | E | | | | | | | | | | | | |
| **Invertebrates** | | | | | | | | | | | | | | |
| Coconut crab *Birgus latro* | N | N | N | N | N | N | N | N | N | N | N | N | N | N |
| Fragile tree snail *Samoana fragilis* | E | | | | | | | | | | | | | |
| Humped tree snail *Partula gibba* | E | E | U | U | | U | U | | U | U | | | | |
| Langford's tree snail *Partula langfordi* | | E | | | | | | | | | | | | |
| **Reptiles** | | | | | | | | | | | | | | |
| Micronesian Gecko *Perochirus ateles* | N | | N | N | | | | | | | | | | |
| Rock Gecko *Nactus pelagicus* | N | | | U | | N | | | N | | | | | |
| Tide-pool Skink *Emoia atrocostata* | N | N | | N | | | | N | N | | | | | |
| Slevin's Skink *Emoia slevini* | | | | | | | E | | E | | | E | | |

# GOLDEN WHITE-EYE

**Common Name**
Golden White-eye.
Formerly, Golden honeyeater

Figure 27. Golden White-eye.
Photo credit: Scott Vogt.

**Scientific Name**
*Cleptornis marchei*

**Chamorro Name**
Canario

**Carolinian Name**
Khanooriyo

**Listing Status**
Not federally protected. Local regulations protect the Golden White-eye by prohibiting hunting (CNMI 2000).

**Reasons for selecting the Golden White-eye as a species of special conservation need**
The Golden White-eye has a limited distribution, occurring on only two islands in the world, and living primarily in the native forest. It is susceptible to habitat loss and degradation, and is vulnerable to predation, especially by the Brown Treesnake. This species has not been well studied, and little is known about its natural history or habitat requirements. Funding for research and management is lacking: because this species is not federally listed, it does not qualify for ESA Section 6 funding.

**Unique characteristics**
The Golden White-eye is a brilliant yellow bird with orange bill and feet. (See Figure 27.) It makes a cup-shaped nest from fine vegetation (e.g. grasses, Casurina needles, coconut fiber) attached to tree branches by a handle. (See Figure 28.) It travels in pairs or small family groups in native and secondary forest. It forages on the leaves and bark of trees, often turning upside down or sideways to probe into bark crevices. It feeds on insects, hard seeds and fruits. Larger than the Saipan Bridled White-eye, and sharing the same habitat, the Golden White-eye is a more generalized forager (Bruce 1978; CNMI Div. of Fish and Wildlife n.d., Craig 1990; Marshall and Stinson 1994).

Figure 28. Golden White-eye in its nest.
Photo credit: Scott Vogt.

**Distribution of the Golden White-eye in the CNMI**

An endemic to the Mariana Islands, this species is found on only two islands, Saipan and Aguiguan. Its absence from Tinian is a mystery, although its bones have been found on Tinian and Rota (Steadman 1991).

**Abundance of the Golden White-eye in the CNMI**

All researchers found Golden White-eyes to be common and plentiful when detected on Aguiguan and Saipan.

Aguiguan

Engbring et al. (1986) made an island-wide estimate of 2,366 Golden White-eyes on Aguiguan in 1982, with a density of 6.1 birds/ha. Cruz et al. (2003d) found a higher island-wide estimate of 9,449 Golden White-eyes on Aguiguan in 2002, with a density of 34.4 birds/ha.

Saipan

Engbring et al. (1986) made an island-wide estimate of 55,522 Golden White-eyes on Saipan in 1982, with a density of 5.3 birds/ha. No island-wide estimate for this species has recently been made on Saipan, but surveys made in three conservation areas have yielded the following density estimates:

- Saipan Upland Mitigation Bank, in Marpi – Densities ranged from 25.0 to 46.2 birds/ha in bi-annual surveys conducted from 1999 to 2003 (Cruz and Williams 2003).
- Kagman Conservation Area – A density estimate of 21.2 birds/ha was made in 2002 – 2003 (Cruz et al. 2003c).
- Bird Island Conservation Area – A density estimate of 16.6 birds/ha was made in 2001 (Cruz et al. 2003b).

**Location and relative condition of key habitats for the Golden White-eye in the CNMI**

Golden White-eyes are found in native forests, secondary forests, tangantangan forests and even in residential areas with trees. Native forests appear to be the preferred habitat, as Golden White-eyes were two to three times more abundant in limestone forest than in tangantangan forest (Marshall 1995). Tangantangan flowers are too small to provide nectar for birds, therefore, Golden White-eyes eat the fruits of introduced, weedy papaya plants that are scattered throughout tangantangan thickets (Craig 1990). Locations and conditions of these habitats are addressed in Chapter 4.

**Problems which adversely affect the Golden White-eye and its habitats**

Probable extirpation by the Brown Treesnake

The Golden White-eye did not occur on Guam, so there is no precedent established that would predict whether Brown Treesnakes would prey on Golden White-eyes in the CNMI. However, the Golden White-eye is a small bird, of an appropriate size to be preyed upon by snakes. The Brown Treesnake has already established an incipient population on the island of Saipan (Colvin et al. 2005). The Golden White-eye is the most distinctive of several forest bird species that face extinction on Saipan (Stinson and Stinson 1994). The Golden White-eye is particularly vulnerable to extinction because of its limited distribution to just two islands.

**Priority research and survey efforts**

Life history and ecology research on this species was initiated in the 1990s. Craig (1990) studied foraging behavior vis-à-vis the Saipan Bridled White-eye. Stinson and Stinson (1994) studied nesting sites, clutch size and incubation behavior. Marshall and Stinson (1994) studied food habits and sexual dimorphism. Craig and Beal (2001) further studied microhabitat use for foraging by the Golden White-eye, Rufous fantail, Bridled White-eye and Micronesian honeyeater. After the mid-1990s, however, research directed at the Golden White-eye was discontinued by the CNMI Div. of Fish and Wildlife due to staffing problems. Priority research and surveys for the Golden White-eye are as follows, taken from Marshall (1995).

Color banding studies

Color banding and morphometry investigations started in the mid-1990s should be continued to investigate habitat use and territoriality.

Densities by habitat

Data should be collected on habitat and density of Golden White-eyes to document the apparent preferred use of limestone forest.

Translocation suitability

Translocation studies could begin with this common, though restricted species, to aid in determining translocation details (e.g. holding times, transport container design). These procedures could then be used on other species that are endangered and therefore potentially more difficult to successfully translocate.

**Conservation actions**

Conservation actions to conserve the Golden White-eye are listed below. A detailed description and priority rank for each conservation action is given in Chapter 6.

| |
|---|
| Cull goats from the island of Aguiguan |
| Eradicate rats, cats and other predators from Aguiguan Island |
| Eradicate scarlet gourd (*Coccinia grandis*) from Saipan |
| Interdiction of the Brown Treesnake (*Boiga irregularis*) |
| Translocation of native forest birds from the southern islands to the northern islands and establishment of a captive breeding program |
| Prevent the introduction of West Nile Virus to the Mariana Islands |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition |
| Improve management of terrestrial conservation areas in the southern islands |

| |
|---|
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Reforest disturbed areas with native tree species on the southern islands |

**Monitoring**

Monitoring of trends in Golden White-eye populations is accomplished through quarterly breeding bird surveys on Saipan.  Aguiguan is difficult to access, and monitoring of population trends occurs opportunistically, as funding and staff availability dictate.  DFW plans to take a field trip to Aguiguan to monitor all wildlife and habitats on the island within the next five years.

# MARIANA CROW

**Common Name**
Mariana Crow

**Scientific Name**
*Corvus kubaryi*

**Chamorro Name**
Aga

**Carolinian Name**
Mwii'lup

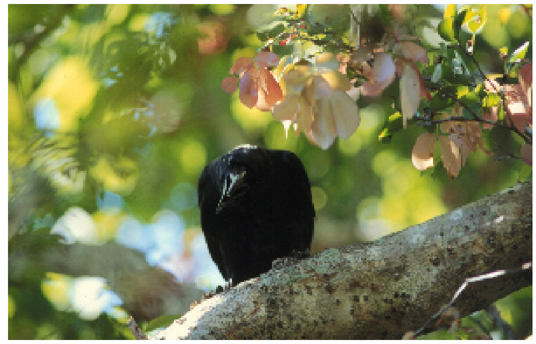

Figure 29. Mariana Crow.
Photo credit: Laura Williams.

**Listing Status**
The Mariana Crow was federally listed as Endangered on August 27, 1984 (U.S. Fish and Wildlife Service 1984). It is locally listed as threatened and endangered, and is also locally protected from hunting by regulation (CNMI 2000). Critical habitat, 2,442 ha, was established on the island of Rota for the Mariana Crow on November 29, 2004 (U.S. Fish and Wildlife Service 2004d). A Habitat Conservation Plan (HCP) for the incidental take of Mariana Crows under Section 10 of the ESA, for an agricultural homestead development has been submitted by the CNMI to the U.S. Fish and Wildlife Service for review.

**Reasons for selecting the Mariana Crow as a species of special conservation need**
The Mariana Crow is endemic to and found on only two islands, Rota and Guam. Numbers of crows have fallen drastically in the last two decades. Conservation funding through Section 6 of the ESA is insufficient to implement all necessary conservation measures to prevent the extinction of this species.

**Unique characteristics**
The Mariana Crow is the only representative of the Corvidae family occurring in Micronesia (Plentovich et al. n.d.). Although it is similar in appearance and habits to the common crow (*C. brachyrhynchos*) of North America (U.S. Fish and Wildlife Service 1984), it is small for a crow, quiet and wary (Pratt et al. 1987). Adults are a glossy black color with a bluish-black tail (CNMI Div. of Fish and Wildlife n.d.). (See Figure 29.) Juveniles resemble the adults with the exception of an occasional brown gloss to the tail (Amidon 2005a). The Aga is omnivorous, eating a variety of plant and animal food, and foraging in the canopy, subcanopy, understory, in forest undergrowth, and on the ground (Amidon 2005a).

Mariana Crows are long-lived and territorial. Mated pairs build elaborate nests in several stages: a platform, followed by an intermediate cup, and then a smaller cup lined with small-diameter materials (Amidon 2005a). Mariana crows build their nests in the subcanopy of the dense forest (Morton et al. 1999). A clutch of up to four eggs is laid, although two or three eggs is the norm (*ibid.*). (See Figure 30.) If a nest should fail, mated pairs will make attempt to re-nest in the same breeding season; Morton et al. (1999) observed one pair of crows attempt to nest seven times in one breeding season on Rota. Incubation takes a minimum of 65 days (*ibid.*). Both parents care for chicks for a long time when compared to other bird species; Morton et al. (1999) noted that family groups stayed together (between fledging and juvenile dispersal) for a range of 3 to 18 months on Rota.

Figure 30. Mariana Crow nestlings, raised in captivity.
Photo credit: Suzanne Chacon

**<u>Distribution of the Mariana Crow in the CNMI</u>**

The Mariana Crow occurs on only one island in the CNMI, Rota. This species formerly occurred also on Guam, but the native Guam population has been extirpated. The current Guam population consists entirely of Mariana Crows translocated from Rota (Amidon 2005a).

**<u>Abundance of the Mariana Crow in the CNMI</u>**

The Mariana Crow is currently rare and declining. Engbring et al. (1986) recorded 454 crows on their survey in 1982, and estimated the island-wide total on Rota to be 1,318 crows. Fancy et al. (1999b) surveyed the Mariana Crow population on Rota in 1995 and estimated 612 crows for the entire island, or a 56% decrease since 1982. Using a different survey method, Morton et al. (1999) estimated an island-wide population of 225 pairs or 450 crows for 1996 through 1999, and found their estimate to be in line with Fancy et al.'s (1999b) estimate. Plentovich et al. (n.d.) augmented previous surveys with an island-wide survey in 1998, and road-side survey data taken in 1991-1993 and again during 1999-2002. They determined that data taken from all sources indicate a significant decline in the Aga population over the entire span of the surveys on Rota. Their island-wide estimate was 117 breeding pairs or 234 adults based on their 1998 survey. Amar et al. (2004) made an island-wide estimate for 2004 of only 85 pairs of crows, and noted a 94% decline in the numbers of crows counted per station since 1982.

**<u>Location and relative condition of key habitats for the Mariana Crow in the CNMI</u>**

Engbring et al. (1986) reported that the Mariana Crow on Rota was found in all woodland habitats, including mature forest, second growth, mixed woodlands and coastal strand. Recent studies, however, indicate that Mariana Crows are found at greatest abundance in mature native forest. Morton et al. (1999) found that Mariana crows generally nested in the subcanopy trees, averaging 16.9 cm DBH and 8.7 m high. Canopy cover averaged 93% and was never less than 79%, suggesting that Mariana crows generally chose fairly dense forest for nesting. Nests were found only in native forest trees on Rota, and were located an average of 290 m from the closest paved or graded road.

Another indicator of the Aga's preference for native forest is shown by the densities of breeding pairs in varying amounts of forested habitat. Morton et al. (1999) studied six blocks of forested land on Rota and found that breeding pairs were packed densely in large contiguous blocks of native forest (e.g. one pair per 12 ha along the coastal terrace above Puntan Saguagahga), but were at lower densities in fragmented forest patches (e.g. one pair per 37 ha at Duge, an area fragmented by agricultural development).

Rota's forests are degraded in condition. During the Japanese era, Rota's forests were cleared for sugar cane production and phosphate mining. By the end of World War II, the forests of Rota may have been in their most degraded state during the twentieth century and as much as 50% of Rota's forests had been cleared. By 1976, 60% of Rota was measured as being forested by aerial photography. The total forest coverage and maturity may have been at its greatest since the Japanese era during 1982 when Engbring et al. (1986) estimated more than 1,300 crows on Rota (Plentovich et al. n.d.). Since then, however, the forests of Rota have been fragmented or cleared by agricultural, residential and resort development. Rota has suffered numerous devastating typhoons, resulting in downed trees, broken limbs and further damage to the closed-canopy forests (U.S. Fish and Wildlife Service 2004a). There is almost no question that the forest canopy has continued to open up since Typhoon Roy in 1998 (Morton et al. 1999). Deer browsing on the Sabana may also be preventing natural regeneration of native forest (Amidon 2005b). Further discussion on the condition of habitats on Rota is given in Chapter 4.

**Problems which adversely affect the Mariana Crow and its habitats**

Habitat loss, nutritional deficiencies, human persecution, contaminants, and introduced species such as disease organisms, cats (*Felis catus*), rats (*Rattus* spp.), black drongos (*Dicrurus macrocercus*), monitor lizards (*Varanus indicus*), and Brown Treesnakes (*Boiga irregularis*) have all been suggested as factors in the population decline of this species. However, the Brown Treesnake is believed to be the overriding factor in the extirpation of Mariana crow from Guam; habitat loss, human persecution, and possibly rat predation on nests are believed to be major factors in the decline on Rota (Amidon 2005a).

Habitat loss and degradation

Native limestone forests, both mature and immature, are valuable habitats for the Mariana Crow. The highest crow densities are found in closed canopy forest (Morton et al. 1999). Past actions resulting in degradation and loss of forests on Rota are discussed above. Due to increasing pressure for tourism, recreation, and the government practice of donating public land for homesteads on Rota, the loss or fragmentation of native forests will become an increasingly significant factor limiting Mariana crow population size and viability (Amidon 2005a).

Predation by rats, monitor lizards, feral cats and drongos

Morton et al. (1999) tracked the fate of 164 Mariana Crow nests found during 1996-1999 on Rota. Of 148 nests for which the fate was known, 40 nests (27%) were lost to predation. Nest predators were not determined, but rats (*Rattus spp.*) and monitor lizards (*Varanus indicus*) were suspected. Contrary to expectations, Amar (2004) found a significant positive association between calculated rat abundance index and both hatching success and fledging success on Rota in 2003 and 2004. He suggested that a habitat-driven factor such as food availability (since both rats and crows are omnivorous) was benefiting both species. Amar (2004) also used cameras on artificial nests containing chicken eggs, set near crow nests after failure or fledging. Rats made multiple visits to the artificial nests and attempted to eat the chicken eggs; one artificial nest was also predated by a Mariana Crow.

Predation of adult crows by monitor lizards and feral cats is very likely (Morton et al. 1999) Drongos have been observed mobbing crows, and may interfere with breeding activities, but it is not likely that drongos could actually prey on adult crows (*ibid.*)

Human persecution

Plentovich et al. (n.d.) noticed a pattern in their roadside surveys suggesting that the Mariana Crow population decline since 1991 was concentrated in the vicinity of Rota Resort and the agricultural homesteads. The decline in these areas is probably due to replacement of habitat by private and commercial development, but also possible due to human persecution. Persecution of adult crows has been verified by the presence of two dead Aga at the base of a tree during construction of the Rota Resort; necropsy revealed that the crows died of gunshot wounds. The extent of human persecution of crows is not known (Schroer 2005b; Amidon 2005a), but is of concern, because adult survivorship is the most important factor in maintaining the Aga population (Plentovich et al. n.d.). The U.S. Fish and Wildlife Service (2002) is concerned about the effect of its decision to designate critical habitat in possibly generating increased persecution of crows.

Predation by the Brown Treesnake

Since 1982, there have been 4 sightings and 2 captures of Brown Treesnakes (*Boiga irregularis*) on the island of Rota (Hawley 2005). Airport and marina expansion projects on Rota will result in an increased risk of BTS infestation due to an increase in cargo traffic from Guam (*ibid.*). At the time of Savidge's (1987) study of the decline of avian species on Guam due to the Brown Treesnake, crows numbered less than 100 on Guam; adult crows were thought too large for Brown Treesnakes to consume, but unsuccessful reproduction and the lack of recruitment into the adult cohort was noted. Since then, the native Mariana Crow population of Guam has disappeared with the spread of the Brown Treesnake (U.S. Fish and Wildlife Service 2002). If and when a breeding population of Brown Treesnakes becomes established on Rota, the Mariana Crow population will face the added threat of snake predation on nests (eggs and chicks).

Avian disease

Avian disease was ruled out as a factor causing the decline of the Mariana Crow (Plentovich et al. n.d.). However, the mosquito-borne West Nile Virus poses a new threat. Corvids are particularly susceptible to fatal infection by West Nile Virus; under laboratory conditions, crows transmitted the disease to other individuals without mosquito intermediaries (McLean 2000). Three genera of mosquitoes which can carry the virus occur in the Northern Mariana Islands (Amidon 2005a). West Nile Virus has been reported in all 50 states of the U.S., the eastern provinces of Canada and the eastern states of Mexico (U.S. Geological Survey 2004). As the virus spreads to more locations on the Pacific Coast of North America, the threat to corvids in the Pacific islands increases (Amidon 2005a).

Typhoons

Aside from the damage caused to closed-canopy forests, typhoons cause direct loss of crow nests. Morton et al. (1999) documented immediate and catastrophic effects on the crow population of Rota as a result of Typhoon Keith in November 1997 and Typhoon Paka in December 1997, which occurred while crows were sitting on their nests, resulting in putting almost the entire sample population into synchronous breeding at the start of the 1998-99 season. Of 148 nests that failed due to known causes during Morton et al.'s (1999) study, 23 nests (15.5%) failed due to typhoons. Some adult crows were apparently also injured or killed during these typhoons (*ibid.*)

**Priority research and survey efforts**

Mariana Crow Ecology Study

DFW has recently entered into an agreement with Drs. Renee Robinette and James C. Ha of the University of Washington to study the ecology of both the Rota Bridled White-eye and the Mariana Crow (Robinette and Ha 2005). This study will initially be funded by Section 6 funds through the U.S. Fish and Wildlife Service Federal Aid program, but it is anticipated that the researchers will seek additional sources of funding for supplemental projects. Some objectives of the study are as follows.

- Employ an intensive capture and banding effort to record and identify individual Mariana Crows to study their population dynamics.
- Use radio telemetry to determine home range and territory sizes, facilitate location of individuals, and determine location/disposition of fatalities.
- Pilot a variety of nest monitoring systems for monitoring nest success and identifying predators.
- Explore the application of information from studies of less-threatened, more common Rota species to the recovery of the Mariana Crow.
- Explore the application of biological and ecological information from related corvid species from other island, tropical and mainland locations.

DFW has high hopes that a long-term relationship with these researchers will be established, and that research results will help to formulate and guide conservation actions for Mariana Crow recovery.

**Conservation actions**

Conservation actions that benefit the Mariana Crow are as follows. A detailed description and priority ranking for each of these conservation actions is given in Chapter 6.

| |
|---|
| Implement the Rota Agricultural Homestead Habitat Conservation Plan |
| Conserve habitat for endangered bird species on Rota through an island-wide habitat conservation plan |
| Decrease deer numbers on the Sabana of Rota |
| Interdiction of the Brown Treesnake (*Boiga irregularis*) |
| Prevent the introduction of West Nile Virus to the Mariana Islands |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on the southern islands through avoidance and mitigation conditions placed on land development proposals |
| Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition |
| Improve management of terrestrial conservation areas in the southern islands |
| Reforest disturbed areas with native tree species on the southern islands |
| Improve enforcement of hunting regulations on the southern islands |

**Monitoring**

Monitoring of Mariana Crow populations on Rota will be an ongoing part of the research being conducted by Drs. Robinette and Ha of the University of Washington. In addition to new research directed at the Mariana Crow, continuing efforts will be made to monitor the status of all the avifauna on the island of Rota. Future surveys will be conducted using the same methods of past censuses so that a longitudinal analysis remains possible.

# MARIANA FRUIT DOVE

**Common Name**
Mariana Fruit Dove

Figure 31. Adult Mariana Fruit Dove.
Photo credit: Shelly Kremer.

**Scientific Name**
*Ptilinopus roseicapilla*

**Chamorro Name**
Paluman totut
Also, Tottot.

**Carolinian Name**
Mwee'mwe

**Listing Status**
This species is not listed federally as endangered or threatened. It was added to the list of local endangered and threatened species in the CNMI by Public Law 12-8 on June 26, 2000. It is locally protected from hunting by regulation (CNMI 2000).

**Reasons for selecting the Mariana Fruit Dove as a species of special conservation need**
The Mariana Fruit Dove occurs on only four of the southern islands. Because it is not federally listed, funding under Section 6 of the ESA is not available for research or conservation for this species. It became rare due to overhunting, although declaration as the official bird of the CNMI may have resulted in less hunting pressure in recent years. It has been extirpated from Guam by the Brown Treesnake.

Figure 32. Juvenile Mariana Fruit Dove.
Photo credit: Shelly Kremer

**Unique characteristics**
The Mariana Fruit Dove is the most brilliantly colored bird amongst the native forest birds of the CNMI. The head, neck, breast and upper back are pearly grey; the rest of the upperparts are bright green. The cap is rose red. The underparts are variegated with a purple bar below the breast, orange flanks, yellow belly, and pinkish orange undertail coverts. (See Figure 31.) The juvenile is entirely green (Pratt et al. 1987). (See Figure 32.) In spite of this splash of colors on the Mariana Fruit

Dove, it is often difficult to see in the forest, because it is so secretive and freezes in position (Kremer 2005a) and because its green back blends in with the foliage (CNMI Division of Fish and Wildlife n.d.). The call is a series of "tot" sounds, which gives the bird its local name of Totot. The Totot was declared the state bird of the Commonwealth in 1981 (Engbring et al. 1986).

## Distribution of the Mariana Fruit Dove in the CNMI

The Mariana Fruit Dove is endemic to the Mariana Islands. It occurs only on Rota, Aguiguan, Tinian and Saipan, in the southern part of the archipelago. This species has been extirpated from Guam by the Brown Treesnake (Wiles et al. 2003).

## Abundance of the Mariana Fruit Dove in the CNMI

Pratt et al. (1987) described the Mariana Fruit Dove as common on Rota, Aguiguan, Tinian and Saipan, with the highest population on Rota. Engbring et al. (1986) found the Mariana Fruit Dove to be the third most common bird (after the Saipan Bridled White-eye and the Rufous Fantail) during their bird surveys of the southern islands in 1982.

### Rota

Engbring et al. (1986) estimated Rota's Mariana Fruit Dove population in 1982 at 3,535 birds, at a density of 0.45 birds/ha. Amar et al. (2004) surveyed the same stations along transects that were used by Engbring in 1982, and the preliminary results suggest dramatic declines in the intervening 22 years: 72% decrease in numbers of Mariana Fruit Doves counted per station; 30% decrease in the proportion of stations where Mariana Fruit Doves were recorded; and 59% decrease in abundance at stations where presence of Mariana Fruit Doves was recorded.

### Aguiguan

Engbring et al. (1986) made an island-wide estimate in 1982 on Aguiguan of 292 total birds at a density of 0.8 birds/ha. Using the same survey techniques in 2002 as Engbring's 1982 study, a total of 149 birds at a density of 0.5 birds/ha were estimated for Aguiguan (Cruz et al. 2003d); this is a decrease in abundance over 20 years.

### Tinian

Engbring et al. (1986) estimated a total of 3,075 birds at a density of 0.4 birds/ha on Tinian in 1982. No island-wide surveys of Mariana Fruit Doves have been done for Tinian since Engbring's 1982 survey.

### Saipan

Engbring et al. (1986) estimated a total of 2,541 birds at a density of 0.3 birds/ha on Saipan in 1982. Craig (1996) found Mariana Fruit Doves at a density of 0.3 birds/ha in limestone forest in 1991 and 1992, and at 0.1 birds/ha in disturbed habitats in 1993. Island-wide surveys of Mariana Fruit Doves have not been done for Saipan since Engbring's 1982 survey. However, recent surveys made in three conservation areas on Saipan have yielded the following density estimates:

- Saipan Upland Mitigation Bank, in Marpi – Densities ranged from 0.7 to 1.4 birds/ha in bi-annual surveys conducted from 1999 to 2003 (Cruz and Williams 2003).
- Kagman Conservation Area – A density estimate of 0.16 birds/ha was made in 2002 – 2003 (Cruz et al. 2003c).
- Bird Island Conservation Area – A density estimate of 0.33 birds/ha was made in 2001 (Cruz et al. 2003b).

**Location and relative condition of key habitats for the Mariana Fruit Dove in the CNMI**

Mariana Fruit Doves live and nest mainly in native forest, although they also occupy secondary forest (Kremer 2005a). Engbring et al. (1986) found Mariana Fruit Doves on all transects, in all forested habitat types. They noted that, although tangantangan did not supply adequate food resources for doves, it supplied marginal cover. On Saipan, Craig (1996) found Mariana Fruit Doves more often in native forest than disturbed habitats. The Mariana Fruit Dove is a canopy frugivore, and is found to feed on the fruits of native *Ficus* spp. and *Premna obtusifolia* trees, the vine *Jasminum marianum*, and the introduced *Muntingia calabura*, among others (Craig 1996). Nests have been found in native limestone forest, strand forest or scrub, forest edges, and in agricultural forests (Kremer 2005a). Location and conditions of forested habitats are described in Chapter 4.

**Problems which adversely affect the Mariana Fruit Dove and its habitats**

Predation by the Brown Treesnake

The Mariana Fruit Dove was extirpated from Guam by the Brown Treesnake (Wiles et al. 2003). All indications are that the Brown Treesnake has established an incipient population on Saipan (Colvin et al. 2005), putting the Mariana Fruit Dove under threat of extirpation throughout the remainder of its range.

Hunting

Until recently, the Mariana Fruit Dove was hunted as a game bird, and hunting pressure may have reduced its numbers, especially near urban areas (Engbring et al. 1986). This species is now locally protected from hunting by regulation (CNMI 2000). It is not known how numbers of fruit doves have responded to decreased hunting pressure, or if poaching may still occur.

**Priority research and survey efforts**

Life history study

Life history studies of the Mariana Fruit Dove are limited. Villagomez (1988) observed calling, feeding, nest characteristics, flocking behavior and breeding seasonality. Craig (1996) compared surveying techniques and studied food and habitat preferences on Saipan. Now that the Tottot has been added to the local list of endangered and threatened species, more thorough life history studies are warranted.

**Conservation actions**

Conservation actions to conserve the Mariana Fruit Dove are as follows. Detailed descriptions and priority rankings of each of these conservation actions are given in Chapter 6.

| |
|---|
| Conserve habitat for endangered bird species on Rota through an island-wide habitat conservation plan |
| Decrease deer numbers on the Sabana of Rota |
| Cull goats from the island of Aguiguan |
| Eradicate rats, cats and other predators from Aguiguan Island |
| Conserve remnant native limestone forest on Tinian by establishing a conservation area |
| Eradicate scarlet gourd (*Coccinia grandis*) from Saipan |
| Interdiction of the Brown Treesnake (*Boiga irregularis*) |
| Translocation of native forest birds from the southern islands to the northern islands and establishment of a captive breeding program |
| Prevent the introduction of West Nile Virus to the Mariana Islands |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition |
| Improve management of terrestrial conservation areas in the southern islands |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Reforest disturbed areas with native tree species on the southern islands |

**Monitoring**

Trends in Mariana Fruit Dove populations are monitored on a regular basis through the quarterly breeding bird surveys conducted on Rota and Saipan. Breeding bird surveys are conducted on Tinian more erratically, depending on staff availability. Surveys on Aguiguan are not regularly accomplished, due to difficulty of access to this small island and attention paid to projects of higher priority, but a field trip to Aguiguan to survey all wildlife populations is being planned in the next one to five years.

# MARIANA SWIFTLET

**Common Name**
Mariana Swiftlet (Banks et al. 2002). Also: Guam Swiftlet; Island Swiftlet; Mariana Gray Swiftlet. Formerly: Vanikoro Swiftlet; Edible Nest Swiftlet.

**Scientific Name**
*Aerodramus vanikorensis bartschi.* Formerly, *Collocalia [vanikorensis] bartschi.* Baker (1951) lists 15 different scientific names formerly used by various researchers for this bird.

**Chamorro Name**
Chachaguak

**Carolinian Name**
Leghe'kiyank

Figure 33. Mariana Swiftlet in flight.
Photo copied from "Wildlife of the CNMI" CD-ROM

**Listing status**
The Government of Guam petitioned for declaration of endangered status from the U.S. Fish and Wildlife Service in 1978 (U.S. Fish and Wildlife Service 1979). This species was proposed for endangered listing by the U.S. Fish and Wildlife Service (1983). It was listed as an endangered species effective August 27, 1984 throughout its entire range, including Guam, Rota, Tinian, Saipan and Aguiguan (U.S. Fish and Wildlife Service 1984). A recovery plan was published in 1991 (U.S. Fish and Wildlife Service 1991b). This species is also locally protected from take by regulation, and is listed locally as a threatened and endangered species (CNMI 2000).

**Reasons for selecting the Mariana Swiftlet as a species of special conservation need**
Mariana Swiftlets occur in their native habitat on only three islands in the entire world – Guam, Saipan and Aguiguan. They are locally extinct on the islands of Rota and Tinian and numbers have drastically declined on Guam. The objectives of the recovery plan have not yet been met.

**Unique characteristics**
These small, black birds with long, narrow, pointed wings are acrobatic flyers, allowing them to catch insects in mid-flight. (See Figure 33.) They roost and nest exclusively in limestone caves. Most of the flock leaves the cave to forage for insects at dawn, preferring ridge crests and open grassy areas (U.S. Fish and Wildlife Service 1991b). Swiftlets enter and leave the cave throughout the day, but the entire flock returns at sunset to rest for the night (CNMI Division of Fish and Wildlife, n.d.). Swiftlets employ echolocation to navigate in the complete darkness of the caves they inhabit. The only

other bird species known to have echolocation capabilities is the Oilbird of South America (Reichel and Glass 1988).

Figure 34. Swiftlet nest adhered to cave wall, with large juvenile. Photo credit: Shelly Kremer

Swiftlets build nests of mosses and other plant materials, glued together and adhered to the cave wall by the birds' saliva (U.S. Fish and Wildlife Service 1991b, Reichel and Glass 1988). Nests are small, just over two inches in diameter (CNMI Division of Fish and Wildlife, n.d.). (See Figure 34.) Field observations on Saipan and Aguiguan have confirmed that the clutch size for this species is a single egg (Rice 1993).

**<u>Distribution of Mariana Swiftlets in the CNMI</u>**

The Mariana Swiftlet is endemic to the Mariana Islands of Guam, Rota, Aguiguan, Tinian and Saipan (U.S. Fish and Wildlife Service 1991b). However, this species is currently found only on two islands in the CNMI, Saipan and Aguiguan.

Historically, swiftlets were once abundant on the island of Rota, as evidenced by presence of prehistoric swiftlet bones (Steadman 1999), deep guano deposits found in some caves, old nests and the remains of a fledgling found at Vampire Bat Cave (Reichel and Glass 1988) and reports of senior residents (Rice 1993). Swiftlets were last recorded on Rota in 1976 (Engbring et al. 1986) and have not been observed since then. Relocation of swiftlets to caves formerly used on Rota remains an objective of the recovery plan and the CNMI Division of Fish and Wildlife (U.S. Fish and Wildlife 1991b; CNMI Division of Fish and Wildlife 2003).

There is no record of a breeding population of swiftlets on the island of Tinian. The few birds that have been observed at Tinian were most likely traveling temporarily from Saipan or Aguiguan. Some sightings may have been mistakenly identified as swiftlets, but were most likely migratory Barn Swallows (Reichel and Glass 1988). Cruz (1993) suggested the possibility that swiftlets remain in low numbers on Tinian.

Swiftlets have not been reported on any of the Mariana Islands north of Saipan (U.S. Fish and Wildlife Service 1991b).

**<u>Abundance of Mariana Swiftlets on Saipan and Aguiguan</u>**

Census data was not available for swiftlet populations in the CNMI until a breeding bird survey was conducted in 1982, using variable circular plots placed at regular intervals along transects (Engbring et al. 1986). This survey estimated 9,100 birds on Saipan and 1,022 birds on Aguiguan. These estimates may be biased, because use of this survey method is not appropriate for the species. With the variable circular plots method, birds are recorded during an 8-minute count period at each of many stations along a transect. This method may not accurately sample swiftlets, highly mobile birds which may be counted more than once. Swiftlets are also concentrated at cave entrances, and are not evenly distributed along transects. (U.S. Fish and Wildlife Service 1991b).

In 1985, the CNMI Division of Fish and Wildlife started to conduct periodic swiftlet surveys by arrival counts at cave entrances in the evenings, as the birds were returning to roost for the night. This initial arrival count survey yielded 3,135 swiftlets from five known caves on Saipan, and 970 swiftlets from five known caves on Aguiguan (Reichel and Glass 1988). These numbers were remarkably lower for the island of Saipan than Engbring's numbers from 1982, but they are considered more accurate, and are considered to be the best baseline data available (U.S. Fish and Wildlife Service 1991b).

In 1987 and 1988, the arrival count surveys were conducted monthly on Saipan. After that, arrival count surveys were conducted bi-annually: in April, to coincide with the original count, and in October, following the peak of reproduction for the best estimate of maximum population (Rice 1993). Annual counts were estimated by averaging the April and October counts. Trends in annual average swiftlet counts taken at the four main caves on Saipan from 1985 through 2004 are given in Figure 35 (CNMI Division of Fish and Wildlife 2004). It should be noted that counts are missing for Takpochao cave in 1997 and for Hourglass Cave for in 2002, resulting in "dips" in the graph of total swiftlets for those years. With this exception, a general upward trend is shown in swiftlet numbers in these four main caves through recent years.

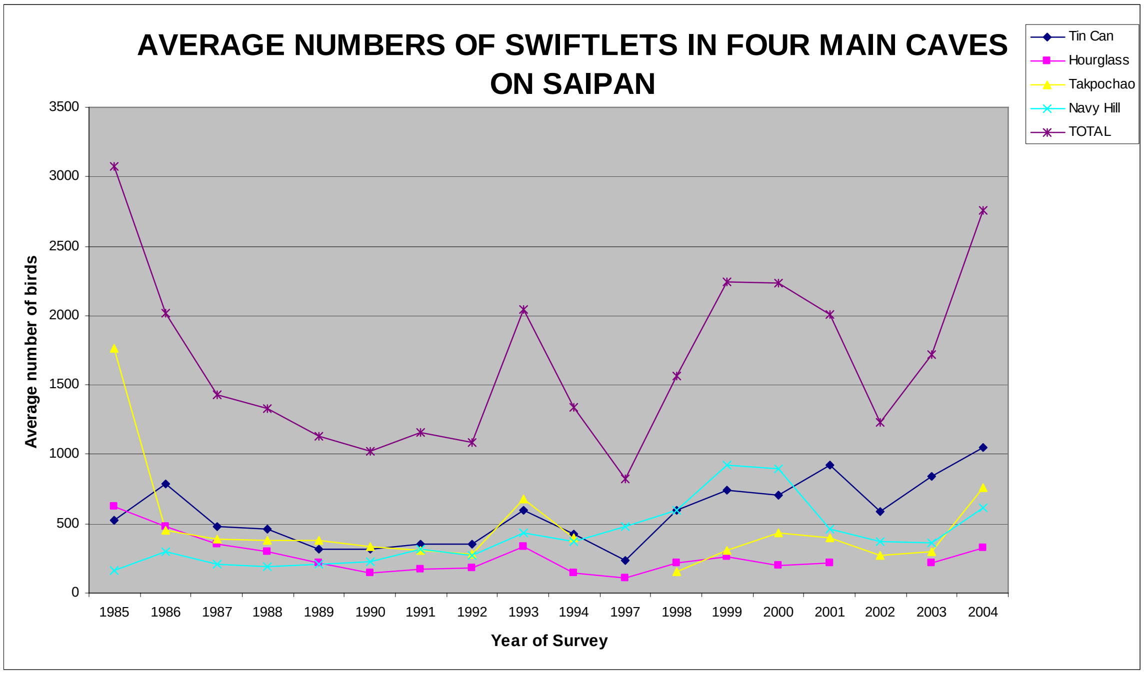


Figure 35. Graph showing average numbers of swiftlets in the four main caves on the island of Saipan based on cave entrance counts taken twice each year, for all years surveyed between 1985 and 2004. Counts taken in April and October were averaged to yield the count for each year. Totals for each year over all four caves are also shown. Note that no data was collected from Takpochao Cave in 1997, nor from Hourglass Cave in 2002, with the result that the totals for these two years are depressed.

Aguiguan Island is more difficult to access for field work; therefore, bi-annual arrival counts at Aguiguan have not been possible. On Aguiguan, because swiftlet counts have been performed only as opportunity allowed (7 times in 17 years) and because not all known swiftlet caves were surveyed on each field trip, no abundance estimate or trend for the population has been attempted by DFW. In 1995, Wiles and Worthington (2002) estimated about 390-460 birds on Aguiguan. In 2000, DFW counted 408 birds in five caves on Aguiguan (Cruz 2000). The most recent count by DFW was made in 2002 at 8 caves and yielded a total of 267 swiftlets. This was a marked decline from earlier counts and is a cause for concern (Cruz et al. 2003d).

**Location and relative condition of key habitats for Mariana Swiftlets**

Mariana Swiftlets require limestone caves for roosting and nesting. The cave entrances must be of sufficient size to allow entering and exiting by large numbers of these agile, fast and small birds at the same time, especially at sunset. The cave interior must offer crevices or pockets high on the walls or ceiling well back from the entrance for securing nests (Rice 1993). Swiftlets forage in mid-flight on small flying insects and require unimpeded air space above a wide variety of terrain and vegetation, preferring ridge crests or open grassy areas (U.S. Fish and Wildlife Service 1991b).

When arrival count surveys were initiated in the mid-1980s, there were five known swiftlet caves on Saipan, and five on Aguiguan. New swiftlet caves have been discovered and surveyed on both islands since then, with ten known swiftlet caves on Saipan and ten on Aguiguan (Williams 2002).

On Aguiguan, 78 limestone caves have been documented, and others may yet be discovered. Only a small percentage of these, however, have been surveyed for swiftlets, so it is not yet known how many of the unsurveyed caves may house swiftlets. One limiting factor is the size of cave entrance. Of ten caves surveyed in 2002 that had no swiftlets, it was thought that the cave entrances for six of these were too small to be conducive as swiftlet roosts (Cruz et al. 2003d).

On Saipan, swiftlet surveys have been performed twice annually for some years, so the locations, conditions and sizes of swiftlet caves are well known and documented. Efforts have been undertaken to educate tourists and other cave visitors through posting informational signs at Tin Can, Navy Hill and Japanese Hospital Caves (Williams 2002).

On Rota, former cave use by swiftlets is evidenced by deep guano deposits, old nests and the remains of a fledgling (Reichel and Glass 1988). Reichel and Glass (1988) examined seven caves and mapped the locations of four caves which have historic evidence of swiftlet usage or indications of possible historic usage. A project has been proposed to collect beneficial ecological information, including cave characteristics, swiftlet breeding biology and availability of food preferred by swiftlets, with the ultimate goal of reintroducing swiftlets to Rota (CNMI Division of Fish and Wildlife 2003).

**Problems which adversely affect Mariana swiftlets and their habitats**

Deforestation

From the 1920s to 1940s, most of the forested land on Aguiguan and Saipan was cleared for sugar cane production. Subsequent military development on Saipan, and grazing by feral goats on Aguiguan, has prevented regeneration of native forest trees, and has probably altered and reduced the insect prey base for swiftlets (Wiles and Worthington 2002).

Predation by cockroaches

During 1987-88, field biologists found swiftlet nests falling in Saipan caves, sometimes shortly after being built, occasionally with eggs or young in them. Cockroaches were seen on numerous occasions on and around swiftlet nests apparently feeding on nesting material or nest cement. It was felt that cockroaches might be causing mortality by 1) causing early nest falling with egg/young being lost; 2) accidentally knocking eggs from the nest while feeding; and/or 3) eating eggs. In April and July 1989, bait traps were deployed in Navy Hill Cave, resulting in the eradication of cockroaches by September 1989 in this cave and a marked increase in nest life and egg survival. Cockroach control was extended to Tin Can Cave in 1990, resulting in a reversal of the downward trend in swiftlet numbers that had been observed between 1985 and 1989 (Rice 1993). Replacement of cockroach bait traps has continued on a quarterly basis for the accessible caves in Saipan, and on an opportunistic basis on Aguiguan. When traps were changed in 1999, cockroaches were observed devouring swiftlet nests and molesting the chicks (Cruz 1999). Biologists have speculated that cockroaches may have become resistant to the poison in the bait over the years, resulting in recent years with experimenting with other types of traps (Cruz 2001).

Human and feral animal disturbances to swiftlet caves

Historically, limestone caves, including those inhabited by swiftlets, have undergone various human disturbances, including occupation by Japanese soldiers and local residents during World War II, guano mining, visits by recreationists (hunters, hikers, and WWII memorabilia collectors), visits by wildlife biologists, vandalism, and wandering of feral or farm animals. Guano mining and vandalism were thought to continue to the early 1990s, especially on Rota, and may have contributed to the extirpation of swiftlets there (U.S. Fish and Wildlife Service 1991b). More recently, caves were thought to be used mostly by spelunkers, worshipers or tourists (Cruz 1999). The Marianas Visitors Authority and the CNMI Historic Preservation Office did not have information on numbers of tourists visiting caves each year, but DFW personnel interviewing tour operators found that only one of three operators offered a “jungle tour” which included cave visits, mostly to caves not occupied by swiftlets. Still, potential adverse effects on swiftlet nesting or roosting caused by tourists’ use of caves has not been adequately studied (Cruz 2000). The extent of disturbance to swiftlets in caves by feral and farm animals is likewise unknown.

Predation by Brown Treesnakes

The Brown Treesnake, *Bioga irregularis*, is responsible for the extirpation or drastic reduction in numbers of most of Guam’s 25 native resident species. The cause of a dramatic decline in swiftlet populations on Guam during the late 1960s and early 1970s is unknown, but may have been due to pesticide use. From 1980 to 2000, only three roosts totaling 250-900 swiftlets remained on the island of Guam. Snake predation is evident at the largest colony, and is probably preventing any population recovery, as only birds nesting and roosting on high, smooth walls and ceilings are able to avoid snakes. (Wiles et al. 2003). Brown Treesnakes have not yet infested the islands of Rota, Tinian, Aguiguan and Saipan, however, if they are successful in invading these islands of potential or actual swiftlet habitat, the remaining Mariana swiftlet populations would most probably be eliminated. Brown Treesnakes have the ability to climb up cave walls and ceilings, and could prey on swiftlet nests, taking roosting or nesting adults, eggs or nestlings (S. Kremer, pers. comm. December 2004).

Pesticides affecting swiftlets’ food source

Pesticide use resulting in the removal of small flying insects upon which swiftlets feed may have contributed to the extirpation of swiftlets on Rota. However, pesticide use on Rota was more prevalent in years past than today (S. Kremer, pers. comm. December 2004). No definitive data is yet available to indicate if the use of pesticides on any of the CNMI’s islands with swiftlet caves has resulted in the reduction of swiftlet numbers due to decreased food supply. Two objectives of the CNMI Division of Fish and Wildlife proposal to study swiftlet ecology are: to determine the food items selected by the Mariana swiftlet from guano samples in 3 caves on Saipan and quantify ambient prey availability on Saipan and Rota; and, to quantify current pesticide use on Saipan and Rota (CNMI Division of Fish and Wildlife 2003).

**Priority research and survey efforts needed to address swiftlet recovery**

Swiftlet diet study

DFW has hired the Institute for Wildlife Studies to conduct a swiftlet diet study with ESA Section 6 funding. Insect availability will be studied at swiflet caves and foraging grounds on Saipan. Potential swiftlet cave sites on Rota will also be assessed for suitable swiftlet food availability. The results of these surveys will determine whether translocation of swiftlets from Saipan to Rota is feasible. Field work started in August 2005.

**Conservation actions**

Conservation actions to conserve the Mariana Swiftlet are listed as follows. For a complete description and priority ranking for each action, see Chapter 6.

| |
|---|
| Protect limestone caves on Rota, Aguiguan, Tinian and Saipan from disturbance by people |
| Continue to control predation by cockroaches in swiftlet caves |
| Translocate Mariana Swiftlets from Saipan to Rota |
| Cull goats from the island of Aguiguan |
| Eradicate rats, cats and other predators from Aguiguan Island |
| Eradicate scarlet gourd (*Coccinia grandis*) from Saipan |
| Interdiction of the Brown Treesnake (*Boiga irregularis*) |
| Prevent the introduction of West Nile Virus to the Mariana Islands |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on the southern islands through avoidance and mitigation conditions placed on land development proposals |
| Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition |
| Improve management of terrestrial conservation areas in the southern islands |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Reforest disturbed areas with native tree species on the southern islands |

**Monitoring**

Monitoring of swiftlet population trends is accomplished by conducting swiftlet counts at certain caves on Saipan twice each year, in April and October. Monitoring of swiftlet counts in caves on Aguiguan can only be accomplished opportunistically, due to the difficulty of accessing Aguiguan. Additional information on swiftlet ecology resulting from the research currently being conducted by the Institute for Wildlife Studies will aid in monitoring efforts.

# MICRONESIAN MEGAPODE

**Common Name**
Micronesian Megapode

Figure 36. Micronesian Megapode.
Photo credit: Scott Vogt.

**Scientific Name**
*Megapodius laperouse laperouse*

**Chamorro Name**
Sasangat

**Carolinian Name**
Sasangal

**Listing status**
Federally listed as an endangered species on June 2, 1970 (U.S. Fish and Wildlife Service 1998a).
Locally listed as a protected species, and locally listed as a threatened and endangered species (CNMI 2000).

**Reasons for selecting the Micronesian Megapode as a species of special conservation need**
The Micronesian Megapode is an endemic bird, found only in the Northern Mariana Islands. On the southern islands in the archipelago, it is rare or extirpated. On the northern islands, numbers are low, and are probably declining due to the presence of feral animals which destroy megapode habitat.

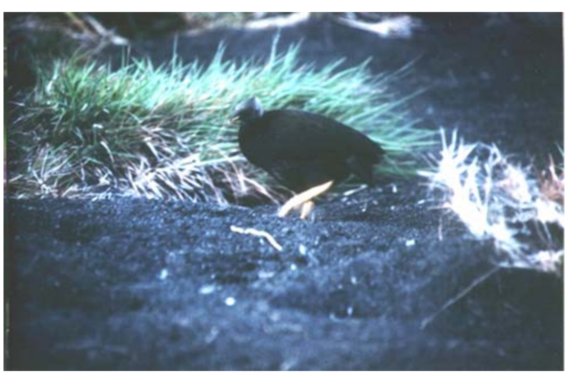

Figure 37. Micronesian Megapode digging in cinder material on western slope of Guguan, June 2000.
Photo credit: Cruz et al. 2000c

**Unique characteristics**
Megapodes live on the forest floor, foraging by scratching on the ground and exposing food items such as insects and seeds. (See Figures 36 and 37.) They usually feed and move through the forest in pairs or family groups. Megapodes are known as incubator birds, because they rely on outside sources of heat to incubate their eggs. The female will lay a single large egg in a warm area, such as a thermal vent from volcanic activity, in dark-colored volcanic sand

warmed by the sun, or in decomposing vegetation.

**Distribution of the Micronesian Megapode in the CNMI**

Micronesian Megapodes live on the islands of Aguiguan, Saipan, Farallon de Medinilla, Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, and Maug. They may also inhabit Tinian, Asuncion and Uracas, but their presence on these islands has not been recently verified. Megapodes are thought to be extirpated from Rota.

**Abundance of the Micronesian Megapode in the CNMI**

Very small populations of megapodes can be found in the southern, populated islands of the CNMI. Megapodes are more abundant in the northern islands. The abundance of megapodes throughout the islands is described as follows, and is summarized in Table 8.

- Rota – Researchers in the 1980s believed the megapode to be extirpated on Rota (U.S. Fish and Wildlife Service 1998a). The CNMI Division of Fish and Wildlife declared the megapodes to be extinct on Rota, and disclaimed a 1985 sighting as being in error (Stinson 1993). During routine breeding bird surveys conducted on Rota in recent years, no megapodes were detected (L. Williams, pers. comm., July 2004).
- Aguiguan – Historically, megapodes occurred on Aguiguan. At least ten birds, including two pairs, were observed during a 1987 field trip (Glass and Aldan 1988). During a 1992 census, 11 megapodes were detected at a calculated density of 0.04 birds per hectare (Craig, Chandran, and Ellis1992). During a 2002 census, 16 megapodes were detected, but biologists described their sightings of megapodes to be uncommon to rare, and restricted to small areas of Aguiguan. Megapode densities were calculated at 1.4 birds per hectare, with a population abundance estimate of 72 birds (Cruz et al. 2003d).
- Tinian – Glass and Aldan (1988) stated that biologists have spent hundreds of hours in the field on Tinian without seeing or hearing megapodes, indicating that this species is extremely rare or absent. Stinson (1993) described the status of megapodes on Tinian as unknown. Lack of native forest is the most likely limiting factor for megapodes on Tinian (Vogt 2005a, Vogt 2005b). During a survey of the proposed conservation area in southeastern Tinian during 2000, only one megapode was detected, but it was heard outside of the surveyed area (Cruz et al. 2000a). The U.S. Navy conducted surveys for megapodes on transects in the military leased area on the northern part of the island, and found few birds: two birds detected in April and July 2001; one bird calling in December 2001; two or possibly three birds detected in February 2004 (Vogt 2005a, Vogt 2005b).
- Saipan – Between 1983 and 1987, biologists conducted call counts in the Marpi area of Saipan and estimated that approximately 10 pairs and 3 single birds occupied an area of approximately 160 hectares, with an estimated 15 additional birds occupying the remainder of the island of Saipan (Glass and Aldan 1988). During a 1992 census of forest birds on Saipan, Craig, Chandran and Ellis (1992) calculated a megapode density at 0.02 birds per hectare. In 1999, CNMI Division of Fish and Wildlife (1999) reported that no serious study had been undertaken during the previous six years to determine the megapode population on Saipan, but that megapodes are detected during Breeding Bird Surveys. Megapodes were

observed primarily in the Marpi region, but also at Naftan Point. Cruz and Williams (2003) conducted several bird surveys during 1999 through 2003 in three conservation areas located at Marpi -- the Saipan Upland Mitigation Bank, the Bird Island Wildlife Preserve and the Kagman Conservation Area -- and found megapodes only in the Saipan Upland Mitigation Bank area, where megapode densities ranged from 0.08 to 0.5 birds per hectare in eight surveys conducted from September 1999 to March 2003.

- Farallon de Medinilla – The U.S. Fish and Wildlife Service (1998a) estimated the Farallon de Medinilla megapode population at less than ten birds. But, due to the military's use of the island as a live-fire range, the U.S. Navy has been issued a permit by the U.S. Fish and Wildlife Service for the taking of all ten megapodes (Helber Haster & Fee 2003). (Funding for various projects has come from the Navy to unofficially mitigate for this taking, including feral animal eradication on Sarigan and Anatahan, and vegetation and wildlife surveys throughout the northern islands.)
- Anatahan – In 1988, the megapode population on Anatahan was estimated at 300 birds, based on sightings at the west end and south shore of the island (Stinson 1993). In 2000, the megapode population on Anatahan appeared to be widely distributed over the island, but the numbers encountered were quite low for an island of its size. The population estimate of 423 megapodes on Anatahan made in 2000 was in line with the 1988 estimate of 300 birds, however, Sarigan, an island one-sixth the size of Anatahan, supports nearly the same number of megapodes (Cruz et al. 2000f). Overgrazing by feral animals has replaced two-thirds of Anatahan's 3,230 hectares of native forest with swordgrass, bare open ground, and highly disturbed areas prone to weed invasion (*ibid.*). Following an effort to eradicate feral goats and pigs from Anatahan in January through April of 2003, a population estimate of megapodes in the remaining 1,050 hectares of forest was made at 2,928 birds. An island-wide megapode density estimate was made at 2.79 birds per hectare (Cruz et al. 2003a). Following this most recent field survey, however, the eastern volcano on Anatahan erupted in May 2003, sending steam, ash and rocks over the majority of the island's area. It continues to erupt as of the date of this writing. It is unknown what effect the eruptions have had on wildlife populations on the island.
- Sarigan – Bird surveys conducted in different years have yielded varying total numbers of megapodes on Sarigan. In 1990, Stinson (1991) measured a range of 423 – 522 birds and a density of 2.3 – 2.9 birds per hectare based on variable circular plot counts. Fancy et al (1999a) reported on two surveys conducted in 1990 and 1997, using variable circular plot counts on two transects in both native forest and coconut forest types. They found no difference in density of megapodes between 1990 and 1997 on either transect. Mean densities in 1997 were calculated at 3.885 birds per hectare in coconut forests, and 5.468 birds per hectare in native forest and an island-wide estimate of 677 birds. A feral animal eradication program was completed in February 1997, and two additional megapode surveys were conducted in 1999 and 2000. In coconut forests, megapode densities were calculated at 1.32 birds per hectare in 1999 and 2.29 birds/ha in 2000. In native forest, densities were 1.19 birds/ha in 1999 and 1.86

birds/ha in 2000. An island-wide population estimate for year 2000 was made at 360 pairs. Although the difference in megapode detections between 1999 and 2000 were not statistically significant, the suggestion of a positive trend based on mean detections per station from 1990 to 2000 supports the belief that the megapode population is steadily increasing after feral animal eradication (Cruz et al. 2000e).

- Guguan – Estimates for total numbers of megapodes on Guguan have varied, from 1500-2000 birds in 1986, to 500 birds in 1992 (Stinson 1993). Field work conducted in June 2000 resulted in estimates of 63 megapodes in open habitat and 242 megapodes in forested habitat, for an island-wide total of 305 megapodes. The lower population estimate was not statistically analyzed and the methods utilized to arrive at the estimates were not the same. Future surveys utilizing similar estimation methods will be needed to appropriately analyze population trends. There are also detection differences due to a seasonal fluctuation in calling rates that can affect data collected at different times of the year (Cruz et al. 2000c).
- Alamagan – Megapodes have been uncommon on Alamagan. Megapodes were not recorded in field surveys conducted in 1988 and in 1990. In May 1992, six birds were seen, and one heard, on the north part of the island; this was the first sighting by biologists since a collection made in the 1930's (Stinson 1993). During transect surveys conducted in June 2000, only two megapodes were detected; therefore no density estimates were attempted for this small population. Megapodes were also heard singing and calling in the ravine forests that extend up the flanks of the volcano, outside of the surveyed area (Cruz et al. 2000d). Alamagan has a large feral animal population which may be heavily impacting habitat that the megapodes would otherwise occupy.
- Pagan – Stinson (1993) described megapodes as locally common, on the south peninsula of the island. Forest bird surveys detected only one megapode in 1999 and only three megapodes in 2000. An island-wide population estimate of 134 megapodes was made in 2000 (Cruz et al. 2000g).
- Agrihan – No sightings of megapodes were made during a 1990 bird survey (Cruz et al. 2000h), or during a 1992 field expedition (Stinson 1993). In August 2000, seven megapodes were detected on one of four transects, yielding an island-wide estimate of 395 megapodes (Cruz et al. 2000h).
- Asuncion – Field researchers visiting Asuncion in recent years have found megapodes: Falanruw (1989) observed megapodes during field trips in the 1970s; in 1987, two birds were detected, and in 1992, one bird was heard (Stinson 1993). No systematic bird surveys have been carried out on Asuncion to determine the size of the megapode population. The CNMI Division of Fish and Wildlife plans to conduct wildlife and vegetation surveys on Asuncion in 2006 or 2007.
- Maug – Rice and Stinson (1992) found megapodes to be abundant on the three islands of Maug, not only in forest habitats, but also scrub/brush areas. Active nesting behavior was observed in cinder gravel. No systematic bird surveys have been carried out on Maug to determine the size of the megapode population.
- Uracas – Falanruw (1975) sighted a single adult megapode in the early 1970s. No field visits to count megapodes have been made to this small, actively volcanic

island with very little vegetation. The current status of any megapode population is unknown.

Table 8. Current Status of Micronesian Megapode Populations in the CNMI, based on most recently published estimates.

| Island | Island Population Estimate | Date | Reference |
|---|---|---|---|
| Rota | Extirpated | 1993 | Stinson 1993 |
| Aguiguan | 72 | 2002 | Cruz et al. 2003d |
| Tinian | Unknown | 2000 | Cruz et al. 2000a |
| Saipan | N/a [a] | 1999 to 2003 | Cruz and Williams 2003 |
| Farallon de Medinilla | 10 [b] | 1998 | U.S. Fish and Wildlife Service 1998a |
| Anatahan | 2,928 [c] | 2002 | Cruz et al. 2003a |
| Sarigan | 720 | 2000 | Cruz et al. 2000e |
| Guguan | 305 | 2000 | Cruz et al. 2000c |
| Alamagan | N/a [a] | 2000 | Cruz et al. 2000d |
| Pagan | 134 | 2000 | Cruz et al. 2000g |
| Agrihan | 395 | 2000 | Cruz et al. 2000h |
| Asuncion | Unknown | | |
| Maug | Unknown | | |
| Uracas | Unknown | | |

a “N/a” means that the sample size was too small, or that insufficient data were collected to make a population estimate.
b The U.S. Navy has a permit from the U.S. Fish and Wildlife Service to take all 10 megapodes.
c The eastern volcano of Anatahan erupted in May 2003 and continues to erupt to the present. It is not known what effect the eruptions have had on wildlife populations.

**Location and relative condition of key habitats for the Micronesian Megapode in the CNMI**

On Saipan, megapodes are restricted to remnant native limestone forest at the base of cliffs at Marpi (U.S. Fish and Wildlife Service 1998a), although they can occasionally be seen in the tangantangan forest adjacent to native forest in these areas (personal observation of the author). On FDM, two megapodes were detected in the interior mesic terrace ecosystem, characterized by dense, herbaceous vegetation (Helber Hastert and Fee 2003). In the northern islands, megapodes are found in native forest, secondary forest and agricultural forest (e.g. coconut plantations on Sarigan) (U.S. Fish and Wildlife Service 1998a).

Megapodes require an external heat source to incubate their eggs. Three different heat sources are thought to be utilized – solar, geothermal and microbial (Stinson 1993). Glass and Aldan (1988) observed a large nesting site on Guguan, composed of loose, black, volcanic soil. Nests were dug by up to 15 birds simultaneously at the same site, in tunnels up to 0.75 m long. The site was apparently kept barren by the continuous digging activity of the megapodes. These researchers concluded that solar energy was sufficient to maintain incubation temperatures in the dark soil, even at night time. Nesting behavior has also been observed in cinder gravel on Maug (Rice and Stinson 1992). The extent of these specialized cinder field habitats which are warmed with geothermal or solar energy in the northern islands has not been mapped or quantified.

Geothermal sites and dark cinder fields are absent from the non-volcanic southern islands, and megapodes probably use the humus from rotting vegetation, (e.g. from *Pisonia grandis*, an important large tree in native limestone forest) to incubate their eggs. The rarity of immatures seen on the southern islands suggest that this mode of reproduction has a low success rate, because the necessary temperatures are not often sustained (Stinson 1993).

Locations and conditions of important Megapode habitats – native forest, secondary forest, and agricultural forest – are described in Chapter 4.

**Problems which adversely affect the Micronesian Megapode and its habitats**

Habitat loss and degradation

The substantial loss and degradation of native forest habitat for the southern islands in historic times accounts, in part, for the rarity of the Micronesian Megapode in the southern islands. Forest habitat and nesting sites in the northern islands of Anatahan, Alamagan, Pagan and Sarigan have been destroyed by centuries of overgrazing by feral goats. Loss of vegetation at some sites on these steep and highly eroding islands has resulted in the complete loss of availability of sites suitable for building decompositional nest mounds. On Agrihan, a nesting area was destroyed by village construction during the Japanese period (U.S. Fish and Wildlife Service 1998a).

Hunting and poaching

In past times, megapodes were hunted and their eggs taken for food. Megapodes are conspicuous and relatively tame, making them vulnerable to hunting with firearms or pellet guns. Concentrated nesting areas on the northern islands are vulnerable to the collection of eggs (U.S. Fish and Wildlife Service 1998a). Since the Micronesian Megapode was listed as endangered (both federally and locally), it is illegal to hunt them or take their eggs. But poaching still occurs. On January 12, 2004, conservation officers caught two poachers with a live megapode in the Saipan Upland Mitigation Bank area of Saipan (Ravelo 2004). The extent of poaching on the northern islands, both inhabited and uninhabited, is unknown.

Predation

Megapodes are known to be preyed upon by introduced monitor lizards (Varanus indicus), and may also be preyed on by feral dogs, cats and pigs. Chicks may be taken by rats (U.S. Fish and Wildlife Service 1998a). Even though the Micronesian Megapode became extirpated from Guam for reasons not related to the Brown Treesnake (Wiles et al. 2003), the snakes could easily prey upon megapode eggs and chicks, and therefore pose a serious potential threat. The Brown Treesnake has established an incipient population on Saipan (Colvin et al. 2005).

Volcanic eruptions

The Pagan population of megapodes probably declined due to the impacts of the 1981 volcanic eruption that buried vegetation and a nesting area in fine cinders (U.S. Fish and Wildlife Service 1998a). Anatahan's volcano has been erupting since May 2003, and it is not yet clear how the extensive ash fall has affected megapode habitats or population levels.

## Priority research and survey efforts

Research on megapode breeding and nesting on the southern islands

The breeding biology of the Micronesian Megapode on the southern islands deserves further study. A review of the literature indicates that no true Megapode nests have been found on the southern islands, except for a possible nest mound found on Aguiguan in 1989 by Stinson (1992). How this species successfully reproduces and maintains small populations on Saipan and Aguiguan is a mystery.

New survey method to detect megapodes

A new survey method is needed that is designed to detect megapodes. During regular surveys of the Saipan Upland Mitigation Bank and during Breeding Bird Surveys, megapodes are detected, however, roughly half of those detected are not while the observer is at the detection station at the count time (L. Williams, pers. comm., September 2005). Therefore, it is believed that megapode populations are being underestimated.

## Conservation actions

The Micronesian Megapode can be conserved by taking the conservation actions listed as follows. Detailed descriptions and priority rankings for these actions are given in Chapter 6.

| |
|---|
| Cull goats from the island of Aguiguan |
| Eradicate rats, cats and other predators from Aguiguan Island |
| Eradicate scarlet gourd (*Coccinia grandis*) from Saipan |
| Interdiction of the Brown Treesnake (*Boiga irregularis*) |
| Prevent the introduction of West Nile Virus to the Mariana Islands |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on the southern islands through avoidance and mitigation conditions placed on land development proposals |
| Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition |
| Improve management of terrestrial conservation areas in the southern islands |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Reforest disturbed areas with native tree species on the southern islands |
| Improve enforcement of hunting regulations on the southern islands |
| Assess the suitability of Sarigan Island to receive translocated birds and monitor forest succession and wildlife population trends on Sarigan following the eradication of feral ungulates |
| Establish a fenced nature reserve on the southern peninsula of Pagan |
| Remove feral ungulates from the northern islands of Anatahan, Alamagan, Pagan and Agrihan |
| Prevent the introduction of invasive species to the northern islands |

**Monitoring**

Monitoring of Megapode populations varies by island. Aguiguan is difficult to access and is rarely visited for wildlife surveys. DFW plans to survey Aguiguan for megapodes and other wildlife within the next five years. Trends in megapode populations on Saipan are monitored on a regular basis through the quarterly island-wide breeding bird surveys and the bi-annual variable circular plot surveys taken in the Saipan Upland Mitigation Bank area. It is not possible to conduct wildlife surveys on FDM, because the island is covered with unexploded ordnance. Monitoring on the northern islands will be more of a challenge, because they are remote and transport is expensive. The islands of Anatahan and Sarigan will continue to be monitored for megapode recovery following feral animal removal.

# NIGHTINGALE REED-WARBLER

**Common Name**
Nightingale Reed-warbler

**Scientific Name**
*Acrocephalus luscinia*

**Chamorro Name**
Ga'ga' karisu (Saipan)

**Carolinian Name**
Litchoghoi bwel.
Also, Malul ghariisu.

Figure 38. Nightingale Reed-warbler.
Photo credit: Scott Vogt.

**Listing Status**
The Nightingale Reed-warbler is federally listed as Endangered (U.S. Fish and Wildlife Service 1998b). The U.S. Fish and Wildlife Service (*ibid.*) prepared the *Recovery Plan for the Nightingale Reed-Warbler (Acrocephalus luscinia)* in 1998. This species is locally listed as threatened and endangered, and is also locally protected from hunting by regulation (CNMI 2000).

**Reasons for selecting the Nightingale Reed-warbler as a species of special conservation need**
This endemic species has a limited distribution, and is found only on the islands of Saipan and Alamagan, with perhaps a few individuals on Aguiguan. This is the species for which the Saipan Upland Mitigation Bank was established.

**Unique characteristics**
The Nightingale Reed-warbler is a medium-sized, yellowish passerine with a very long bill. The head feathers are shaggy, and often erect. (See Figure 38.) More often heard than seen, it skulks through reed beds, thickets, forest undergrowth, and tangantangan (Pratt et al. 1987). Males defend territories from conspecifics and from intruders with a melodious song of trills, warbles and whistles which can last several minutes (Craig 1992b; Pratt et al. 1987). Craig (1992b) observed on Saipan that most males use the same territory year to year.

Three subspecies of Nightingale Reed-warbler in the Mariana Islands are currently recognized: *A. l. luscinia* (Guam, Saipan, and Alamagan), *A. l. nijoi* (Aguiguan) and *A. l. yamashinae* (Pagan). Craig and Chandran (1992) questioned the validity of the *nijoi* subspecies on Aguiguan, because it had been determined based on only five specimens, and although it had been distinguished from Saipan birds by its shorter bill and slightly different coloration, they observed that the bill length of post-fledging Nightingale Reed-warblers is substantially shorter than that of attending adults. Genetic research is being undertaken and will be published soon to clarify subspecies distinctions (R. Fleischer, Smithsonian Institute, pers. comm., December 2004).

## <u>Distribution of the Nightingale Reed-warbler in the CNMI</u>

<u>Current distribution</u>

Widespread populations of the Nightingale Reed-warbler are found on the islands of Saipan and Alamagan. A small population of unknown persistence has been found on Aguiguan.

<u>Historic distribution</u>

The Nightingale Reed-warbler occurred prehistorically on Tinian (Steadman 1999). Guam's population of Nightingale Reed-warblers was extirpated in 1969, with the final blow probably being delivered by the Brown Treesnake (Wiles et al. 2003). A population also occurred on Pagan, but was extirpated before 1981 when the volcanic eruption destroyed the only known habitat of the species there (U.S. Fish and Wildlife Service 1998b). Members of the genus *Acrocephalus* are strong island colonizers, and it is possible that the Nightingale Reed-warbler once occurred on other islands (Craig 1992b).

## <u>Abundance of the Nightingale Reed-warbler in the CNMI</u>

<u>Aguiguan</u>

Engbring et al. (1986) detected no Nightingale Reed-warblers during station counts on Aguiguan in 1982, but based on incidental sightings, they liberally estimated an island-wide total of 15 birds at a density of 0.04 per hectare. A maximum of six birds was recorded on one of the four trips by CNMI DFW personnel during 1983 to 1985, and none were found during 1987 to 1990 on eight trips, leading Reichel et al. (1992) to believe that the Aguiguan population was extinct. Craig and Chandran (1992) encountered two singing males, and confirmed sighting one of them in binoculars. In 2000 and in 2002, no Nightingale Reed-warblers were detected during DFW surveys, even when employing play-back methodology to try to elicit a response (Cruz et al. 2000b; Cruz et al. 2003d). At best, the current population on Aguiguan is very small, and at worst, may represent intermittent attempts at colonization from dispersing members of the Saipan population (Cruz et al. 2003d).

<u>Saipan</u>

Engbring et al. (1986) estimated an island-wide total of 4,867 Nightingale Reed-warblers on Saipan in 1982, at a density of 0.46 birds per hectare. They found the Saipan population to be common, and recommended a reassessment of the endangered status, because the population was healthy and appeared to require no special protection. In 1997, the Engbring et al. (1986) forest bird surveys were repeated on Saipan. Preliminary analysis of the data showed that the number of birds detected per station and the number of stations at which reed-warblers were detected has declined since the 1982 surveys. A preliminary population estimate for Saipan in 1997 was made at 4,225 individuals or a 13% decline in 15 years (U.S. Fish and Wildlife Service 1998b).

Surveys of Nightingale Reed-warblers have been conducted in the conservation areas of Saipan. As a part of managing the new Saipan Upland Mitigation Bank area, forest bird surveys are conducted twice yearly. A benchmark of 194 male Nightingale Reed-warbler territories has been established. However, in four out of 8 surveys between September

1999 and March 2003, the point estimate of population abundance was below this benchmark. Densities averaged 0.35 and ranged from 0.2 to 0.6 birds per hectare in the mitigation bank area. This compares to densities measured for the Bird Island Conservation Area (average 0.3 and range of 0.12 to 0.83 birds per ha), an area contiguous with the mitigation bank. But, it contrasts with the lower densities measured for the Kagman Conservation Area (average 0.1 and range of 0.06 to 0.29); Kagman has more intact native forest canopy, a habitat not preferred by reed-warblers (Cruz and Williams 2003).

Roadside bird surveys taken over eleven years from 1991 to 2002 indicate that the Nightingale Reed-warbler population has remained stable (Cruz and Williams 2003).

Alamagan
In 1988, Reichel et al. (1992) made a conservative estimate of 350 pairs of Nightingale Reed-warblers on Alamagan, with actual numbers perhaps ranging to a maximum of 1000 pairs. In 2000, Cruz et al. (2000d) made an island-wide estimate of 173 pairs on Alamagan, roughly half the number estimated from 12 years before. This difference may be explained by an underestimation of the amount of forested area, resulting in an island-wide estimate that is too conservative; or that the year 2000 surveys revealed a less dense and more aggregated population than previously supposed; or that a true decline has resulted due to the combined influences of typhoons, habitat loss due to feral ungulates and predation pressure (Cruz et al. 2000d).

**Location and relative condition of key habitats for the Nightingale Reed-warbler in the CNMI**

Aguiguan
Observations of habitat preferences by the Nightingale Reed-warbler on Aguiguan vary. Reed-warblers appeared restricted to the forested portions of the northwest side of the island in 1982 (Engbring et al. 1986). Craig and Chandran (1992) observed their two reed-warblers in formerly disturbed areas vegetated by groves of *Casuarina equisitifolia* trees and tall *Lantana camara* thickets. The rarity of the Nightingale Reed-warbler on Aguiguan may be the result of destruction to the forest understory by feral goats. The persistence of a dense population of reed-warblers on Alamagan, an island also impacted by feral animals, may be explained in the density of understory vegetation and amount of grassland, which may be greater on Alamagan than on Aguiguan (Reichel et al. 1992).

Saipan
Engbring et al. (1986) found the Nightingale Reed-warbler to thrive in a variety of habitats, including secondary forest, tangantangan forest and around wetlands of varied vegetation. Craig (1992b) found most birds on Saipan inhabit areas with a mosaic of tangantangan and elephant grass (*Pennisetum purpureum*). Other habitats included native reed (*Phragmites karka*) marshes, native forest edges and open woods. No territorial reed-warblers were found in interior native forest anywhere on the island. Mosher (1997, cited in U.S. Fish and Wildlife Service 1998b) found Nightingale Reed-warbler nests in the mangrove (*Bruguiera gymnorrhiza*) forest on Saipan. Cruz and Williams (2003) measured lower densities of Nightingale Reed-warblers in the Kagman

Conservation Area than in the Saipan Upland Mitigation Bank in 2002-2003, and attributed this difference to the more intact and extensive native forest of the Kagman Conservation Area.

Alamagan

In 1988, Reichel et al. (1992) saw Nightingale Reed-warblers on Alamagan in habitats with a partially open overstory and somewhat brushy understory; and in dense swordgrass, but only within 50 m of an ecotone. Cruz et al. (2000d) detected reed-warblers on transects only in forested habitats at lower elevations, and heard them singing in the ravine forests that extend up the flanks of the volcano from the south to at least 350 m above sea level. Reed-warblers were also heard in the remnant forests inside the volcanic crater. None were found in swordgrass or in edge habitat. Only about one-third of Alamagan supports forest, and this is highly impacted by feral goats and pigs. If feral ungulates continue to alter the island's vegetation as they have in the past, the island may become subject to desertification almost as severe as that of Anatahan, and the risk of extinction to reed-warblers will be similar to that of the former population on Pagan (Cruz et al. 2000d).

Information on the locations and conditions of the various habitats occupied by the Nightingale Reed-warbler is given in Chapter 4.

**Problems which adversely affect the Nightingale Reed-warbler and its habitats**

Loss of wetland and tangantangan habitats on Saipan

Prior to World War II, half of the island of Saipan was used for agriculture. The Lake Susupe area, containing the largest wetland on Saipan, was heavily used. Reed-warbler populations likely dropped during this time. Immediately following the war, reports indicated that a small population of reed-warblers was present and restricted to wetland areas (Reichel et al. 1992). The reed-warbler population then grew, probably due to one of more of the following factors: increased edge habitat from fragmentation in recent decades; replacement of large tracts of native forest with tangantangan forest; and/or adaptation of Nightingale Reed-warblers to new habitat types (*ibid.*). Increased demand for land developments during the last decade on Saipan, including agriculture, homesteads and tourist-related facilities, now poses the threat of habitat loss once more (U.S. Fish and Wildlife Service 1998b).

Habitat destruction by feral animals on Aguiguan and Alamagan

The Nightingale Reed-warbler is a bird adapted to dense understory vegetation. Its short, round wings and long tail in comparison to its body size are clearly designed for maneuvering in dense habitat (U.S. Fish and Wildlife Service 1998b). Feral goats on Aguiguan and feral goats and pigs on Alamagan have destroyed understory vegetation.

Predation

The effects of predation by monitor lizards (*Varanus indicus*), feral cats (*Felis catus*) and rats (*Rattus spp.*) are unknown, but all of these species are known to prey on forest birds and could potentially be a threat to recovery of the Nightingale Reed-warbler (U.S. Fish and Wildlife Service 1998b). Mosher (1997, cited in U.S. Fish and Wildlife Service

1998b) tracked the fate of 29 reed-warbler nests, and confirmed 3 predated by rats, and one predated by a Golden White-eye.

The biggest threat of predation, however, is from the Brown Treesnake (*Boiga irregularis*). Reichel et al. (1992) speculate that predation by Brown Treesnakes may have played a key role in the final disappearance of the Nightingale Reed-warbler from Guam. Treesnakes were introduced to Guam after the war and first appeared in south-central Guam in the 1950s in the vicinity of the U.S. Naval Magazine, only 3 to 5 km from several swamps formerly used by reed-warblers. The snake population's increase and geographic spread coincided with the decline of the reed-warblers (*ibid.*). The Brown Treesnake has established an incipient population on Saipan (Colvin et al. 2005); once a breeding snake population is established, the Nightingale Reed-warbler, along with all other forest birds on Saipan, will face extirpation.

The *Management Plan for Nightingale Reed-warblers in the Saipan Upland Mitigation Bank, CNMI* calls for predator control including: Brown Treesnake interdiction, identification of nest predators, trapping of rats and cats, and developing techniques to control other predators (CNMI Division of Fish and Wildlife 2002).

**<u>Priority research and survey efforts</u>**

Priority research needs to improve the ability to manage the Nightingale Reed-warbler are identified in the management plan for the Saipan Upland Mitigation Bank (CNMI Division of Fish and Wildlife 2002). They include:

- Study of Nightingale Reed-warbler reproductive success and recruitment in tangantangan and mixed secondary forest in the protected area.
- Study of availability of food resources and the prey spectrum of Nightingale Reed-warbler in tangantangan and secondary forests of the protected area.
- Determine parameters influencing the population structure of Nightingale Reed-warblers in the protected area, including age of first breeding, fecundity, mortality levels, and causes of mortality.
- Research associated with reducing risks to Nightingale Reed-warblers in the protected area, including quantification of immigration / emigration between the protected area and the rest of Saipan, presence of avian disease and vectors, and genetic studies quantifying the population's heterozygosity and inbreeding potential.

**<u>Conservation actions</u>**

Conservation actions to benefit the Nightingale Reed-warbler are listed below. Complete descriptions and priority rankings for these conservation actions are given in Chapter 6.

| |
|---|
| Cull goats from the island of Aguiguan |
| Eradicate rats, cats and other predators from Aguiguan Island |
| Eradicate scarlet gourd (*Coccinia grandis*) from Saipan |
| Interdiction of the Brown Treesnake (*Boiga irregularis*) |
| Translocation of native forest birds from the southern islands to the northern islands and establishment of a captive breeding program |
| Prevent the introduction of West Nile Virus to the Mariana Islands |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on the southern islands through avoidance and mitigation conditions placed on land development proposals |
| Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition |
| Improve management of terrestrial conservation areas in the southern islands |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Remove feral ungulates from the northern islands of Anatahan, Alamagan, Pagan and Agrihan |
| Prevent the introduction of invasive species to the northern islands |

**Monitoring**

Aguiguan is difficult to access, and opportunities to survey the island for the presence, if any, of Nightingale Reed-warblers are rare. DFW plans to take a field trip to Aguiguan to monitor all wildlife and habitats on the island within the next five years. Island-wide monitoring of trends in Nightingale Reed-warbler populations on Saipan is accomplished through quarterly breeding bird surveys. In addition, the forest bird surveys in the Saipan Upland Mitigation Bank that have been conducted twice annually since 1999 will continue. A trip to the northern islands is costly and logistically challenging. Alamagan's bird populations were last surveyed in 2000. DFW hopes to rally another northern islands expedition in the next five years, funding permitting.

# ROTA BRIDLED WHITE-EYE

Figure 39. Rota Bridled White-eye.
Photo credit: Fred Amidon

**Common Name**
Rota Bridled White-eye

**Scientific Name**
*Zosterops rotensis*

**Chamorro Name**
Nosa' (named for its small size)

**Carolinian Name**
Litchogh

**Listing Status**
The Rota Bridled White-eye was listed on January 22, 2004 as an endangered species under the ESA (U.S. Fish and Wildlife Service 2004a). It is locally listed as a threatened and endangered species, and is protected from hunting by regulation (CNMI 2000).

**Reasons for selecting the Rota Bridled White-eye as a species of special conservation need**
The Rota Bridled White-eye has only recently been listed as endangered under ESA. This tiny bird, a separate species from other white-eyes in the CNMI, occurs only on the island of Rota. Numbers of Rota Bridled White-eyes have declined an estimated 89% between 1982 and 1996 (Fancy and Snetsinger 2001). Its range has become restricted to the Sabana Heights region of Rota. Although the U.S. Fish and Wildlife Service found it prudent to designate critical habitat for the Rota Bridled White-eye, current funding is insufficient to propose critical habitat (U.S. Fish and Wildlife Service 2004a).

**Unique characteristics**
The Rota Bridled White-eye is a tiny bird, weighing less than 10 grams (U.S. Fish and Wildlife Service 2004a), or about a third of an ounce. The Rota Bridled White-eye has recently been determined to be a separate species from the Saipan Bridled White-eye on the basis of mitochondrial sequence data analysis (Slikas et al. 2000), and differences in calls, coloration and habitat preference (Engbring et al. 1986; Pratt et al. 1987; CNMI Division of Fish and Wildlife n.d.). In contrast to the Saipan Bridled White-eye, the Rota Bridled White-eye is a brighter yellow color, (see Figure 39), and is limited to mature native forest habitat. Like the Saipan Bridled White-eye, the Rota Bridled White-eye features a white ring of feathers around the eye, and builds a cup-shaped nest suspended from tree branches or leaves (Figure 40).

Figure 40. Nest of the Rota Bridled White-eye. Left: Note attachment of the nest by a "handle" to tree branches. Right: Characteristic cup shape.
Photos by Fred Amidon.

**Distribution of the Rota Bridled White-eye in the CNMI**

The Rota Bridled White-eye occurs only on the island of Rota. Its core range has been contracted to pockets of mature native forest of the Sabana, the upper plateau of Rota over the past several decades.

**Abundance of the Rota Bridled White-eye in the CNMI**

Rota Bridled White-eyes were apparently abundant at lower elevations (less than 150 m) prior to the 1960s, based on interviews with elderly Rotanese in 1989 (Fancy and Snetsinger 1996). Since the early 1960s, the Rota Bridled White-eye has been restricted to higher elevations (greater than 150 m) of Rota and became rare (*ibid.*). Engbring et al. (1986) found 93% of the entire Rota population of white-eyes in the Sabana region, and estimated a total population of 10,015 birds in 1982. Fourteen years later, in 1996, Fancy and Snetsinger (2001) estimated a total population of 1,165 birds, equating to a decline of 89%. All of these birds were recorded in the Sabana region at higher elevations (*ibid.*).

**Location and relative condition of key habitats for the Rota Bridled White-eye in the CNMI**

The Rota Bridled White-eye is primarily restricted to fragmented patches of mature native limestone forest on the upper plateau of the Sabana region and at the base of cliffs surrounding the Sabana (Fancy and Snetsinger 1996). White-eyes now have a patchy distribution among remnant stands of relatively pristine native forest separated by areas cleared for agriculture or supporting only scattered trees and *Pandanus* (Fancy and Snetsinger 2001). In 1998 and 1999, Amidon (2000) found that forested areas with high densities of Rota Bridled White-eyes had higher volumes of epiphytic plants such as *Asplenium nidus* and *Davallia solida*, and were primarily composed of *Elaeocarpus joga, Hernandia labyrinthica, Merrilliodendron megacarpum, Pandanus tectorius,* and *Premna obtusifolia* trees. The condition of these forests has been degraded by fragmentation and typhoon damage.

**Problems which adversely affect the Rota Bridled White-eye and its habitats**

The recent and dramatic decline in Rota Bridled White-eye numbers has been documented by a number of researchers, yet the reasons for the decline are not clearly understood. Many causes have been cited.

<u>Habitat damaged by typhoons and deer browsing</u>

The majority of high elevation forests along the upper plateau of Rota have not been threatened by development or clearing because of their rugged topography (Amidon 2000). However, these high elevation areas have been exposed to the force of numerous typhoons, resulting in damage to the cloud forests of the Sabana (*ibid.*). Supertyphoon Roy in January 1988 hit Rota with winds exceeding 150 mph, causing complete defoliation of almost all forests, half of the trees downed and all of the trees with broken limbs. The wet forests of the upper cliffline were drastically altered and had not recovered completely by the time Supertyphoon Paka hit Rota in December 1997 (*ibid.*). Since then, Rota has twice been hit by supertyphoons, Pongsona in December 2002, and Chaba in August 2004. Clearing of land on the Sabana has been limited, but may have accelerated degradation of mature native forests on the Sabana by typhoons, because fragmentation of the forest increases the forest edge and exposes more of the forest to typhoon-force winds (U.S. Fish and Wildlife Service 2004a). It appears that large areas of mature native forest are being converted into *Pandanas tectorius* thickets as canopy trees are damaged and die off (Amidon 2005b). Browsing by deer (*Cervus mariannus*) may also be impacting natural regeneration of native forests, further limiting the distribution of Rota Bridled White-eyes by reducing mature native forest habitat in the Sabana (*ibid.*).

<u>Predation by black drongos</u>

A number of researchers have suggested that black drongos (*Dicrurus macrocercus*) prey on Rota Bridled White-eyes. Engbring et al. (1986) found black drongos to be abundant in lowlands but uncommon in the forests of the Sabana where white-eyes were found. Craig and Taisacan (1994) noted that black drongos became abundant on Rota in the 1960s at the time when the decline in the Rota Bridled White-eye population was first noted, and hypothesized that white-eyes are susceptible to predation by drongos because they are small and exposed where they feed on the upper branches of the forest canopy. Drongos are known to harass other birds, but few direct observations have been made of drongos taking small birds as prey (Fancy and Snetsinger 2001). Amidon (2000) did observe a black drongo predating an adult or juvenile Rota Bridled White-eye. Drongos are not found in pristine limestone forest at high elevation where white-eyes are expected to occur but are absent, calling the drongo predation hypothesis into question (Fancy and Snetsinger 2001). Amidon (2000) did note that black drongo numbers increased on the Sabana from 1982 to 1994 while white-eye numbers decreased, but statistical analysis did not find a negative relationship between black drongo numbers and white-eyes which would support the drongo predation hypothesis.

<u>Other Nest Predators</u>

A variety of predators which prey on Rota Bridled White-eye nests (eggs and nestlings) are suspected or have been observed, including introduced rats (*Rattus spp.*), feral cats (*Felis cattus*), monitor lizards (*Varanus indicus*), collared kingfishers (*Halcyon chloris*), Micronesian starlings (*Aplonis opaca*) and one unidentified black bird (Amidon 2000, 2005b; Fancy and Snetsinger 2001; Williams et al. 2003b). Data is insufficient and additional research is required to understand the dynamics of predation, and to determine whether one or many of these predators is primarily responsible for the decline in Rota Bridled White-eye numbers.

Predation by the Brown Treesnake
Since 1982, there have been 4 sightings and 2 captures of Brown Treesnakes (*Boiga irregularis*) on the island of Rota (Hawley 2005). Airport and marina expansion projects on Rota will result in an increased risk of BTS infestation due to an increase in cargo traffic from Guam (*ibid.*). On the island of Guam, the Guam Bridled White-eye was the first avian species to be driven extinct by the Brown Treesnake. White-eyes were the smallest of passerine species on Guam, and could be swallowed by both small and large snakes (Savidge 1987). Brown Treesnakes are not now thought to have caused the recent decline in Rota Bridled White-eye numbers (U.S. Fish and Wildlife Service 2004a); however, if and when a breeding population of Brown Treesnakes becomes established on Rota, the Rota Bridled White-eye will be faced with the threat of extinction.

Avian disease
The role of avian disease in the decline of Rota Bridled White-eye numbers is unclear. In Hawaii, avian malaria and avian pox carried by a cold-intolerant mosquito have made native forest birds rare or absent from lower elevations. But, the mosquito is capable of living at higher elevations than the highest elevation on Rota. Avian disease cannot be ruled out as a mortality factor on Rota without further field studies on vectors and parasites (Fancy and Snetsinger 2001). West Nile Virus, another mosquito-borne avian disease, may pose a significant risk to the Rota Bridled White-eye if it reaches the Pacific Islands (Amidon 2005b).

**Priority research and survey efforts**

Rota Bridled White-eye Ecology Study
DFW has recently entered into an agreement with Drs. Renee Robinette and James C. Ha of the University of Washington to study the ecology of both the Rota Bridled White-eye and the Mariana Crow (Robinette and Ha 2005). This study will initially be funded by Section 6 funds through the U.S. Fish and Wildlife Service Federal Aid program, but it is anticipated that the researchers will seek additional sources of funding for supplemental projects. Objectives of the study are as follows.

- Employ an intensive capture and banding effort to record and identify individual Rota Bridled White-eyes to study their population dynamics.
- Use radio telemetry to determine home range and territory sizes, facilitate location of individuals, and determine location/disposition of fatalities.
- Pilot a variety of nest monitoring systems for monitoring nest success and identifying predators.
- Evaluate Rota Bridled White-eye foraging requirements, especially invertebrates.

- Explore the application of information from studies of less-threatened, more common Rota species to the recovery of the Rota Bridled White-eye.

DFW has high hopes that a long-term relationship with these researchers will be established, and that research results will help to formulate and guide conservation actions for Rota Bridled White-eye recovery.

**Conservation actions**

The following list of conservation actions would benefit the Rota Bridled White-eye. Detailed descriptions and priority rankings for these conservation actions are given in Chapter 6.

| |
|---|
| Conserve habitat for endangered bird species on Rota through an island-wide habitat conservation plan |
| Decrease deer numbers on the Sabana of Rota |
| Interdiction of the Brown Treesnake (*Boiga irregularis*) |
| Translocation of native forest birds from the southern islands to the northern islands and establishment of a captive breeding program |
| Prevent the introduction of West Nile Virus to the Mariana Islands |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on the southern islands through avoidance and mitigation conditions placed on land development proposals |
| Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition |
| Improve management of terrestrial conservation areas in the southern islands |
| Reforest disturbed areas with native tree species on the southern islands |

**Monitoring**

Monitoring of Rota Bridled White-eye populations on Rota will be an ongoing part of the research being conducted by Drs. Robinette and Ha of the University of Washington. In addition to new research directed at the Rota Bridled White-eye, continuing efforts will be made to monitor the status of all the avifauna on the island of Rota. Future surveys will be conducted using the same methods of past censuses so that a longitudinal analysis remains possible.

# RUFOUS FANTAIL

**Common Name**
Rufous Fantail.
Also, Rufous-fronted Fantail.

**Scientific Name**
*Rhipidura rufifrons*

**Chamorro Name**
Naabak (meaning, "someone who will get you lost", based on the belief that if you follow it as it flits through the forest, you'll become lost.)

Figure 41. Rufous Fantail displaying its tail.
Photo credit: DFW files.

**Carolinian Name**
Leteghipar

**Listing Status**
The Rufous Fantail is not listed as threatened or endangered, either federally or locally. It is locally protected from hunting by regulation (CNMI 2000).

**Reasons for selecting the Rufous Fantail as a species of special conservation need**
Two subspecies of the Rufous Fantail are endemic to the Marianas, and occur on only four islands. The Guam subspecies (*Rhipidura rufifrons uraniae*) has been extirpated by the Brown Treesnake (Wiles et al. 2003); CNMI's fantails will be easily preyed upon by Brown Treesnakes and will face the threat of extirpation when snakes establish breeding populations on the southern islands. Because the Rufous Fantail is not federally listed, it does not qualify for research or management funded under Section 6 of the Endangered Species Act and other funding sources are insufficient.

**Unique characteristics**
The Rufous Fantail is a small bird (15 cm from bill to tail tip) with a proportionately long tail that it likes to fan out in display (Vogt and Williams 2004). (See Figure 41.) The body and wings are brown, the breast is white with black spots, and the forehead and base of the tail are a bright rusty color. The tail is tipped in white (Pratt et al. 1987). It is an active flycatcher, seldom sitting still, catching insects on the wing in an erratic in-and-out flying pattern, or picking insects from foliage. The nest is made in a cone shape, with a characteristic "beard" of fine vegetation extending from the bottom (see Figure 42) (Engbring et al. 1986).

Figure 42. Rufous Fantail nests. Left: Characteristic "beard" hanging from bottom of nest. Above: Rufous Fantail chicks.
Photos by Shelly Kremer.

**Distribution of the Rufous Fantail in the CNMI**

*Rhipidura rufifrons* is widely distributed from the Mariana Islands and Yap to Australia. Two endemic subspecies occur in the CNMI. *R. r. saipanensis* occurs on the islands of Aguiguan, Tinian and Saipan. *R. r. mariae* occurs on the island of Rota (Pratt et al. 1987).

**Abundance of the Rufous Fantail in the CNMI**

Pratt et al. (1987) described the Rufous Fantail as common on Aguiguan, Tinian and Saipan, and less common on Rota. Engbring et al. (1986) found the Rufous Fantail to be in great abundance, the second most abundant and second most commonly recorded forest bird (after the Saipan Bridled White-eye) during their 1982 surveys of the southern islands.

Rota

Engbring et al. (1986) estimated Rota's Rufous Fantail population in 1982 at 15,769 birds, at a density of 2.0 birds/ha. Amar et al. (2004) surveyed the same stations along transects that were used by Engbring in 1982, and measured dramatic declines in the intervening 22 years: 64% decrease in numbers of Rufous Fantails counted per station; 23% decrease in the proportion of stations where Rufous Fantails were recorded; and 39% decrease in abundance at stations where presence of Rufous Fantails was recorded.

Aguiguan

Engbring et al. (1986) made an island-wide estimate in 1982 on Aguiguan of 1,472 total birds at a density of 3.8 birds/ha. Using the same survey techniques in 2002 as Engbring's 1982 study, a total of 8,951 birds at a density of 32.6 birds/ha were estimated for Aguiguan (Cruz et al. 2003d); this is an increase in abundance of 6 times in 20 years.

Tinian
Engbring et al. (1986) estimated a total of 28,122 birds at a density of 3.7 birds/ha on Tinian in 1982. No island-wide surveys of Rufous Fantails have been done for Tinian since Engbring's 1982 survey.

Saipan
Engbring et al. (1986) estimated a total of 46,912 birds at a density of 4.6 birds/ha on Saipan in 1982. Island-wide surveys of Rufous Fantails have not been done for Saipan since Engbring's 1982 survey. However, recent surveys made in three conservation areas on Saipan have yielded the following density estimates:

- Saipan Upland Mitigation Bank, in Marpi – Densities ranged from 27.0 to 44.6 birds/ha in bi-annual surveys conducted from 1999 to 2003 (Cruz and Williams 2003).
- Kagman Conservation Area – A density estimate of 22.6 birds/ha was made in 2002 – 2003 (Cruz et al. 2003c).
- Bird Island Conservation Area – A density estimate of 32.2 birds/ha was made in 2001 (Cruz et al. 2003b).

**Location and relative condition of key habitats for the Rufous Fantail in the CNMI**
The Rufous Fantail inhabits all forested habitats, including native forest, secondary forest, tangantangan forest and agricultural forest. It is generally not found in savannah habitat. It has adapted extremely well to tangantangan forests on Saipan and Tinian, and has also adapted to urban habitats (Engbring et al. 1986). Engbring et al. (1986) found Rufous Fantails to be widespread and recorded on all transects on all four islands. Locations and conditions of these habitats are discussed in Chapter 4.

**Problems which adversely affect the Rufous Fantail and its habitats**
Probable extirpation by the Brown Treesnake
The Guam subspecies of Rufous Fantail (*Rhipidura rufifrons uraniae*) disappeared from Guam shortly after the Guam subspecies of the Bridled White-eye (*Zosterops conspicillatus conspicillatus*) (Savidge 1987), and has been extirpated from Guam by the Brown Treesnake (Wiles et al. 2003). The Brown Treesnake has already established an incipient population on the island of Saipan (Colvin et al. 2005). DFW believes that the same pattern of avian extirpation will occur on the southern islands of the CNMI as occurred on Guam, with the smallest birds disappearing first as the Brown Treesnake invades.

Habitat loss and degradation
Forested habitats frequented by the Rufous Fantail are threatened by loss and degradation. Native forests on Saipan and Tinian are very limited in extent. Native forests on Aguiguan cover about half of the island, but feral goats have damaged the understory and regeneration of tree seedlings is not occurring. Both native and secondary forests, including tangantangan forests, are being smothered by scarlet gourd (*Coccinia grandis*) on Saipan. Other invasive plants prevent re-establishment of native tree species after disturbance. Although the Rufous Fantail is adapted to the human environment, development of land for agricultural, commercial or residential purposes converts forest

habitat of a higher quality to for this and other forest birds to more marginal habitat. These threats to forested habitats are discussed in greater detail in Chapter 4.

**Priority research and survey efforts**

Life history study

Because of their abundance, the Rufous Fantail subspecies in the CNMI have not received much research attention. In response to the impending threat of extirpation by the Brown Treesnake, one conservation action is to capture birds for captive breeding and translocation. Life history studies must be done prior to undertaking this conservation action, to ensure successful capture, handling, holding and transport of captive birds.

Reason for decline in Rota population

The reasons for the decline in the population of Rufous Fantails over the last two decades are not understood. Seven out of eight terrestrial bird species on Rota have dramatically declined in abundance (Amar et al. 2004) and this is great cause for alarm. DFW has recently hired researchers to investigate the declines in Rota Bridled White-eyes and Mariana Crows on Rota, under Section 6 funding. Their investigations may include peripheral research on the Rufous Fantail to determine the reasons for overall bird declines.

**Conservation actions**

Conservation actions to conserve the Rufous Fantail are listed as follows. Detailed descriptions and priority rankings for these conservation actions are given in Chapter 6.

| |
|---|
| Conserve habitat for endangered bird species on Rota through an island-wide habitat conservation plan |
| Decrease deer numbers on the Sabana of Rota |
| Cull goats from the island of Aguiguan |
| Eradicate rats, cats and other predators from Aguiguan Island |
| Conserve remnant native limestone forest on Tinian by establishing a conservation area |
| Eradicate scarlet gourd (*Coccinia grandis*) from Saipan |
| Interdiction of the Brown Treesnake (*Boiga irregularis*) |
| Translocation of native forest birds from the southern islands to the northern islands and establishment of a captive breeding program |
| Prevent the introduction of West Nile Virus to the Mariana Islands |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition |
| Improve management of terrestrial conservation areas in the southern islands |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Reforest disturbed areas with native tree species on the southern islands |

## Monitoring

Trends in Rufous Fantail populations are monitored on a regular basis through the quarterly breeding bird surveys conducted on Rota and Saipan. Breeding bird surveys are conducted on Tinian more erratically, depending on staff availability. Surveys on Aguiguan are not regularly accomplished, due to difficulty of access to this small island and attention paid to projects of higher priority, but a field trip to Aguiguan to survey all wildlife populations is being planned in the next one to five years.

# SAIPAN BRIDLED WHITE-EYE

**Common Name**
Saipan Bridled White-eye

**Scientific Name**
*Zosterops conspicillatus saypani*

**Chamorro Name**
Nosa'

**Carolinian Name**
Litchogh

Figure 43. Saipan Bridled White-eye
Photo credit: Scott Vogt.

**Listing Status**
This species is not listed federally or locally, and is afforded no additional protection status by regulation (CNMI 2000).

**Reasons for selecting the Saipan Bridled White-eye as a species of special conservation need**
This endemic subspecies has a limited distribution, occurring only on three islands. Because it is not federally listed, it does not qualify for funding under Section 6 of the ESA. No additional protection is afforded to this subspecies. The Guam subspecies is already extinct due to the Brown Treesnake (*Boiga irregularis*). Due to its gregarious nature and habit of sleeping shoulder to shoulder on a tree branch, this bird would be easy prey for the Brown Treesnake.

**Unique characteristics**
The Saipan Bridled White-eye, *Zosterops conspicillatus saypani*, is a subspecies of the Bridled White-eyes of Micronesia, *Z. conspicillatus* (U.S. Fish and Wildlife Service 2004a). This tiniest of CNMI's native forest birds is also the most numerous (Engbring et al. 1986). The Saipan Bridled White-eye has a dull cream colored or golden underside, and an olive-green back, head and wings, which contrasts with the brighter yellow Rota Bridled White-eye (Vogt and Williams 2004). A conspicuous white ring surrounds the eye. (See Figure 43.) This bird is often seen on Saipan foraging in flocks of 10 to 40 birds, using gleaning, probing, hovering, and sallying to feed on invertebrates, nectar, fruits and seeds (Craig 1989). Bridled white-eyes build small cup-shaped nests of grasses bound together with spider webs and lined with hairs and small roots. Nests are attached to a tree branch by a handle formed of nesting materials attached to a tree branch (CNMI Division of Fish and Wildlife *n.d.*).

**Distribution of the Saipan Bridled White-eye in the CNMI**
The Saipan Bridled White-eye occurs on only three islands, Aguiguan, Tinian and Saipan (Slikas et al. 2000; Craig 2002; CNMI Division of Fish and Wildlife *n.d.*).

## Abundance of the Saipan Bridled White-eye in the CNMI

The Saipan Bridled White-eye is the most abundant native forest bird of the southern islands. The abundance of Saipan Bridled White-eyes on each island is discussed below.

Aguiguan

Engbring et al. (1986) made an island-wide estimate in 1982 on Aguiguan of 7,431 total bridled white-eyes at a density of 19.3 birds/ha. In 2002, using the same survey techniques as Engbring et al.'s 1982 study, a total of 18,576 birds at a density of 67.6 birds/ha were estimated for Aguiguan (Cruz et al. 2003d); this is an increase in abundance of 2-1/2 times in 20 years.

Tinian

Engbring et al. (1986) estimated a total of 241,352 bridled white-eyes at a density of 29.3 birds/ha on Tinian in 1982. In 1996, the transects surveyed by Engbring et al. (1986) were resurveyed to determine the status of the Tinian Monarch (*Monarcha takatsukasae*) (Lusk et al. 2000a). Data was collected on all forest bird species (F. Amidon, pers. comm., September 2005) but population estimates and densities were only calculated for the Tinian Monarch.

Saipan

Engbring et al. (1986) estimated a total of 229,138 bridled white-eyes at a density of 22.2 birds/ha on Saipan in 1982. In 1997, the transects surveyed by Engbring et al. (1986) were resurveyed to determine the status of the Nightingale Reed-warbler (*Acrocephalus luscinia*) (U.S. Fish and Wildlife Service 1998b). Data was collected on all forest bird species (F. Amidon, pers. comm., September 2005) but population estimates and densities were only calculated for the Nightingale Reed-warbler. However, recent surveys made in three conservation areas on Saipan have yielded the following density estimates:

- Saipan Upland Mitigation Bank, in Marpi – Densities ranged from 101.1 to 154.8 birds/ha in bi-annual surveys conducted from 1999 to 2003 (Cruz and Williams 2003).
- Kagman Conservation Area – A density estimate of 94.4 birds/ha was made in 2002 – 2003 (Cruz et al. 2003c).
- Bird Island Conservation Area – A density estimate of 89.2 birds/ha was made in 2001 (Cruz et al. 2003b).

## Location and relative condition of key habitats for the Saipan Bridled White-eye in the CNMI

Saipan Bridled White-eyes occupy forested habitats, including native limestone forest and tangantangan thickets (Craig 1990), but are also found in less woody habitats, including scrubby second growth and in dense herbaceous vegetation (Engbring et al. 1986). Sachtleben (2005) found Saipan Bridled White-eye nest densities to be higher in tangantangan than in native forest in 2004. Foraging behavior is similar between native forest and tangantangan habitats, and every microenvironment from ground to treetops is utilized (Craig 1989). Flexibility in habitat choice may explain why this bird has persisted in the face of periodic typhoon damage and extensive human-caused habitat change (Craig 1990). Locations and conditions of key habitats for this species are addressed in Chapter 4.

**Problems which adversely affect the Saipan Bridled White-eye and its habitats**

Probable extirpation by the Brown Treesnake

On the island of Guam, the Guam Bridled White-eye was the first avian species to be driven extinct by the Brown Treesnake. White-eyes were the smallest of passerine species on Guam, and could be swallowed by both small and large snakes. They are gregarious and flocking, and have been observed sleeping shoulder to shoulder at night. In a cage, one could be taken out without disturbing the others from sleep. Presumably, a nocturnal predator such as a snake could eat several birds at one roost (Savidge 1987).

The Brown Treesnake has already established an incipient population on the island of Saipan (Colvin et al. 2005). DFW has no reason to believe that the pattern of avian extirpation on Saipan will be any different than that which occurred on Guam: that the smallest, most gregarious bird, the Saipan Bridled White-eye, will disappear first once a breeding population of Brown Treesnakes becomes established on any of the southern islands of the CNMI.

Habitat loss and degradation

Forested habitats frequented by the Saipan Bridled White-eye are threatened by loss and degradation. Native forests on Saipan and Tinian are very limited in extent. Native forests on Aguiguan cover about half of the island, but feral goats have damaged the understory and regeneration of tree seedlings is not occurring. Both native and secondary forests, including tangantangan forests, are being smothered by scarlet gourd (*Coccinia grandis*) on Saipan. Other invasive plants prevent re-establishment of native tree species after disturbance. Development of land for agricultural, commercial or residential purposes removes white-eye habitat. These threats to forested habitats are discussed in greater detail in Chapter 4.

**Priority research and survey efforts**

The foraging ecology and social behavior of the Saipan Bridled White-eye were studied by Craig (1989 and 2002). Comparisons in habitat use with other passerine species have been made by Craig (1990). Sachtleben (2005) has studied predation and nest success. Priority research and survey efforts for the Saipan Bridled White-eye should now be directed toward translocating white-eyes from the southern islands to the northern islands in response to the Brown Treesnake threat. DFW has chosen Sarigan Island as the first operational translocation site, although others of the northern islands may be considered in the future. The following research is needed to support a translocation program:

- Develop techniques to capture, hold and transport Saipan Bridled White-eyes.
- Evaluate suitability of habitat for Saipan Bridled White-eyes on Sarigan or other northern islands where translocations may be considered.
- Determine if any avian diseases are present on Sarigan or on other northern islands where translocations are being considered.

- Evaluate the status of Saipan Bridled White-eye predators to determine if management is needed.
- Evaluate the suitability of Saipan Bridled White-eye foraging resources on Sarigan or on other northern islands that may be considered for translocation.

**Conservation actions**

The Saipan Bridled White-eye is a good candidate species for translocation to Sarigan or to others of the northern islands because: 1) it is the most abundant endemic bird species in the southern islands of the CNMI; 2) it is not endangered, but its distribution is limited to only three islands; 3) white-eyes were the first avian species to become extinct from Guam as a result of BTS infestation (Savidge 1987); and 4) success in translocation of this one species will drive translocation plans for other species in the future. Other conservation actions benefiting the Saipan Bridled White-eye are focused on habitat restoration. Conservation of the Saipan Bridled White-eye could be accomplished through the conservation actions listed below. For more detailed descriptions and priority rankings of these conservation actions, refer to Chapter 6.

| |
|---|
| Cull goats from the island of Aguiguan |
| Eradicate rats, cats and other predators from Aguiguan Island |
| Conserve remnant native limestone forest on Tinian by establishing a conservation area |
| Eradicate scarlet gourd (*Coccinia grandis*) from Saipan |
| Interdiction of the Brown Treesnake (*Boiga irregularis*) |
| Translocation of native forest birds from the southern islands to the northern islands and establishment of a captive breeding program |
| Prevent the introduction of West Nile Virus to the Mariana Islands |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition |
| Improve management of terrestrial conservation areas in the southern islands |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Reforest disturbed areas with native tree species on the southern islands |
| Assess the suitability of Sarigan Island to receive translocated birds and monitor forest succession and wildlife population trends on Sarigan following the eradication of feral ungulates |

**Monitoring**

Monitoring of trends in Saipan Bridled White-eye populations is accomplished through quarterly breeding bird surveys on Saipan and Tinian. Aguiguan is difficult to access, and monitoring of population trends occurs opportunistically, as funding and staff availability dictate. When a new population of Saipan Bridled White-eyes is established on Sarigan or on any of the other northern islands through translocation, it will be monitored to the extent that funding is available for transportation to this more remote island.

# TINIAN MONARCH

**Common Name**
Tinian Monarch

Figure 44. Tinian Monarch perched.
Photo credit: Tim Sutterfield.

**Scientific Name**
*Monarcha takatsukasae*

**Chamorro Name**
Chichirikan Tinian

**Carolinian Name**
Leteighi'par

**Listing status**
The Tinian Monarch was federally listed as endangered on June 2, 1970. Because numbers of monarchs had begun to recover on Tinian, the species was downlisted from endangered to threatened on May 6, 1987 (U.S. Fish and Wildlife Service 1987). The species was removed from the federal list of endangered and threatened wildlife on September 21, 2004, owing to increased numbers of birds, increased forest density, indicating an improvement in monarch habitat quality (U.S. Fish and Wildlife Service 2004c). This species is locally protected from take by regulation, and is listed locally as a threatened and endangered species (CNMI 2000).

**Reasons for selecting the Tinian Monarch as a species of special conservation need**
The Tinian Monarch is found only on the island of Tinian. Even though numbers of these birds have increased over the last several years, and the species has been removed from the federal endangered species list, the very real threat exists that the Brown Treesnake will become established on Tinian and will drive the Tinian Monarch to extinction.

Figure 45. Tinian Monarch on its nest.
Photo credit: Tim Sutterfield

**Unique characteristics**
The Tinian Monarch is a small (about 15 cm in length), insectivorous songbird endemic to the island of Tinian. The bird's underparts are light, the upper parts are olive-brown, the wings and tail are brown, and the undertail coverts are white. (See Figure 44.) Monarchs are found in native forests, secondary vegetation and pure tangantangan stands (*Leucaena leucocephala)*, feeding on insects and foraging in the middle and lower canopy of the forest (CNMI Division of Fish and Wildlife, n.d.). The song of the monarch is remarkable for its clarity and purity of tone, and is usually heard in the evenings

(Marshall 1949). Variations in calls have been noted, depending on whether the bird is foraging, advertising for a mate, warning intruders or at the nest with its mate (Downs 1946; Glass 1988; U.S. Fish and Wildlife Service 1996). Cup-shaped nests are woven from grass, leaves and feathers, and incorporated into small tree branches in the forest understory. (See Figure 45). Mean clutch size is two eggs (U.S. Fish and Wildlife Service 1996). Although Marshall (1949) noted that the Tinian Monarch nests year round, a pronounced seasonality in nesting was found during 1994 and 1995, with nesting peaking during periods of increased rainfall (U.S. Fish and Wildlife Service 1996).

**Distribution of the Tinian Monarch in the CNMI**

One observer reported the Tinian Monarch on the island of Aguiguan in 1954, but this observation has been discounted as either a mistaken identification or as a sighting of a migrant bird (Reichel and Glass 1991). Based upon examination of museum specimens, Peters (1996) believed that a now-extinct population of monarchs may have existed at one time on the island of Saipan. Currently, the Tinian Monarch is found only on the island of Tinian, and nowhere else in the world.

**Abundance of the Tinian Monarch on Tinian**

Historically, Tinian Monarchs were less abundant than they are today on the island of Tinian. Gleize (1945) reported 40 to 50 Tinian Island Monarchs as "Est. No.". It is not clear whether these are the number of birds Gleize observed and recorded, or whether this range was his island-wide estimate. The decision to list the species as endangered in 1970 was presumably based on the monarch's small geographical range and on Gleize's report (Glass 1988).

In 1982, Engbring et al. (1986) found an average density of 541 birds per square kilometer, and an island-wide population estimate of 39,338 monarchs. Consequently, a recommendation was made to reassess the monarch's status as endangered.

The U.S. Fish and Wildlife Service (1996) made an island-wide estimate of 52,904 birds based on a banding study conducted in 1994 and 1995 in three different habitats. Bird densities in each habitat type were calculated by observing the number of banded birds on study plots, and adding in the estimated number of unbanded birds. These densities were multiplied by the area of each habitat on the island to yield the total number of monarchs. This method differed from that used by Engbring et al. (1986).

In 1996, Lusk et al. (2000a) recounted the same transects that had been used by Engbring et al. (1986) in 1982, and used the same analysis procedure to yield a population estimate of 55,721 monarchs. After extrapolating the USFWS estimate from 1994 and 1995 over the same study areas used to yield this estimate, Lusk et al. (2000a) determined that these two estimates were within 5% of each other, and that both estimates from the 1990s indicated that monarch numbers were increasing. Ultimately, the species was de-listed in 2004, based upon this recovery in numbers (U.S. Fish and Wildlife 2004c).

Cruz et al. (2000a) surveyed bird species in the proposed Tinian Conservation Area in February 2000. Native limestone forest accounted for 59% of the sampled habitat, yet the Tinian monarch was scarcer than they had hoped to find, with numbers of birds found being too small to make a robust estimate of the population size using variable circular plot analysis.

## Location and relative condition of key habitats for the Tinian Monarch

### Historic vegetation changes

Drastic alterations to the native vegetation have occurred over the years on the island of Tinian. Prior to the beginning of the twentieth century, Tinian harbored much native forest, although the original composition of the forest is unknown. Man-induced disturbances may have started with the burning of large areas, clearing of forest for agriculture and introduction of exotic animals and plants by the indigenous Chamorros over 4,000 years ago. Although Tinian was probably uninhabited during the Spanish administration, wild cattle, pigs and feral junglefowl were abundant. In the mid-1700s, the forest appeared parklike and open, undoubtedly rendered by the thousands of introduced ungulates. During the Japanese era, from 1914 to 1944, nearly the entire island of Tinian was deforested and replaced with sugar cane fields, except for the craggy, forested cliffs and ridges with shallow soils. During World War II, all vegetation on Tinian was virtually leveled, and only tiny pockets of native vegetation remained. After the war, vast areas where sugar cane had formerly grown were re-seeded with tangantangan (*Leucaena leucocephala*), which grows today in monospecific stands over much of the island. Cattle grazing and agriculture increased during the 1980s, resulting in a mosaic of forest habitats within a matrix of grasslands, pastures and cultivated fields. Vegetation density has increased since the 1980s due to less grazing pressure by cattle (U.S. Fish and Wildlife Service 1996, Engbring et al. 1986, Lusk et al. 2000a).

### Location and condition of preferred Tinian Monarch habitats

Tinian Monarchs are forest dwellers, and rely on the presence of trees for their habitat. In 1945, coincident with the extreme alteration of native vegetation due to war-time activities, Downs (1946) described where he found monarchs:

> The localities were rather definitely placed in separate sections of the Island. The first record was made at the extreme north tip…The other findings were at Hagoi Lake…and at the south end of the Island beneath the cover of the trees along a favorite side road in the upland forest…They clung to the mid-branches of the various trees and bushes on the island and preferred to stay within the forest boundaries, except in that one brief instance one was observed feeding high up on the side of the cliff…among heavy vines and roots.

During 1982, Engbring et al. (1986) found Tinian Monarchs on all transects, with lower densities found in pasture lands, present in all types of forested and bushy cover, and abundant around the Marpo wetland (*ibid.*).

The life history study carried out in 1994-5 placed study plots in each of three habitat types: native limestone forest, secondary forest, and tangantangan forest. The density of

Tinian Monarchs was four to five times higher in native limestone forest than in tangantangan and secondary forest habitats. This preference of the monarchs for native forest habitat was also borne out by sizes of the home ranges. The average home range size in the tangantangan forest was only 1.2 times as great as that in the secondary forest, but the average home range size in the native limestone forest was four to five times smaller than in the two non-native forest habitats. This indicates that monarchs may have to travel four to five times as far, and expend a greater amount of energy, to obtain the equivalent amount of food resources in the more xeric environments than in the preferred native forest. Further, compared to the secondary and tangantangan forest habitats, the limestone forest habitat had an extremely extended (nearly year-round) nesting season, and a much higher nest success rate (U.S. Fish and Wildlife Service 1996).

There are more Tinian Monarchs in the 5% of Tinian that is native limestone forest than there are in the 19% that is secondary forest, and almost as many as in the 38% that is tangantangan. The native forest likely outproduces the other two habitats, potentially acting as a population reservoir, with the two disturbed forest habitats potentially functioning as population sinks. But, the native forest is discontinuous and limited in extent to patches at cliff lines and escarpments around the Kastiyo, Piña and Carolinas plateaus on the southeast side of Tinian, and a narrow corridor on the escarpment that connects Mt. Lasso with Maga in the center part of the island (U.S. Fish and Wildlife Service 1996). During bird surveys conducted in February 2000 in the proposed Tinian Conservation Area on the southeast side of the island, Cruz et al. (2000a) did not find monarchs as abundant as expected in the native limestone forest. Densities could not be estimated due to small sample size; an average of 0.6 monarchs per station was detected. Insufficient data are available to verify if monarch densities are declining. However, the perceived decline in monarch densities may be explained by a possible degradation in native forest habitat quality occurring over time.

## Problems which adversely affect the Tinian Monarch and its habitats

Threats which adversely affect the Tinian Monarch and its habitats include potential habitat degradation and the probable infestation of Tinian by the Brown Treesnake.

### Potential habitat degradation

The Tinian Monarch has exhibited the ability to adapt to disturbed, non-native habitats, as evidenced by the increase in island-wide estimates from 39,338 birds in 1982 to 55,721 birds in 1996. While Tinian Monarchs can forage and reproduce in secondary and tangantangan forests, the superior value of the remnant native limestone forest habitat is quite evident. Native forest comprises less than five percent of the island's cover. If these discontinuous pockets of prime monarch habitat were to disappear, so would the breeding population reservoir.

A variety of causes could result in removal or degradation of Tinian Monarch habitat:

- Typhoons. Tangantangan forests are usually completely defoliated during typhoons, resulting in the loss of nesting and foraging habitat for at least six weeks (U.S. Fish and Wildlife Service 1996). Presumably, large numbers of birds are also killed during severe typhoons.

- Agriculture. Although commercial cattle raising has decreased since the 1980s and the CNMI economy has taken a downturn since the mid-1990s, Tinian is blessed with 46% of the CNMI's prime farmland; therefore, habitat clearing for agricultural and grazing uses could certainly increase in the future (U.S. Fish and Wildlife Service 1996).
- Military exercises. The northern two-thirds of the island are leased to the military for training exercises. Now that the Tinian Monarch has been removed from the endangered species list, impacts on the species due to military activities will be unregulated and generally permitted by the U.S. Fish and Wildlife Service.
- Homesteads. If the southeastern part of the island containing pockets of native forest is not otherwise protected, it may be included in future homestead developments, for agricultural or residential use. Public Law 14-19 was passed on July 13, 2004 (Fourteenth Northern Marianas Commonwealth Legislature, First Regular Session, 2004). This new law dictates, in Section 2: "Such areas of public land on the island of Tinian as may be suitable for village and/or agricultural homesteads, specifically the Kastiyo and Carolinas areas, and which are not required for government use or other purposes by any other provision of law, is hereby designated on behalf of the people of Tinian who are of Northern Marianas descent and reserved for village and/or agricultural homestead purposes." It is not clear whether the lands designated for homesteads under this new law encompass the native limestone forest areas.

Infestation of the island of Tinian by the Brown Treesnake.
The Brown Treesnake (*Boiga irregularis*) has decimated avian populations on the island of Guam. Birds of small body size are particularly vulnerable to predation, with the smallest species disappearing more rapidly, presumably because the snakes take the adults, eggs, and nestlings (Wiles et al. 2003). If the Brown Treesnake becomes established on the island of Tinian, it is very likely that the Tinian Monarch would be driven to extinction, along with most other passerine bird populations.

The U.S. Fish and Wildlife Service (1996) reported that there had been no confirmed sightings of Brown Treesnakes on Tinian. Hawley (2005), however, reports that 9 snakes have been sighted on Tinian since 1982, although no captures have been made. Boat and airplane traffic bringing in cargo, including construction materials where snakes can easily hide, comprise a continued risk of snake infestation.

In its proposal to de-list the Tinian Monarch, the U.S. Fish and Wildlife Service stated in 2004, "While there have been reports of possible brown tree snakes on Tinian, the brown tree snake is not known to be established on Tinian, and the monarch is not known to be affected by brown tree snake predation" (U.S. Fish and Wildlife 2004c). The CNMI Division of Fish and Wildlife does not agree with this assessment that the risk to the Tinian Monarch of elimination by Brown Treesnakes is low. Clearly, with nine potential sightings of the snakes on Tinian, with continued cargo traffic, and with the island's close proximity to Guam, the establishment of a predatory snake population on Tinian is only a matter of time. On Guam, the snake caused the extirpation of the Guam Flycatcher, Rufous Fantail and Bridled White-eye, insectivorous forest birds of the same size as the Tinian Monarch (Wiles et al. 2003). An infestation of Brown Treesnakes on Tinian would eliminate the Tinian Monarch (Hawley 2005).

**Priority research and survey efforts needed for improved conservation of the Tinian Monarch and its habitats**

Forest habitat surveys

The prime habitat for the Tinian Monarch, the native limestone forest, covers less than 5% of the island on Tinian. This estimate was based on data taken in the early 1980s, and is now outdated. Cattle grazing pressure on the tangantangan forests has decreased since the 1980s but the effect on vegetation density has not been quantified. The current condition and extent of native, secondary and tangantangan forest habitats on Tinian is unknown. Survey efforts related to these habitats are discussed in Chapter 4.

**Conservation actions**

Conservation actions to conserve the Tinian Monarch and its habitats are listed as follows. Detailed descriptions and priority rankings of these actions are given in Chapter 6.

| |
|---|
| Conserve remnant native limestone forest on Tinian by establishing a conservation area |
| Interdiction of the Brown Treesnake (*Boiga irregularis*) |
| Translocation of native forest birds from the southern islands to the northern islands and establishment of a captive breeding program |
| Prevent the introduction of West Nile Virus to the Mariana Islands |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on the southern islands through avoidance and mitigation conditions placed on land development proposals |
| Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Reforest disturbed areas with native tree species on the southern islands |

**Monitoring**

The Draft Post-delisting Monitoring Plan for the Tinian Monarch (U.S. Fish and Wildlife Service 2004e) proposes monitoring of the Tinian Monarch, the Brown Treesnake, and land use on Tinian. The Tinian Monarch would be monitored by roadside point count surveys, small-scale "early warning system" plots, large-scale variable circular plot surveys (using the same transects as Engbring et al. 1986), and a recommended habitat-specific demographic study. A trained field crew and detector dog teams would be used to monitor Brown Treesnakes. Interdiction of snakes would be accomplished through construction of a containment barrier, and financial support from the U.S. Department of

Defense, U.S. Office of Insular Affairs, U.S. Department of Transportation and the CNMI government. Land use monitoring would involve tracking impacts of projects on forest habitat through National Environmental Policy Act reviews and cooperation with the military through its Integrated Natural Resources Management Plan (INRMP). Successful monitoring depends on cooperation between multiple governmental and non-governmental entities, including not only the U.S. Fish and Wildlife Service and the CNMI Division of Fish and Wildlife, but also the U.S. Navy, the U.S. Geological Survey Biological Resources Division, among others.

# WHITE-THROATED GROUND DOVE

Figure 46. Male White-throated Ground Dove.
Photo credit: Scott Vogt.

**Common Name**
White-throated Ground Dove

**Scientific Name**
*Gallicolumba xanthonura*

**Chamorro Name**
Paluman apaka for the male (named for white foreparts);
Paluman fachi for the female ("fachi" means mud, for the mud color)

**Carolinian Name**
Apooka

**Listing Status**
The White-throated Ground Dove is not listed as threatened or endangered, either federally or locally. It is locally protected from hunting by regulation (CNMI 2000).

**Reasons for selecting the White-throated Ground Dove as a species of special conservation need**
The White-throated Ground Dove is limited in its distribution, and is endemic to the Mariana Islands and Yap (Pratt et al. 1987). Because it is not federally listed as endangered or threatened, ESA funding under Section 6 cannot be used for research on this species. The White-throated Ground Dove is easily preyed upon.

Figure 47. Female White-throated Ground Dove.
Photo credit: Scott Vogt.

**Unique characteristics**
Male White-throated Ground Doves have white heads and throats with dark brown bodies and wings. (See Figure 46.) Females are completely covered with chocolate brown feathers. (See Figure 47.) Unlike other ground doves that forage mainly on the ground, the White-throated Ground Dove forages mainly in trees and feeds on native fruits, seeds and flowers. It characteristically flies high over forests, in a slow, labored fashion, with the upper body held at an angle. White-throated Ground Doves are usually in pairs, although the male is more easily seen when in the open (Pratt et al. 1987; CNMI Division of Fish and Wildlife n.d.).

## Distribution of the White-throated Ground Dove in the CNMI

The White-throated Ground Dove inhabits all of the Mariana Islands from Rota north to Asuncion, but is absent from Maug and Uracas (Villagomez 1988). Along with the Micronesian Megapode, the White-throated Ground Dove is the only other forest bird among the species of special conservation need that occurs on both the southern islands and the northern islands. The Guam subspecies (*Gallicolumba x. xanthonura*) disappeared from Guam in 1986 (Wiles et al. 2003) and was extirpated by the Brown Treesnake (*Boiga irregularis*) (Savidge 1987).

## Abundance of the White-throated Ground Dove in the CNMI

Characterizations of abundance of the White-throated Ground Dove on the various islands of the archipelago include "extremely rare", "rare", "uncommon" and "at densities lower than expected". Abundance estimation for White-throated Ground Doves using the variable circular plot method may result in underestimation, because this species rarely vocalizes and is difficult to detect (Engbring et al. 1986; Fancy et al. 1999a). Details on abundance from the most recent literature follow, by island.

### Rota

In 1982, Engbring et al. (1986) found White-throated Ground Doves to be more abundant on Rota than on Aguiguan, Tinian or Saipan, probably due to the higher quality and quantity of forested habitat found on Rota. They estimated a total of 2,417 birds for Rota, at a density of 0.33 birds/ha. No more recent data is available to indicate if ground dove populations have changed in the intervening 23 years. Road-side breeding bird surveys taken in 2000, 2001 and 2002 indicate a slight drop in abundance on Rota over that period (Williams et al. 2003a).

### Aguiguan

In 1982, Engbring et al. (1986) found White-throated Ground Doves on Aguiguan to be at lower densities than expected; probable causative factors were forest composition, feral goats, or hunting. They estimated a total of 34 birds for Aguiguan, at a density of 0.09 birds/ha. The most recent estimates at Aguiguan are for 146 total birds at a density of 0.5 birds/ha in 2002 (Cruz et al. 2003d), for a four-fold increase in 20 years.

### Tinian

In 1982, Engbring et al. (1986) found White-throated Ground Doves at slightly higher densities on Tinian than on Saipan, but at only one-eighth the density of Rota's ground doves. They estimated a total of 413 birds for Tinian, at a density of 0.04 birds/ha. No island-wide estimates of abundance or density for White-throated Ground Doves have been calculated since 1982. In 2000, Cruz et al. (2000a) conducted bird surveys in the proposed Tinian Conservation Area on the southern end of Tinian, an area containing a variety of forested habitats. They found White-throated Ground Doves to be uncommon and calculated a density of 0.05 birds/ha within their study area.

### Saipan

In 1982, White-throated Ground Doves were found at the lowest density on Saipan compared to the other three islands studied by Engbring et al. (1986). They estimated a total of 254 birds for Saipan, at a density of 0.02 birds/ha. Island-wide estimates of abundance and density have not been calculated since 1982. However, recent surveys made in three conservation areas on Saipan have yielded the following density estimates:

- Saipan Upland Mitigation Bank, in Marpi – Densities ranged from 0.5 to 1.4 birds/ha in bi-annual surveys conducted from 1999 to 2003 (Cruz and Williams 2003).
- Bird Island Conservation Area – During bird surveys conducted in 2002 – 2003, density calculations could not be made for the White-throated Ground Dove, because the sample size was too small (Cruz et al. 2003b).
- Kagman Conservation Area – A density estimate of 0.28 birds/ha was made in 2001 (Cruz et al. 2003c).

Road-side breeding bird surveys between 1991 and 2002 indicate a steadily increasing trend in White-throated Ground Dove numbers on Saipan (Williams et al. 2003a).

Farallon de Medinilla
DFW has no estimates of the abundance of White-throated Ground Doves on FDM. The island is under continuous, periodic bombardment by the military for military exercises, so it is unlikely that abundance of this species would be very high.

Anatahan
Cruz et al. (2003a) estimated a total of 273 White-throated Ground Doves at Anatahan in 2002, at a density of 0.26 birds/ha. They found the White-throated Ground Dove to be the least abundant forest bird species on the island. Since this survey was conducted, the volcano at Anatahan erupted starting in May 2003, and continues to erupt today, spreading ash over most of the island. It is not clear what the status of the White-throated Ground Dove is on Anatahan at the present time.

Sarigan
Fancy et al. (1999a) only detected one White-throated Ground Dove in 1990 and one in 1997 during bird surveys on Sarigan. They stated that this species is difficult to census because it rarely vocalizes and is secretive. They were unable to estimate a population size for the species because of the small sample size and its secretive habits. In 2000, Cruz et al. (2000e) detected three White-throated Ground Doves on their bird survey transects, and found this species to be extremely rare. Predation by cats was noted. A density of 0.15 birds/ha was calculated in coconut forest only; none were found in native forest or in non-forested areas. An island-wide estimate could not be made due to small sample size.

Guguan
Cruz et al. (2000c) found the White-throated Ground Dove to be rare on Guguan in 2000. They calculated an island-wide total of 54 birds. The Micronesian Megapode, an endangered species, was estimated to be more than five times more abundant on Guguan during the same survey.

Alamagan

Cruz et al. (2000d) characterized the White-throated Ground Dove as uncommon, but still detected in all habitats on Alamagan in 2000. They made an island-wide estimate of 83 pairs of ground doves.

Pagan

Pagan was surveyed for bird abundance twice, in 1999 and 2000. In both years, White-throated Ground Doves were rare (Cruz et al. 2000g). An island-wide estimate was made at 379 birds in 2000 (*ibid.*).

Agrihan

In 2000, White-throated Ground Doves were not common, but were detected in all forest types (Cruz et al. 2000h). An estimated total of 377 ground doves was calculated (*ibid.*).

Asuncion

DFW has no recent data concerning the abundance of White-throated Ground Doves on Asuncion. A field trip to assess wildlife and vegetation on Asuncion is planned for 2007.

**Location and relative condition of key habitats for the White-throated Ground Dove in the CNMI**

The White-throated Ground Dove occurs in all forested habitats, and at forest edges. On the southern islands, ground doves prefer native forest or secondary forest over tangantangan forest (Engbring et al. 1986). On Saipan, they occur in native forest, secondary forest, agricultural forest, tangantangan forest, and habitat mosaics that include fields (Craig 1996). In the northern islands, ground doves were found in all habitat types, but at higher densities in native forest (Cruz et al. 2000c, 2000d, 2000e, 2000f, 2000g, 2003a). They prefer to feed on the fruits, seeds and flowers of native plants, including: *Melanolepsis multiglandulosa*, *Premna obtusifolia*, *Artocarpus mariannensis*, *Passiflora foetida*, *Planchonella obovata*, *Polyscias grandifolia*, *Macaranga thompsonii*, *Freycinetia reineckei* (Villagomez 1988; Craig 1996). They have been observed feeding on papaya (*Carica papaya*), an introduced plant (Engbring et al. 1986). They have been observed on road edges and in bare, open fields, searching on the ground for seeds (*ibid.*).

Locations and conditions of key habitats for the White-throated Ground Dove – native forest, secondary forest, and agricultural forest – are presented in Chapter 4.

**Problems which adversely affect the White-throated Ground Dove and its habitats**

Predation by the Brown Treesnake

The Guam subspecies of the White-throated Ground Dove was extirpated from Guam by the Brown Treesnake (Wiles et al. 2003). All indications are that the Brown Treesnake has established an incipient population on Saipan (Colvin et al. 2005), putting the White-throated Ground Dove under threat of extirpation in the southern islands. The White-throated Ground Dove is being considered for captive breeding in response to the BTS threat (Roberts 2005).

Other predators

The White-throated Ground Dove is easy prey to other predators, including rats, cats, monitor lizards and predatory birds. This species is susceptible to extinction by the introduction of other predators because of its limited distribution (CNMI Division of Fish and Wildlife n.d.)

Degradation and loss of forested habitat

The White-throated Ground Dove requires forested habitats, and shows a preference for native forest. The extent of native forest has been drastically reduced since before World War II on the southern islands. The secondary forest that has taken its place on Saipan and Tinian is predominantly tangantangan, a habitat not preferred by this species. Forests on the islands of Aguiguan, Anatahan, Sarigan, Pagan, Alamagan and Agrihan have been degraded by feral animals.

Hunting

Until recently, the White-throated Ground Dove was hunted as a game bird (Villagomez 1988). This species is now locally protected from hunting by regulation (CNMI 2000). It is not known if protection from hunting has resulted in changes in ground dove populations in the southern islands, or if poaching may yet occur.

**Priority research and survey efforts**

Life history study

Life history studies of the White-throated Ground Dove are limited. Villagomez (1988) observed calling, feeding, nest characteristics, flocking behavior and breeding seasonality. Craig (1996) compared surveying techniques and studied food and habitat preferences on Saipan. This species of ground dove differs in its foraging habits from other Gallicolumbid species. More thorough life history studies are needed if a successful captive breeding program is to be instituted.

**Conservation actions**

The White-throated Ground Dove would benefit from the following conservation actions. Descriptions and priority rankings for these conservation actions are given in Chapter 6.

| |
|---|
| Conserve habitat for endangered bird species on Rota through an island-wide habitat conservation plan |
| Decrease deer numbers on the Sabana of Rota |
| Cull goats from the island of Aguiguan |
| Eradicate rats, cats and other predators from Aguiguan Island |
| Conserve remnant native limestone forest on Tinian by establishing a conservation area |
| Eradicate scarlet gourd (*Coccinia grandis*) from Saipan |
| Interdiction of the Brown Treesnake (*Boiga irregularis*) |
| Translocation of native forest birds from the southern islands to the northern islands and establishment of a captive breeding program |

| |
|---|
| Prevent the introduction of West Nile Virus to the Mariana Islands |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition |
| Improve management of terrestrial conservation areas in the southern islands |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Reforest disturbed areas with native tree species on the southern islands |
| Assess the suitability of Sarigan Island to receive translocated birds and monitor forest succession and wildlife population trends on Sarigan following the eradication of feral ungulates |
| Establish a fenced nature reserve on the southern peninsula of Pagan |
| Remove feral ungulates from the northern islands of Anatahan, Alamagan, Pagan and Agrihan |
| Prevent the introduction of invasive species to the northern islands |

**Monitoring**

Trends in White-throated Ground Dove populations are monitored on a regular basis through the quarterly breeding bird surveys conducted on Rota and Saipan. In addition, forest bird surveys are conducted twice yearly along permanent transects in the Saipan Upland Mitigation Bank. Breeding bird surveys are conducted on Tinian more erratically, depending on staff availability. Surveys on Aguiguan are not regularly accomplished, due to difficulty of access to this small island and attention paid to projects of higher priority, but a field trip to Aguiguan to survey all wildlife populations is being planned in the next one to five years. Similarly, field trips to the northern islands to monitor White-throated Ground Dove and other wildlife populations are expensive to undertake, and will only occur as funding allows. A trip to Sarigan to monitor wildlife populations and vegetation succession following feral animal removal is scheduled for 2006.

# MARIANA COMMON MOORHEN

**Common Name**
Mariana Common Moorhen.
Also, Mariana Gallinule.

**Scientific Name**
*Gallinula chloropus guami*

**Chamorro Name**
Pulattat

**Carolinian Name**
Gherel Bweel

Figure 48. Mariana Common Moorhen.
Photo credit: Tim Sutterfield.

**Listing Status**
The Mariana Common Moorhen was federally listed as Endangered on August 1, 1984 (U.S. Fish and Wildlife Service 1984). A recovery plan was prepared (U.S. Fish and Wildlife Service 1991a). It is locally designated as an endangered and threatened species, and is protected from hunting by regulation (CNMI 2000).

**Reasons for selecting the Mariana Common Moorhen as a species of special conservation need**
This endemic subspecies of the common moorhen occurs only on three islands, Saipan, Tinian and Guam, with a possible colonization in an artificial wetland on Rota. Numbers have decreased, and wetland habitat is limited.

**Unique characteristics**
Moorhens are freshwater birds, duck-like in appearance, but without webbed feet. They are black with distinct red beaks and shields on their foreheads. Their feet have long toes and lobes, which facilitates walking across plants in the water (CNMI Div. of Fish and Wildlife n.d.). (See Figure 48.)

**Distribution of the Mariana Common Moorhen in the CNMI**
Moorhens were formerly widely distributed in the wetland habitats of Guam, Tinian, Saipan and Pagan (U.S. Fish and Wildlife Service 1984). Moorhens were extirpated from Pagan in 1981, due to destruction of wetland habitat by volcanic ash deposition, feral ungulates and introduced fish. Moorhens occurred prehistorically on Rota, and were extirpated before historic time; a very few moorhens have started to recolonize an artificial wetland on Rota since 1995 (Worthington 1998).

**Abundance of the Mariana Common Moorhen in the CNMI**
Stinson et al. (1991) estimated a decline in the total population of this subspecies of from 36% to 52% in the 20th century. Worthington (1998) estimated between 300 and 400 moorhens remaining in the Mariana Islands, including Guam, in the mid-1990s. Based on island-wide surveys conducted May through September 2001, Takano (2003)

estimated the total adult moorhen population to be 287: 90 on Guam, 154 on Saipan, 41 on Tinian and 2 on Rota. Williams et al. (2003a) consistently detected an average of 70 moorhens in those wetlands where surveys were conducted on Saipan for the years 2000, 2001, and 2002. An island-wide population estimate for Saipan is difficult to make, because much of the wetland habitat is inaccessible for surveying, and because moorhens are secretive and therefore may not be detected (S. Kremer and L. Williams, pers. comm., September 2005).

**Location and relative condition of key habitats for the Mariana Common Moorhen in the CNMI**

Common Mariana Moorhens prefer sites that support diverse emergent vegetation, contain both deep and shallow areas, and have equal portions of cover and open water (Stinson et al. 1991). Moorhens are wary, and require the cover afforded by edge vegetation (U.S. Fish and Wildlife Service 1991a). Moorhens will utilize man-made habitats, including artificial wetlands, waste water ponds, water hazards on golf courses, and an abandoned WWII-era concrete oil tank now filled with rainwater (Worthington 1998; Williams et al. 2003a).

Wetlands with consistent water levels and an even mix of open water and emergent vegetation support the highest number of moorhens. On Saipan, these include ponds at Kingfisher Golf Course, the Japanese Water Tank, Dan Dan Driving Range, Flores Pond and the Price Costco Mitigation Wetlands (Williams et al. 2003a); on Tinian, Lake Hagoi (Vogt 2005a). Moorhens move between islands, probably in response to seasonal fluctuations in water levels of more ephemeral wetlands (Worthington 1998; Vogt 2005a; Takano 2003). Wetland conditions have supported relatively stable population levels of moorhens in recent years (Williams et al. 2003a; Vogt 2005a).

**Problems which adversely affect the Mariana Common Moorhen and its habitats**

Loss of wetland habitats

The continuing disappearance of suitable wetland habitat is a serious threat to the continued existence of the moorhen. Wetland habitat has been significantly reduced in extent in the Mariana Islands for many reasons. Drainage of wetlands occurred to make way for commercial or residential development (U.S. Fish and Wildlife Service 1991a). Ground water pumping has resulted in the lowering of water levels in wetlands so as to make them unsuitable for moorhens to use; an example is Makpo Swamp in southern Tinian, which is now dry (Helber Hastert & Fee 2003). Some wetlands have been encroached by aggressive plant species such as *Phragmites karka*, which leaves no open water for moorhens to use. Some agricultural practices which relied on wetlands, such as taro and rice farming, have been abandoned, resulting in further wetland loss (U.S. Fish and Wildlife Service 1991a).

Predation by monitor lizards

A sharp decrease in the numbers of moorhen nests and eggs at Lake Hagoi on Tinian in 2003 and 2004 is a cause for great concern. Monitor lizards, abundant on Tinian, have been observed swimming at Lake Hagoi. Predation of moorhen nests by monitor lizards is known to occur, but the extent of the predation is not documented (Vogt 2005b).

Predation by Brown Treesnakes, rats, feral cats and feral dogs

On Guam, Brown Treesnakes appear not to have adversely affected moorhen populations, probably because moorhens occupy a restricted habitat not used by snakes. However, quantitative documentation is lacking (Wiles et al. 2003). At Fena Reservoir on Guam, Takano (2003) observed eggs disappearing at night without any shell fragments left behind and two Brown Treesnakes were observed swimming at night; thus, even moorhen nests built on floating vegetation are not safe from snakes. Other potential predators include rats, feral cats and feral dogs, although the extent of such predation is unknown (U.S. Fish and Wildlife Service 1991a). Feral dogs and cats have been observed in wetland areas on Saipan (L. Williams, pers. comm., September 2005).

Illegal hunting

Moorhens have historically been used as food by the indigenous population, and poaching may occur at the current time, at undocumented levels (U.S. Fish and Wildlife Service 1991a). There is preliminary evidence to suggest that poaching of moorhens may be impacting the population. New trails have been observed between garment factories and Lake Susupe on Saipan, associated with unusually low densities of moorhens there (L. Williams, pers. comm., September 2005).

Disturbance to nesting by red eared slider turtles

Large numbers of red eared slider turtles (*Trachemys scripta elegans*) have been observed at wetlands in Saipan. These non-native turtles were probably pets that have been released by their former owners. They have become established at Lake Susupe and appear also in the Kagman ponds on Saipan. At one Kagman pond, where high numbers of turtles have been counted over several years, moorhens have disappeared. These turtles may be limiting moorhen populations by causing disturbance to nesting. (L. Williams, pers. comm., September 2005).

## Priority research and survey efforts

Cause of decreased nest and egg numbers at Lake Hagoi on Tinian

The causes for the recent dramatic decline in moorhen nest and egg counts at Lake Hagoi on Tinian should be determined. Appropriate management actions to reverse the decline should be designed.

Develop survey protocol to estimate moorhen populations

It has been difficult to census moorhen populations on Saipan, because many of the wetlands are inaccessible, and moorhens, being wary and secretive, are difficult to detect. A survey protocol that more accurately estimates population should be developed and initiated.

## Conservation actions

Conservation of the Mariana Common Moorhen can be accomplished by taking the following conservation actions. Descriptions and priority rankings for these actions are presented in Chapter 6.

| |
|---|
| Take appropriate management action to reverse the decline in numbers of moorhen eggs and nests at Lake Hagoi on Tinian |
| Conserve habitat for endangered bird species on Rota through an island-wide habitat conservation plan |
| Interdiction of the Brown Treesnake (*Boiga irregularis*) |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on the southern islands through avoidance and mitigation conditions placed on land development proposals |
| Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition |
| Develop island-wide habitat conservation plans for all islands in the archipelago |

**Monitoring**

Moorhen populations on Saipan are monitored through the monthly shorebird, wading bird and waterbird surveys conducted by DFW. This monitoring program, however, is not a population census, as it does not cover all of the wetland habitats on Saipan, nor does it employ a method by which to estimate the total population. Moorhen populations at Lake Hagoi on Tinian are monitored monthly by the U.S. Navy.

# MASKED BOOBY

**Common Name**
Masked Booby

**Scientific Name**
*Sula dactylatra*

**Chamorro Name**
La'ao

**Carolinian Name**
Amwo

Figure 49. Masked Booby.
Photo credit: Tim Sutterfield.

**Listing Status**
The Masked Booby is protected from hunting by regulation (CNMI 2000). It is not listed as threatened or endangered, either locally or federally. It is protected by the Migratory Bird Treaty Act of 1918.

**Reasons for selecting the Masked Booby as a species of special conservation need**
The largest known nesting site in the CNMI for Masked Boobies is at Farallon de Medinilla. FDM is used by the US Navy for military exercises, including bombing and live fire. The effects of military exercises (including vegetation removal) on nesting success are unknown. Nesting colonies have been reported in the past at other islands in the archipelago, but further research is needed to determine current population status of this species.

**Unique characteristics**
Masked Boobies are pelagic seabirds, foraging offshore of islands where they breed, but also found far out at sea. They tend to nest on open ground, often near a cliff edge or on low sandy beaches or rocky ground. Two eggs are laid but broods are typically reduced to one chick by siblicide. Sexual maturity begins around 3 to 4 years and most birds return to their natal colony to breed (U.S. Fish and Wildlife Service 2005c). (See Figure 49.)

**Distribution of the Masked Booby in the CNMI**
Reichel (1991) reported breeding colonies of Masked Boobies on the islands of Uracas, Maug and FDM, with one breeding pair reported from Guguan and breeding suspected at Anatahan. Cruz et al. (2000c) observed one adult and one sub-adult on Guguan in 2000. DFW wildlife biologists believe that Masked Boobies may also nest at Naftan Rock, off the coast of Aguiguan (L. Williams, pers. comm., March 2004). Masked Boobies are vulnerable to human disturbance (U.S. Fish and Wildlife Service 2005c); it is interesting to note that they do not breed on islands inhabited by humans.

**Abundance of the Masked Booby in the CNMI**

Masked Boobies are pantropical in distribution, and are estimated to number at hundreds of thousands of birds (U.S. Fish and Wildlife Service 2005c). Based on the literature for surveys taken between 1979 and 1988, Reichel (1991) reported 351 breeding pairs on four islands in the CNMI: 50 pairs on Uracas, 250 on Maug, 1 on Guguan and 50 on FDM.

With the exception of Guguan and FDM, current population status in the Mariana Islands is unknown. In June 2000, Cruz et al. (2000c) found one adult and one juvenile Masked Booby on Guguan, at the top of the volcano. Lusk et al. (2000b) estimated 750 Masked Boobies on FDM in 1996. Vogt (2005c, 2005d) reports substantially lower numbers for FDM: he has made monthly helicopter counts of sitting Masked Boobies since 1999, and has observed average monthly numbers ranging from 100 to 300 individual birds, with peak numbers occurring during the summer months.

**Location and relative condition of key habitats for the Masked Booby in the CNMI**

Lusk et al. (2000b) mapped the locations of Masked Booby colonies at FDM in 1996. Nests and family groups are concentrated on cliffs, on bare hardpan soil along the eastern rim of the main body of the island, with some also being found on the southern tip. Limited documentation exists about Masked Booby habitat at FDM prior to its being used as a military bombing target, but it is apparent that tall trees have been removed and replaced by grasses and short, shrubby trees. FDM has been used by the military for over 40 years (S. Vogt, pers. comm., June 2005) and it is unlikely that the Masked Booby habitat condition has changed much in that time (Lusk et al. 2000b).

Two different accounts (Reichel 1991, Cruz et al. 2000c) report the presence of low numbers of Masked Boobies on Guguan. Although large Masked Booby colonies are not yet established on Guguan, this pristine island may serve for expansion of Masked Booby habitat in the future.

There is no recent, specific documentation of habitat location or condition for Masked Boobies on the other islands where there may still be colonies, including Maug and Uracas.

**Problems which adversely affect the Masked Booby and its habitats**

Military use of FDM

The continued use of FDM by the military for direct bombardment has almost certainly caused direct death to Masked Boobies, destruction of nests, and abandonment of the island by adults and fledged birds until bombing stops. Loss of eggs and chicks results, but Lusk et al. (2000b) suggests that most adults would likely survive, and return to re-nest. Vogt (pers. comm., June 2005) finds that seabirds on FDM persist at stable levels from year to year, in spite of the bombing, and have probably reached a steady state. If live fire and bombing exercises are increased in the future at FDM, it is likely that Masked Booby numbers will decline.

Permanent changes to vegetation
Bombardment by the military has resulted in a permanent change to the vegetation of FDM, from a closed canopy forest to barren areas, grasslands and scrubby trees. The effect of these changes on Masked Booby numbers is not known, but Lusk et al. (2000b) suggest that Masked Boobies may be more common due to a higher percentage of bare ground and open grasslands for nesting.

Nest predation
A number of small islets may support Masked Booby nesting habitat of barren ground on cliff faces. These include: Naftan Rock off of Aguiguan, and Bird Island and Forbidden Island off of Saipan. It is possible that rat numbers are so high on these islets that establishment of nesting colonies is prevented.

**Priority research and survey efforts**
Habitat suitability of islets
The cliffs and bare ground found on Bird Island and Forbidden Island off the coast of Saipan, as well as Naftan Rock off the coast of Aguiguan, may provide suitable nesting habitat for Masked Boobies. Research is needed to determine: if Masked Booby habitat is suitable; if Masked Boobies could be attracted to these islets to establish colonies; and if predators (including rats) prevent the establishment of colonies.

**Conservation actions**
Conservation of the Masked Booby in the CNMI could be furthered by taking the following conservation actions. Descriptions and priority rankings for these conservation actions are given in Chapter 6.

| |
|---|
| Continue to monitor seabird populations on FDM |
| Establish a seabird recovery colony on Saipan |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Eradicate rats and other predators on islets |
| Prevent the introduction of invasive species to the northern islands |

**Monitoring**
Seabird populations are monitored on a monthly basis at FDM by helicopter surveys. The ordnance load at FDM makes it unsafe to conduct ground surveys; this is not likely to ever change. Continued monitoring is subject to funding priorities of the U.S. Navy.

Monitoring of Masked Booby populations on the remote islands of Maug and Guguan will occur rarely, due to the high cost of mounting an expedition.

# WEDGE-TAILED SHEARWATER

**Common Name**
Wedge-tailed Shearwater

**Scientific Name**
*Puffinus pacificus*

**Chamorro Name**
Lifa'ru

**Carolinian Name**
Lifo'ro

Figure 50. Juvenile Wedge-tailed Shearwater.
Photo credit: Shelly Kremer

**Listing Status**
The Wedge-tailed Shearwater is not listed as threatened or endangered, either locally or federally. It is not listed in DFW's regulations as a protected species, however, taking of its eggs is prohibited (CNMI 2000). It is protected by the Migratory Bird Treaty Act of 1918.

**Reasons for selecting the Wedge-tailed Shearwater as a species of special conservation need**
Based on current knowledge, the Wedge-tailed Shearwater nests only on Mañagaha Island. More research is needed to determine if this species nests on other islands within the archipelago.

**Unique characteristics**
Shearwaters are pelagic birds, foraging at sea. They come ashore to breed in April and May at Mañagaha Island. Shearwaters are ground nesters, and dig out a burrow in soft substrate, laying a single egg each nesting season. Parents leave the chicks during the day to forage. It takes up to six months from the time an egg is laid, and a shearwater chick is fledged (Kremer 2005c). (See Figure 50.)

**Distribution of the Wedge-tailed Shearwater in the CNMI**
Wedge-tailed Shearwaters are widespread throughout the tropical and subtropical Indian and Pacific Oceans (U.S. Fish and Wildlife Service 2005c). In the U.S. Pacific Islands, most birds breed in the Hawaiian Islands with smaller colonies on Johnston Atoll and in the Mariana Islands (*ibid*.).

The location of all Wedge-tailed Shearwater colonies within the CNMI is not known. Engbring et al. (1986) observed a small colony of Wedge-tailed Shearwaters at Naftan Rock in 1982. However, in 1985, no nests were found on Naftan Rock, and chewed, disarticulated skeletons of seabirds were found in burrows; rats (*Rattus exulans*) were suspected to be the cause for the deaths (Reichel 1991). A few nests of Wedge-tailed Shearwaters were found on Saipan near Bird Island in the early 1980s (*ibid.*), but it is not known if shearwaters still nest at Bird Island today. During DFW expeditions to the northern islands in 2000, shearwaters were observed in flight at Sarigan, Guguan, Pagan and Agrihan (Cruz et al. 2000e, 2000c, 2000g, 2000h), although it is not known if they nest on these islands. With the high concentration of shearwaters off shore of the northern islands, it is likely that they breed on some of them, including at Agrihan, Asuncion and Maug (Reichel 1991).

A nesting colony of Wedge-tailed Shearwaters was discovered at Mañagaha Island off of Saipan in 2001. This is currently the only known nesting site for Wedge-tailed Shearwaters in the CNMI.

**Abundance of the Wedge-tailed Shearwater in the CNMI**

No surveys measuring the abundance of Wedge-tailed Shearwaters throughout the CNMI have been made. Nesting success of the newly-discovered colony at Mañagaha Island is monitored throughout each nesting season by DFW and volunteers; trends in abundance have not yet been determined. The U.S. Fish and Wildlife Service (2005c) estimates that less than 2,000 pairs breed on the U.S. Pacific islands outside of Hawaii, and that the global population of this species is far below historical levels.

**Location and relative condition of key habitats for the Wedge-tailed Shearwater in the CNMI**

Wedge-tailed Shearwaters forage at sea and nest on land. Nesting habitat is typically flat ground, plateaus, slopes or cliff tops (U.S. Fish and Wildlife Service 2005c). At Mañagaha Island, shearwaters dig burrows in sandy soil, at the base of shrubs and trees, and in the grass. Mañagaha Island is only 4 ha in size, and shearwaters use a small fraction of the land for nesting. (See Figure 52.) Habitat condition is difficult to ascertain; factors limiting the number of nests that this small area can support are unknown (S. Kremer, pers. comm. August 2005).

Figure 51. The islet of Mañagaha.
Photo credit: Shelly Kremer

Figure 52. Old trail through shearwater nesting habitat has been closed off and revegetated.
Photo credit: Shelly Kremer

**Problems which adversely affect the Wedge-tailed Shearwater and its habitats**

Nest predation

Introduced predators are the greatest threat to shearwaters in the U.S. Pacific Islands (U.S. Fish and Wildlife Service 2005c). Rats were implicated in the death of shearwaters and lack of nesting at Naftan Rock in the 1980s (Reichel 1991). At Mañagaha, young downy chicks incapable of flight are vulnerable to predation by cats (*Felis cattus*) and rats (*Rattus spp.*). Eradication of cats and reduction in rat numbers at Mañagaha in 2003 and 2004 has resulted in a very successful 2004 nesting season (Kremer 2005c).

Once Brown Treesnakes become established on Saipan, it is likely that they could also invade Mañagaha Island posing a predation threat to any ground-nesting bird species, such as the Wedge-tailed Shearwater.

<u>Human disturbance at nesting sites</u>

Mañagaha Island receives from 500 to 800 visitors each day of the year (Schroer 2005a). Although most of these visitors frequent the southwestern side of the island dedicated to water sports, many walk around the island on a developed, sandy trail. This trail bisected the shearwater nesting habitat on the western side of the island. In 2003 and 2004, the trail was re-routed around the nesting area and the old trail was re-vegetated to prevent trampling of burrows by people (Figure 51).

<u>Shoreline erosion</u>

As a result of the removal of two partly submerged World War II wrecks in 1995, the beach on the eastern side of Mañagaha Island lost more than 100 feet of sandy shoreline (U.S. Army Corps of Engineers 2001). (See Figure 53.) This soil erosion is encroaching on shearwater nesting sites (Kremer 2005c). The rate of erosion is being monitored by the CNMI Coastal Resources Management Office. Preliminary analysis indicates that the rate of erosion has declined since 2001 and that the shoreline may be stabilizing (Schroer 2005a).

Figure 53. Erosion of east shoreline of Mañagaha Island, 2003.
Photo credit: Shelly Kremer

**<u>Priority research and survey efforts</u>**

<u>Survey of nesting success at Mañagaha Island</u>

Baseline surveys of the nesting population of shearwaters at Mañagaha Island were performed in 2003, 2004 and 2005. (See Figure 54.) Both adults and chicks were banded. A high priority is to conduct surveys at Mañagaha Island each nesting season to determine: number of banded birds returning to breed and nest; nesting success in terms of trends in numbers of burrows where eggs and chicks are found; juvenile mortality rates; and vegetation characteristics of preferred burrowing habitat.

Figure 54. DFW Ornithologist Shelly Kremer holds a downy Wedge-tailed Shearwater chick at the nesting site at Mañagaha Island, August 2004.

Surveys to determine whether shearwaters nest at islets

There are past reports of shearwater nesting at Naftan Rock off the southwest coast of Aguiguan, and at Bird Island off the northeast coast of Saipan (Reichel 1991), but no recent surveys have been conducted to confirm if nesting still occurs on these islets. It is also not known if shearwaters nest at Forbidden Island off the southeast coast of Saipan. Surveys to determine the presence of shearwaters could be conducted during the nesting season (March through December) at these three islets, as time and funding allow.

Surveys to determine whether shearwaters nest in the northern islands

Wedge-tailed shearwaters have been sighted in flight at many of the northern islands of the CNMI, but it is not known if they have established nesting colonies on any of these islands. It is unlikely that surveys of any potential nesting sites in the northern islands can be carried out, because the prohibitive cost of transportation outweighs the benefit of any information gained. Unlike at Mañagaha, where human-induced causes have affected nesting success, there is almost no human impact on potential shearwater nesting habitat in the northern islands. Rats and feral animals are possibly impacting nesting on the northern islands.

**Conservation actions**

Conservation of the Wedge-tailed Shearwater in the CNMI could be accomplished through the following conservation actions. Descriptions and priority rankings for these conservation actions are given in Chapter 6.

| |
|---|
| Conserve nesting habitat for Wedge-tailed Shearwaters at Mañagaha Island |
| Improve management of terrestrial conservation areas in the southern islands |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Eradicate rats and other predators on islets |
| Prevent the introduction of invasive species to the northern islands |

**Monitoring**

During 2003 and 2004, several field trips during the nesting season were made by the DFW Ornithologist and volunteers to measure Wedge-tailed Shearwater nesting success after eradication of predators, by banding adults and chicks, counting numbers of active nest sites, observing chick development, and assessing juvenile mortality. DFW expects to continue monitoring for nest success and return of adult shearwaters in the future.

# MARIANA FRUIT BAT

**Common Name**
Mariana Fruit Bat

**Scientific Name**
*Pteropus mariannus mariannus*

**Chamorro Name**
Fanihi

**Carolinian Name**
Pai'scheei

Figure 55. Mariana Fruit Bat.
Photo credit: Merlin Tuttle.

**Listing Status**
The Mariana Fruit Bat was federally listed as Endangered only on the island of Guam on August 27, 1984 (U.S. Fish and Wildlife Service 1984). On January 6, 2005, the Mariana Fruit Bat was federally listed as Threatened throughout its entire range of Guam and the Northern Mariana Islands because the best available scientific information suggests that fruit bats comprise one subspecies throughout the entire Mariana archipelago (U.S. Fish and Wildlife Service 2005a). It is also locally listed as a threatened/endangered species in the CNMI (CNMI 2000).

**Reasons for selecting the Mariana Fruit Bat as a species of special conservation need**
This subspecies of fruit bat is endemic to the Mariana Islands. Although hunting for fruit bats is illegal, poaching is a known threat. Numbers of fruit bats have declined over the last few decades, especially in the populated southern islands. The Mariana Fruit Bat has only recently received federal ESA protection as a threatened species.

**Unique characteristics**
These primarily frugivorous, flying mammals roost in colonies of up to several hundred individuals. Adult Mariana fruit bats weigh about one pound, but have a wing span of up to three feet. The fur is black to brown in color, with gray hair interspersed, creating a grizzled appearance, with a golden mantle around the neck. (See Figure 55.) Because of their large ears and the canine appearance of the head, fruit bats are sometimes called flying foxes. They hang upside down from tree branches during the day, sleeping, grooming, breeding, scent-rubbing, marking and flying to other roosts. At dusk, they leave the roost to forage throughout the night, feeding on fruits, flowers, leaf stems and twig tips of native and introduced trees. They are important agents for seed dispersal and pollination in the native forest. Females give birth to one young at a time after a seven month gestation period, then nurse their young for at least three months. Young non-volant bats are carried by their mothers, but when they become too heavy, they are left at the roost while the adults depart for foraging. Mariana fruit bats depend on forest habitats, both for roosting and foraging (CNMI *n.d.*, U.S. Fish and Wildlife Service 2005a, U.S. Fish and Wildlife Service 2005b). Eating fruit bats is an important

Chamorro custom that dates back to pre-Hispanic times, as long as 2,500 years ago (Lemke 1992a).

**Distribution of the Mariana Fruit Bat in the CNMI**

The Mariana Fruit Bat has inhabited all of the islands in the Mariana archipelago from Guam to Maug (Wiles and Glass 1990). During one-day surveys in 1983 and 1984, Wiles et al. (1989b) found no fruit bats on Uracas, the northernmost island in the archipelago and found no suitable bat habitat there.

**Abundance of the Mariana Fruit Bat in the CNMI**

Historic abundance

Little information is available about the abundance of fruit bats in the Marianas before 1979, but bats may have historically numbered in the several thousands on Saipan and Tinian. Prior to European contact in 1521, Chamorro populations on individual islands may have reached up to 20,000 people. Even though fruit bats were hunted for food, primitive harvest methods and cultural restrictions probably buffered the effects of hunting (Stinson et al. 1992).

Current abundance

It has not been possible to obtain an accurate estimate of current fruit bat numbers in the CNMI, due to the logistical difficulty and high cost of conducting surveys in the remote northern islands and lack of standardized survey methods. Surveys taken in different years may not be comparable, because fruit bats migrate between islands, depending on food availability and in response to catastrophic events such as typhoons (Wiles and Johnson 2004, Wiles and Glass 1990). Clearly, however, fruit bat numbers have declined since historic times, especially on the populated southern islands.

Only two archipelago-wide surveys of fruit bats have been conducted. In 1983-84 (Wiles et al. 1989b) estimated 8,335 – 8,535 fruit bats in the Mariana Islands (not including Guam). In 2001, Johnson (2001) estimated 6,975 – 7,475 fruit bats in the CNMI. The methods used by these two surveys differ; therefore, the estimates may not be comparable (U.S. Fish and Wildlife Service 2005a). However, they represent the best scientific information available for monitoring the CNMI's fruit bat population.

Northern islands abundance

Cruz et al. (2000c-h) conducted evening dispersal counts at bat colonies and evening and morning station counts of solitary fruit bats during an expedition to six of the northern islands (Anatahan, Sarigan, Guguan, Alamagan, Pagan and Agrihan) during 2000. They estimated a total of 4,250 fruit bats, a reduction of 40% from the 7,025 fruit bats estimated in 1983 on these same six islands by Wiles et al. (1989b). On Anatahan, the third largest of the northern islands, Wiles et al. (1989b) estimated 3,000 bats, the largest bat population of any one island in the archipelago. Cruz et al. (2000f), however, estimated only 1,000 bats in 2000. Anatahan's volcano continues to erupt, covering more than half the island with ash, and it is not clear what effect this has had on the island's bat population (C. Kessler, pers. comm., June 2005).

Southern islands abundance

Fruit bats on the populated southern islands of Tinian, Aguiguan and Saipan are much less common now than in historic times. Wiles et al. (1989b) estimated less than 85 bats on these three islands in 1983, and Johnson (2001) estimated 75 bats in 2001. Rota's fruit bat population fluctuates, probably in response to typhoons, hunting at colonies and movement to other islands (Wiles and Glass 1990, U.S. Fish and Wildlife 2005a). Wiles et al. (1989b) estimated 800 – 1,000 fruit bats in 1983, and Johnson (2001) estimated 1,500 – 2,000 bats in 2001.

**Location and relative condition of key habitats for the Mariana Fruit Bat in the CNMI**

Fruit bats depend on native plants for food and native forest for roost sites. Nonnative plants make up a very small fraction of the resources used by bats (U.S. Fish and Wildlife Service 2005a). The location and condition of native forests in the CNMI is discussed in Chapter 4.

**Problems which adversely affect the Mariana Fruit Bat and its habitats**

Loss and degradation of native forest habitat

Habitat loss and degradation are a significant threat to fruit bats, because it deprives them of foraging and sheltering resources that they need for survival and reproduction. Native forest habitat on islands throughout the archipelago has undergone degradation and loss for many reasons. The effects of feral ungulates on Rota, Aguiguan, Tinian, Anatahan, Sarigan, Alamagan, Pagan and Agrihan, include preventing forest regeneration, promoting erosion and facilitating the establishment of invasive vines. Native forest has been converted by agricultural and other development on Rota, Tinian, Aguiguan and Saipan (U.S. Fish and Wildlife Service 2005a). Fruit bats have been observed at Farallon de Medinilla (Helber Hastert & Fee 2003), but continued use by the military for bombing precludes forest regeneration. Typhoons cause defoliation of trees, resulting in at least a temporary loss of food source for fruit bats (Wiles and Glass 1990).

Illegal hunting

Commercial hunting of fruit bats occurred from the 1960s through the late 1970s. From 1975 to 1981, approximately 15,800 fruit bats were shipped from Rota and Saipan to Guam for human consumption (Wiles and Payne 1986); this is about twice the number of fruit bats in existence in the CNMI today (U.S. Fish and Wildlife Service 2005a). In 1977, a moratorium banning the taking or capturing of fruit bats was passed, but enforcement was inadequate (Lemke 1992a). In 2000, DFW adopted regulations designating the Mariana Fruit Bat as a locally threatened and endangered species, which can not be harvested, captured, harassed or propagated except under special permit. Further, these regulations make it illegal to discharge a firearm within 500 meters of a known bat roosting site (CNMI 2000). In spite of these protections, poaching of fruit bats continues. Abuses of permits for special hunts have been noted (Lemke 1992a, U.S. Fish and Wildlife Service 2005a). Fruit bats are especially vulnerable to hunting following typhoons, because usual food sources are destroyed and bats will desperately forage near human habitations, (Lemke 1992b), even during daylight hours (Wiles and Glass 1990). A case in point is at the Liyo colony in Rota, where more than 1,000 bats were known to roost before a typhoon struck in December 2002. After the typhoon, bats foraged in municipal and agricultural areas, and an unknown number were taken by poaching (Esselstyn and Williams 2003). In spite of regrowth in vegetation and an apparent decrease in poaching (*ibid.*), there were no bats found during monthly counts at Liyo from August 2003 until January 2005 (unpublished DFW data). Because fruit bats are so highly valued culturally for food, enforcement of conservation laws and regulations banning their harvest poses a complex problem (Lemke 1992a).

Predation by Brown Treesnakes

The Brown Treesnake is thought to be responsible for the lack of recruitment at the single remaining fruit bat colony on the north end of Guam. Wiles (1987) made 33 monthly observations from 1982 to 1986 at the Ritidian Point colony on Guam and found that juvenile fruit bats were not surviving beyond an estimated age of one to two months. Snakes are capable of preying on non-volant young bats that are too large to be carried by their mothers and are left at the roosts at night (*ibid.*). In the CNMI, there have been 108 confirmed sightings and 13 captures of Brown Treesnakes since 1982 (Hawley 2005), and it is thought that an incipient BTS population has been established on the island of Saipan (Colvin et al. 2005). Brown Treesnakes, once established on the southern islands of Saipan, Tinian and Rota, will possibly prey on young fruit bats, potentially extirpating fruit bats from these islands.

**Priority research and survey efforts**

Fruit bat research design for Rota

Rota supports the largest fruit bat population in the southern islands. The causes for wide fluctuations in Rota's fruit bat population are not well understood. There is a need for a full-time biologist on Rota, with expertise on fruit bats, dedicated to Mariana Fruit Bat research: designing accurate survey methods, investigating migration and updating the research of life history that was initiated by biologists in the late 1980s and early 1990s.

Post-eruption fruit bat survey on Anatahan

Anatahan has previously supported the largest fruit bat population in the northern islands. Anatahan's volcano started to erupt in May 2003, and continues to violently erupt to the present time, spreading ash over more than half the island's land surface. Once it becomes safe for humans to visit the island on foot, a survey should be conducted to determine the effects of the eruptions on the size of the fruit bat population. (See Figure 56.)

Figure 56. Mariana Fruit Bat colony persists at Anatahan, in spite of volcanic eruption and ash fall, June 2005.
Photo credit: Curt Kessler

**Conservation actions**

Conservation of the Mariana Fruit Bat could be accomplished through the following conservation actions. Descriptions and priority ranking for these conservation actions is given in Chapter 6.

| |
|---|
| Conserve habitat for endangered bird species on Rota through an island-wide habitat conservation plan |
| Decrease deer numbers on the Sabana of Rota |
| Cull goats from the island of Aguiguan |
| Conserve remnant native limestone forest on Tinian by establishing a conservation area |
| Eradicate scarlet gourd (*Coccinia grandis*) from Saipan |
| Interdiction of the Brown Treesnake (*Boiga irregularis*) |
| Prevent the introduction of West Nile Virus to the Mariana Islands |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on the southern islands through avoidance and mitigation conditions placed on land development proposals |
| Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition |
| Improve management of terrestrial conservation areas in the southern islands |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Reforest disturbed areas with native tree species on the southern islands |
| Improve enforcement of hunting regulations on the southern islands |
| Assess the suitability of Sarigan Island to receive translocated birds and monitor forest succession and wildlife population trends on Sarigan following the eradication of feral ungulates |
| Establish a fenced nature reserve on the southern peninsula of Pagan |
| Remove feral ungulates from the northern islands of Anatahan, Alamagan, Pagan and Agrihan |
| Prevent the introduction of invasive species to the northern islands |

**Monitoring**

Monitoring on Rota

Monthly departure counts from known roost sites and station counts are conducted on Rota under the Pittman-Robertson Grant. Currently, continuation of monthly monitoring and data analysis is hampered because the Rota wildlife biologist resigned in 2003, and funding is insufficient to hire a replacement biologist who can further fruit bat research on Rota (Williams 2004; L. Williams, pers. comm., June 2005).

Monitoring on the northern islands

The prohibitive cost of travel to the remote northern islands, associated with the CNMI's poor economic condition, makes it unlikely that regular surveys for fruit bats will be conducted in the near future by DFW. Scientists from other organizations (including the

U.S. Fish and Wildlife Service and the U.S. Navy) may conduct surveys in association with feral animal eradication projects on some northern islands.

# SHEATH-TAILED BAT

**Common Name**
Sheath-tailed Bat.  Also, Pacific Sheath-tailed Bat.

**Scientific Name**
*Emballonura semicaudata rotensis*

**Chamorro Name**
Liyang

**Carolinian Names**
Payesyes
Pai'Scheei

Figure 57.  Sheath-tailed Bat.
Photo credit:  Tom Lemke.

**Listing Status**
The Marianas population of the Sheath-tailed Bat was recognized as a distinct population segment and was listed as a Candidate species by the U.S. Fish and Wildlife Service (2004b).  It is locally listed as a threatened and endangered species (CNMI 2000).

**Reasons for selecting the Sheath-tailed Bat as a species of special conservation need**
The entire population of the Mariana Islands subspecies occurs on only one island in the entire world, Aguiguan.  It has been extirpated from other Mariana Islands and is extremely vulnerable to extinction, with only a few hundred individuals remaining as of the mid-1990s (Wiles and Worthington 2002).  Funding is not available for research concerning the life history of this species.

**Unique characteristics**
This tiny bat weights less than a quarter of an ounce.  (See Figures 57 and 58).  It roosts in limestone caves and feeds nocturnally on insects.  It is named "sheath-tailed" for the uropatagium, a skin-like membrane surrounding the tail, which can be lengthened or shortened to provide agility in flight (Wiles and Worthington 2002, CNMI Div. of Fish and Wildlife n.d.)

Figure 58. The Sheath-tailed Bat is tiny.
Photo credit:  Tom Lemke.

**Distribution of the Sheath-tailed Bat in the CNMI**
Historically, the subspecies endemic to the Mariana Islands occurred on Guam, Rota, Aguiguan, Tinian, Saipan, and possibly Anatahan and Maug.  Today, it is known to occur only on the island of Aguiguan (U.S. Fish and Wildlife Service 2004b).  It is possible that Sheath-tailed Bats may still occur on other southern islands of the CNMI, but have escaped detection (N. Hawley and L. Williams, pers. comm., September 2005).

**Abundance of the Sheath-tailed Bat in the CNMI**

After inventorying 86 caves on Aguiguan in 1995, Wiles and Worthington (2002) recorded 108 bats, and estimated an island-wide population of from 150 to 200 animals. In 2000, Cruz et al. (2000b) found no Sheath-tailed Bats. Cruz et al. (2003d) observed only from 10 to 20 bats in 4 caves in 2002, but hesitated to make an island-wide population estimate because their survey was so quick. This subspecies is extremely rare and is extremely vulnerable to extinction (Wiles and Worthington 2002).

**Location and relative condition of key habitats for the Sheath-tailed Bat in the CNMI**

Roosting

This bat subspecies requires limestone caves and crevices for roosting. Although colony sizes have recently been observed to be small, larger caves are preferred. The largest colonies are found in caves on cliffs that are inaccessible to humans and ungulates; inland caves are largely unoccupied. Bats share five out of seven caves on Aguiguan with Mariana Swiftlets (Wiles and Worthington 2002).

Foraging

The Sheath-tailed Bat forages almost exclusively in the degraded native forest on Aguiguan, flying either low over the canopy or in the forest understory from 2 to 5 meters above the ground. Although almost half of Aguiguan's land area is in open fields, the bat appears to avoid this type. Aguiguan's native forest has been dramatically altered since the 1930s by agricultural practices and grazing by feral goats, which is speculated to account for reduced populations of Sheath-tailed Bats due to elimination of foraging habitat and lowering of prey base availability (Wiles and Worthington 2002).

**Problems which adversely affect the Sheath-tailed Bat and its habitats**

No single threat has been shown to cause the decline in numbers of this species, or the contraction of its range to a few square kilometers of Aguiguan. Reasons for the decline in Sheath-tailed Bats could be related to the reasons for the decline in Mariana Swiftlets, as both species are small, insectivorous cave-dwellers (Wiles and Worthington 2002).

Deforestation

From the 1920s to 1940s, nearly half of Aguiguan was cleared for sugar cane production; few of these open fields have returned to native forest. Feral goats have dramatically altered the remaining 3.5 to 4.5 square kilometers of forest by removing the understory vegetation, which prevents regeneration of native forest trees, and has probably altered and reduced the insect prey base for the bats. The presence of feral goats has exacerbated the colonization of the invasive *Lantana camara*, which is rampant on Aguiguan. The native forest on Aguiguan, the only remaining foraging habitat for the Sheath-tailed Bat, is limited in extent, degraded in quality, and in danger of dying out. (Cruz et al. 2000b, Wiles and Worthington 2002).

Pesticide contamination

Sheath-tailed Bats may persist on Aguiguan because this island was probably not subjected to the heavy pesticide use employed from the 1940s to 1970s on Rota, Tinian and Saipan. Sheath-tailed Bats may be more susceptible to pesticide contamination than other wildlife species due to their small size, or because their prey base abundance declined more rapidly. Past pesticide use in the southern islands is poorly documented, so the effect of this threat on Sheath-tailed Bat populations is difficult to determine without further study (Wiles and Worthington 2002).

Predation by monitor lizards, cockroaches and rats
Monitor lizards, cockroaches and rats are abundant on Aguiguan and may be limiting the selection of roosting sites used by bats to places where these predators cannot reach (Wiles and Worthington 2002).

Predation by Brown Treesnakes
There is no precedent from Guam indicating the likelihood of Brown Treesnakes (*Boiga irregularis*) preying on Sheath-tailed Bats. However, if Brown Treesnakes are successful in colonizing Aguiguan, they are likely to take any Sheath-tailed Bats that they encounter (N. Hawley, pers. comm., August 2005).

Use of caves by humans and feral ungulates
Caves in the southern islands were heavily impacted by human occupation and warfare during World War II. Although such use was temporary, caves continue to be visited by hunters, vandals, hikers and guano miners (U.S. Fish and Wildlife Service 1991b). Feral ungulates may take shelter in caves. Caves on Aguiguan with the largest bat colonies are inaccessible to humans and ungulates (Wiles and Worthington 2002).

Severe typhoons
Severe storms and typhoons may potentially flood seaside caves. Storms of several days' duration may cause starvation by precluding foraging and damaging important foraging habitat. Although typhoons are typical occurrences in the Northern Mariana Islands, a particularly severe or long typhoon may wipe out significant parts of the small remaining population of Sheath-tailed Bats (Wiles and Worthington 2002).

**Priority research and survey efforts**

Surveys to detect Sheath-tailed Bats on other southern islands
It is possible that Sheath-tailed Bats occur on other southern islands of the CNMI aside from Aguiguan, but have escaped detection (N. Hawley and L. Williams, pers. comm., September 2005). Limestone caves and crevices on Saipan, Tinian and Rota can be surveyed, using a bat-detection device during night-time hours to determine if this species is indeed limited only to the island of Aguiguan.

Life history studies
The life history of this subspecies is not well understood. Further study is needed to provide better information on population status and trends, distribution, foraging needs, cave habitat requirements and limiting factors (Wiles and Worthington 2002, Cruz et al. 2003d). In addition, caves not previously surveyed on Aguiguan due to difficulty in access should be surveyed.

Pesticide studies
Studies of levels of pesticides in guano deposits throughout the southern islands may help determine if pesticide use contributed to the extirpation of the Sheath-tailed Bat from all Mariana Islands except Aguiguan, and may ascertain whether translocation of this species to caves on Rota, Tinian and Saipan is a feasible conservation action.

Palaeobiological studies
Search for fossil remains or bones of the Sheath-tailed Bat in caves on the southern islands may identify formerly occupied caves, and provide likely sites for future translocation.

**Conservation actions**
Preservation of the Sheath-tailed Bat on Aguiguan hinges on maintenance of its forested habitat and safe roosting sites (Wiles and Worthington 2002). Conservation of the Sheath-tailed Bat could be accomplished through the following conservation actions. Descriptions and priority ranking of these conservation actions are given in Chapter 6.

| |
|---|
| Protect limestone caves on Rota, Aguiguan, Tinian and Saipan from disturbance by people |
| Translocate Sheath-tailed Bats to caves formerly occupied on Rota, Tinian and Saipan |
| Cull goats from the island of Aguiguan |
| Eradicate rats, cats and other predators from Aguiguan Island |
| Interdiction of the Brown Treesnake (*Boiga irregularis*) |
| Prevent the introduction of West Nile Virus to the Mariana Islands |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on the southern islands through avoidance and mitigation conditions placed on land development proposals |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Reforest disturbed areas with native tree species on the southern islands |

**Monitoring**
Wildlife and vegetation surveys have been conducted only opportunistically or sporadically on Aguiguan due to funding limitations and the island's inaccessibility. Ideally, baseline information should be collected through an exhaustive initial survey, followed by regular, periodic monitoring on a quarterly basis. Such periodic surveys would monitor trends in Sheath-tailed Bat populations, as well as native forest condition, goat population trends and condition of bat caves.

# COCONUT CRAB

**Common Name**
Coconut crab

**Scientific Name**
*Birgus latro*

**Chamorro Name**
Ayuyu

**Carolinian Name**
Iyāf

Figure 59. BTS Biologist Nate Hawley displays a large coconut crab on the island of Anatahan in 2002. Photo credit: Paul Reyes.

**Listing Status**
*Birgus latro* is listed as Rare on the IUCN Red List of Threatened Species by the World Conservation Union (www.redlist.org). Locally, take of this game species is regulated by license requirements, season and bag limits (CNMI 2000).

**Reasons for selecting the Coconut Crab as a species of special conservation need**
In addition to being a highly-valued game species in the CNMI, the Coconut Crab serves important ecological functions of dispersing seeds and carrying fruits, and as scavengers. Because traditional Pittman-Robertson funding can not be used for research on invertebrates, life history and abundance information is lacking throughout the CNMI. Hunting pressure on the populated islands of the CNMI has made crabs rare.

**Unique characteristics**
The Coconut crab is the world's largest land invertebrate. (See Figure 59.) A coconut crab grows slowly, and it takes nearly a decade to reach the legal size limit for hunting; maximal size is reached after 40 years. The life cycle of the coconut crab includes both seawater and land environments. Copulation takes place on land. Two to three weeks later, the female extrudes an egg mass and carries it through a 25 to 45 day gestation period on her abdomen, using feathery pleopods. One researcher counted embryos carried by four gravid ("berried") females coconut crabs in Palau and Enewetak; the number of embryos per female ranged from 51,000 to 138,000 (Amesbury 1980). The female releases her eggs into the ocean, just after dark and generally when a high tide at dusk coincides with a dark phase of the moon. The eggs hatch on contact with the water and develop through four zoeal larval stages over two to three weeks. The larva then metamorphoses into an amphibious glaucothoe stage. The glaucothoe finds a suitable gastropod shell, emerges from the water and inhabits the upper intertidal areas, where there is coral rubble that is shaded. Little is understood about the glaucothoe stage, because this form is difficult to find and difficult to distinguish from other hermit crab species. Finally, the glaucothoe emerges from its shell and metamorphoses into an adult coconut crab. The subsequent development consists of a series of molts in which the

adult crab increases in size but does not change in morphology. The coconut crab is unique in being the only member of the Coenobitidae family that dispenses with the habit of protecting its abdomen with a borrowed gastropod shell at a very small size (Fletcher and Amos 1994; Amesbury 1980; Robertson 1991).

Coconut crabs are omnivorous scavengers, feeding on fruits, carrion, invertebrates (including other coconut crabs) and decaying vegetation. Large crabs are capable of cracking open coconuts with their front claws; this is the preferred food, when available. In areas where coconut crabs are found in low densities, foraging occurs at night and crabs seek additional protection by hiding during the day in cracks and crevices, hollow tree stumps and caves. At higher densities, such as on Asuncion and Guguan, crabs forage during the day time as well; the reason for this difference in foraging behavior is not well understood (Fletcher and Amos 1994; Amesbury 1980).

## Distribution of the Coconut Crab in the CNMI

*Birgus latro* occurs on islands throughout the Indo-Pacific tropics (Robertson 1991). In the CNMI, coconut crabs occur on every island of the archipelago (CNMI Division of Fish and Wildlife n.d.)

## Abundance of the Coconut Crab in the CNMI

No systematic surveys have established the abundance of coconut crabs on each of the CNMI's islands. Generally, however, crabs are fewer in number and smaller in size on the populated southern islands, as a result of hunting and poaching. Coconut crabs grow larger and more abundant on the northern islands, because these islands are remote and difficult to access.

Recent observations on abundance of coconut crabs taken from DFW's Technical Report series are as follows. (Note: There is no data on coconut crabs from this series for Rota, FDM, Sarigan, Agrihan, Asuncion, Maug or Uracas. Therefore, abundance data from other recent literature is also included, when available.)

### Aguiguan

During 2000 field work, a coconut crab survey was conducted, the sex ratio was calculated, but no population estimate was made. Crabs were observed to be small in size, leading to the conclusion that hunting pressure on large crabs has not lessened in recent years (Cruz et al. 2000b). Coconut crabs were not surveyed during 2002 field work, but six were caught in native forest and three in tangantangan forest, in traps set to catch rats (Cruz et al. 2003d).

### Tinian Proposed Conservation Area

The coconut crab survey done in 2000 was not extensive due to difficulty in obtaining permission to access the site from the private owner; therefore, no population estimate was made. However, six crabs were captured on one night on one transect. Of these, two were under the legal size for hunting, and the other four were only slightly larger (Cruz et al. 2000a).

Saipan, Kagman Conservation Area
Coconut crabs were noted to be one of many important wildlife species in the Kagman Conservation Area, characterized by native and secondary forest. However, no survey of coconut crab abundance was made (Cruz et al. 2003c).

Saipan, Naftan Point
A removal study was conducted in 1996 in tangantangan forest at Naftan Point. Coconut crab densities were found to be low (16 crabs per ha) when compared to islands with unharvested populations, with 90% of the crabs under the legal size limit (Kessler 1999).

FDM
Coconut crabs occur (Helber Hastert and Fee 2003), but no data is available on their abundance.

Anatahan
Sight records of coconut crabs were taken by an invertebrate specialist in 2002. Large-sized crabs were observed on the eastern side of the island (Cruz et al. 2003a).

Sarigan
Abundance of coconut crabs was described by Arriola et al. (1999) as being uncommon in 1999.

Guguan
Although coconut crabs were not surveyed during the 2000 field trip, quite a few large crabs were observed, bright blue in color, with carapace widths of 15 to 20 cm (Cruz et al. 2000c), more than twice as big as the minimum legal size for hunting.

Alamagan
During the 2000 field trip, no coconut crabs were observed at all on the island. Residents reported that feral pigs have had a large impact on the crab population (Cruz et al. 2000d).

Pagan
A survey of coconut crabs in 1999 using baited traps yielded none caught. Feral pigs were encountered at bait stations, and it is thought that they prey on coconut crabs to the extent that none can be found (Arriola et al. 1999).

**Location and relative condition of key habitats for the Coconut Crab in the CNMI**
The Coconut Crab depends on the ocean, both high in the water column and on the benthic surface, for egg hatching and larval development. The strand habitat is important for the glaucothoe stage. Adult coconut crabs are found in nearly all terrestrial habitats: native forest, secondary forest, tangantangan forest (especially on Tinian), coconut forest, and grassland. Coconut crabs are seldom found more than 4 km from the ocean (Fletcher and Amos 1994). Different habitats probably support varying densities of coconut crabs, but this has not been quantified for the CNMI (Kessler 1999). The condition of these habitats is discussed in Chapter 4.

**Problems which adversely affect the Coconut Crab and its habitats**

Overharvesting and illegal hunting

CNMI hunting regulations limit the take of coconut crabs: a license is required; only crabs greater than three inches across the back may be taken; berried females may not be taken at all; crabs may be taken only by hand; bag and season limits apply; sale of crabs is prohibited; and preserving or mounting of crabs for display is prohibited (CNMI 2000). Coconut crabs grow very slowly; it may take a decade for a crab to reach the legal size for harvest. On other populated islands in the Pacific, overharvesting due to intense demand for coconut crabs, combined with deficient management, has decimated coconut crab populations (Lindner 2004). It appears the same trend is occurring on the southern islands of the CNMI, where large coconut crabs are seldom seen. Even though existing hunting regulations are intended to provide for sustainable crab stocks, illegal hunting of coconut crabs occurs: crabs are taken out of season; are undersized; or are taken in a protected area. (See, for example, Ravelo 2004, viewable at http://www.saipantribune.com/archives/newsstoryarch.aspx?cat=1&newsID=34155&archdte=1-15-2004). The Saipan Upland Mitigation Bank protected area at Marpi in Saipan is riddled with illegal coconut crab traps (observation of the author). Enforcement is difficult and poaching is chronic (Kessler 1999).

Feral animals and predators

Feral animals on the islands of Pagan and Alamagan have contributed to the decline in coconut crab abundance. Pigs are especially problematic, because they prey on coconut crabs, and because they dig up burrows and hiding places used by crabs (Cruz et al. 2000d; Arriola et al. 1999). During public meetings, people stated that monitor lizards are a serious threat, and reduce the coconut crab stocks on Tinian and Aguiguan.

Fragmentation, degradation and loss of coconut crab habitat

Terrestrial habitats utilized by coconut crabs must be close to and contiguous with the ocean for completion of the life cycle (i.e. egg release and larval development). Land clearing for development on the southern islands has resulted in removal of terrestrial coconut crab habitat and has likely cut off migration routes to the ocean. Chapman (1948) describes how a rapidly constructed airstrip at Munda in the Solomon Islands was built across the migration trails of female crabs "pouring out of the jungle toward the sea for six weeks". On the island of Saipan, coconut crabs are generally found in established protected areas proximate to the ocean, and have probably been bound there by the pressures of land clearing and development.

During the public meetings, people reported that coconut crabs die in the frequent wildfires that often occur in dry habitats, tangantangan and grasslands, on the island of Tinian.

Competition with *Coenobita* hermit crabs

Several species of hermit crabs of the genus *Coenobita* utilize shells of the giant African snail (*Achatina fulica*), introduced to the southern islands of the Marianas after World War II. It is conceivable that *Coenobita* crab populations have exploded in the last several decades, and that these hermit crabs compete with coconut crabs for food. The *Coenobita* crab, in its glaucothoe stage, may be putting heavy pressure on the availability of small gastropod shells and making them less available to coconut crab glaucothoe. This hypothesis is supported by the fact that on the northern islands, spared the *Achatina* snail invasion, coconut crab densities are higher (Amesbury 1980).

**Priority research and survey efforts**

Both USFWS and DFW proposed coconut crab surveys to the U.S. Navy for INRMP funding, but these surveys were not funded (Helber Hastert and Fee, 2003). State Wildlife Grant funds have been used to hire Dr. Tina de Cruz, a wildlife biologist, to produce an annotated bibliography of coconut crab literature, and to design a survey protocol (Cruz 2005a, 2005b). The task now remains to put this valuable information to use, and survey coconut crab populations (including sex ratios and size distribution) throughout the archipelago, comparing findings from the populated southern islands to the more remote northern islands.

**Conservation actions**

Conservation of the Coconut Crab could be accomplished through the following conservation actions. Descriptions and priority rankings for these conservation actions appear in Chapter 6.

| |
|---|
| Improve hunter report card quality control and data analysis |
| Conserve habitat for endangered bird species on Rota through an island-wide habitat conservation plan |
| Decrease deer numbers on the Sabana of Rota |
| Cull goats from the island of Aguiguan |
| Eradicate rats, cats and other predators from Aguiguan Island |
| Conserve remnant native limestone forest on Tinian by establishing a conservation area |
| Eradicate scarlet gourd (*Coccinia grandis*) from Saipan |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition |
| Improve management of terrestrial conservation areas in the southern islands |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Reforest disturbed areas with native tree species on the southern islands |
| Improve enforcement of hunting regulations on the southern islands |
| Assess the suitability of Sarigan Island to receive translocated birds and monitor forest succession and wildlife population trends on Sarigan following the eradication of feral ungulates |
| Establish a fenced nature reserve on the southern peninsula of Pagan |
| Remove feral ungulates from the northern islands of Anatahan, Alamagan, Pagan and Agrihan |

Prevent the introduction of invasive species to the northern islands

**Monitoring**

Hunters are required by regulation to submit hunter report cards after the close of each hunting season, stating the species taken, the area hunted, the number taken, date taken, and hours hunted. Hunters failing to turn in hunter report cards are not issued hunting licenses the following season. Hunter report cards are compiled and analyzed by the Enforcement Section of DFW. In this way, coconut crab harvest level and hunter effort expended can be monitored. This method has limitations: In 2003, a student intern worked with hunter report cards for years 1996 – 2001, and found data gaps big enough to preclude ascertaining meaningful trends. She recommended that hunter report cards be examined for completeness by the Enforcement Section before they are accepted for submission.

The incidence rates of hunting violations for illegal take of coconut crabs is another way that DFW can monitor hunting pressure on coconut crab populations, especially in the southern islands.

# ENDEMIC TREE SNAILS

Three species of endemic tree snails belonging to the family Partulidae occur in the Northern Mariana Islands.

## HUMPED TREE SNAIL

Figure 60. Humped Tree Snail.
Photo credit: Dave Hopper, USFWS

**Common Name**
Humped Tree Snail

**Scientific Name**
*Partula gibba*

**Chamorro Name**
Denden (means "snail")

**Carolinian Name**
Unknown

**Listing status**
The humped tree snail was listed as candidate species under the federal Endangered Species Act for the island of Guam in November 1994 (U.S. Fish and Wildlife Service 1994). In 1997, the humped tree snail was additionally listed as a candidate species for the Northern Mariana Islands (U.S. Fish and Wildlife Service 1997).

## LANGFORD'S TREE SNAIL

Figure 61. Langford's Tree Snail
Photo credit: Dave Hopper, USFWS

**Common Name**
Langford's Tree Snail

**Scientific Name**
*Partula langfordi*

**Chamorro Name**
Denden (means "snail")

**Carolinian Name**
Unknown

**Listing status**
The Langford's tree snail was listed as candidate species under the federal Endangered Species Act for the Northern Mariana Islands in September 1997 (U.S. Fish and Wildlife Service 1997).

# FRAGILE TREE SNAIL

**Common Name**
Fragile Tree Snail

**Scientific Name**
*Samoana fragilis*

**Chamorro Name**
Denden (means "snail")

**Carolinian Name**
Unknown

Figure 62. Fragile Tree Snail.
Photo credit: Dave Hopper, USFWS

**Listing status**
The fragile tree snail was first listed as a candidate species under the Endangered Species Act in 1994 for the island of Guam (U.S. Fish and Wildlife Service 1994). In 1997, the fragile tree snail was also listed as a candidate species for the Northern Mariana Islands (U.S. Fish and Wildlife Service 1997).

# ALL PARTULID SNAILS IN THE CNMI

**Reasons for selecting Partulid snails as species of special conservation need**
The limited funding available for wildlife research in the CNMI has not been devoted to invertebrates such as endemic tree snails. Numbers have declined, but research on these animals has not been undertaken in over a decade, and it is not clear whether any Partulids still survive.

**Unique characteristics**
One hundred twenty-three species of tree snails from the Partulidae family inhabit the high islands of Oceania, with three species occurring in the CNMI (Smith 1995). (See Figures 60, 61, and 62.) Partulids are small, growing up to 18 mm in length (*ibid.*). Partulids are ovoviviparous hermaphrodites, whereby the eggshell is resorbed by the parent before birth, and young are born live (Cowie 1992). *Samoana fragilis* is the only Partulid that reaches sexual maturity before it expands the varical lip characteristic of adults (Smith 1995). When compared to most other snail families, and especially the introduced giant African snail (*Achatina fulica*), Partulids are relatively slow-growing, long-lived and slow to reproduce (Cowie 1992).

**Distribution and abundance of Partulids in the CNMI**
Historically, Partulids were known from certain islands in the Marianas archipelago to be more abundant than they are today. Crampton (1925) conducted field surveys for Partulids on the west side of Saipan in 1920. He found *Partula gibba* "in extraordinary abundance", and collected 2,666 adults and 664 partly grown individuals from eight sites

located within a six-mile north to south extent. Kondo (1970) documented *Partula gibba* distributed northward from Guam to Rota, Aguiguan, Tinian, Saipan, Alamagan and Pagan, and credited their northward migration to annual typhoons. *Samoana fragilis* was found on Rota, and thought by Kondo (1970) to be a migrant from Guam. Kondo (1970) described *Partula langfordi* as a newly identified species, probably evolving from *Partula gibba* elsewhere, and occurring only on Aguiguan.

Land mollusks were collected from the nine northern islands in the Marianas archipelago during the Chiba Expedition in May 1992. Kurozumi (1994) reported *Partula gibba* on the islands of Anatahan (19 specimens collected), Sarigan (102 specimens), Alamagan (123 specimens) and Pagan (22 specimens).

Smith (1995) gives the most recent account of the status of endemic tree snails in the Mariana Islands, based on a review of the literature, and on the author's own field research conducted from 1990 to 1995, and summarized here.

<u>Rota</u>
In March 1995, an island-wide survey of tree snails was undertaken on 24 forested sites. Dead ground shells of *Partula gibba* were found at all sites, but live *P. gibba* were only found on four sites. One of the sites with live snails, at Sailigai Papa', supported a population of about 1,000 snails in an area of 3,000 square meters. The other three sites were inhabited by relatively small colonies: 200, 100 and 50 snails respectively. The abundance of dead *P. gibba* shells, in conjunction with photographs and literature accounts, suggests higher population densities in past years. *Samoana fragilis* was not found during this survey. One year later in March 1996, however, a *S. fragilis* colony was discovered near the Water Cave by S. Miller, A. Asquith and S. Bauman. When J. Schmerfeld, R. Helling and B. Smith returned to the site in October 1996, they were unable to relocate the *S. fragilis* colony, but did find live *Partula gibba* snails at that site (B. Smith, e-mail comm., November 2004).

<u>Aguiguan</u>
Two field surveys were conducted in 1992. During the first, in May, *Partula gibba* snails were found at three locations on the western slope of the island, but no population estimates were made. During the second survey, in November, only two living *P. gibba* snails and one living *Partula langfordi* snail were found. Dead shells of both species littered the ground, many of them still lustrous in appearance, indicating recent mortality.

<u>Tinian</u>
Although Kondo reported *P. gibba* from Tinian in 1970, no recent surveys for Partulids have been conducted. Abundance is therefore unknown.

<u>Saipan</u>
Five of the eight sites that Crampton visited in 1920 were re-surveyed by Smith and Hopper in 1991. No living Partulids were found, and empty shells, bleached white by the sun, were the only sign that the areas were ever inhabited by Partulids. Four of the five sites were no longer even suitable for tree snail habitation (Smith and Hopper 1994).

Since 1991, two other Partulid colonies have been located on Saipan, one near the Santa Lourdes shrine on private land, and one in a wetland near Smiling Cove Marina (B. Smith, pers. comm., September 2004).

Anatahan, Sarigan, Alamagan, Pagan

Smith (1995) reiterated the most recent data on Partulids for these islands from Kurozumi (see above). Smith did note, however, that Kondo and Kurozumi reported similar numbers of snails collected from Pagan and Alamagan, which is remarkable considering the forty year interval between their studies.

No field studies of endemic tree snails have been conducted in the decade since Smith's 1995 report. The systematic vegetation and wildlife surveys that were conducted by the CNMI Division of Fish and Wildlife during the year 2000 did not examine snails. It is therefore unknown if populations of these snail species continue to decline, or if they even still exist.

**Location of key habitats and community types for endemic tree snails**

Endemic tree snails have been found in a variety of forest habitats in the Mariana Islands. Crampton (1925) noted that the "intrinsic or specific characters of the plants with which Partulae are associated are virtually indifferent; the indispensable requisites are that there shall be a sufficiently high and dense growth to provide shade, to conserve moisture, and to effect the production of a rich humus". Crampton observed snails living on the leaves and branches of trees, shrubs and herbs, remaining generally still during the day and becoming more active during the night or during rain showers to move to the ground for feeding. Snails fed on dying and decaying plant matter, presumably for its fungoid growth which provided the snails with sustenance.

Crampton (1925) described eight degrees of vegetation density, ranging from thick forest at one extreme to open, treeless savannas at the other. He found Partulae in the first three degrees of vegetation density, namely forest, thicket, and scattered bush; in the latter, he found as many as 31 snails on the underside of a single leaf of caladium at Chalan Kiya in Saipan. Snails were also found in habitats near the sea.

On Alamagan, *Partula gibba* snails were found in 1949, in dense, wet forest at elevations ranging from 180 to 240 meters (Smith 1995). Kondo (1970) found *Partula langfordi* "in open forest, on native plants" at Aguiguan Island in 1954. During the Chiba Expedition of 1992, Kurozumi (1994) collected many different species of land snails (including *P. gibba*) in forest types, from litter layers, tree trunks, undersides of leaves and among mosses. Also in 1992, *P. gibba* were observed on trees in both native and secondary forests at Aguiguan Island, at elevations ranging from 30 to 100 meters (Smith 1995).

Smith (1995) studied population biology of *Partula gibba* on the island of Rota in the early 1990's on a permanent quadrat. He noted that forest canopy is of great importance to the survival of the snails. When canopy foliage was lost during tropical storms, snail population densities dropped, but rebounded after the canopy was recovered.

When taken into consideration together, these accounts demonstrate that Partulids of the Mariana Islands require a wet, forest habitat. Partulids have occurred in both native and secondary forests. Tree species composition is not an important factor in determining the presence of Partulids; of overriding importance is the existence of enough overstory to capture and maintain consistent, high moisture content in the vegetation and humus of the forest.

**Relative condition of endemic snail habitats**

Historically, native forest cover for the populated islands of Rota, Tinian and Saipan was much more extensive than it is today, with changes occurring due to land clearing for agriculture and urban development. During the 1920's, almost all of the native vegetation on Saipan and Tinian was cleared by the Japanese for growing sugarcane. During World War II, Saipan and Tinian were essentially denuded of vegetation. Subsequent broadcast seeding of tangantangan (*Leucaena leucocephala*) to prevent erosion has resulted in large areas of native forest being replaced by secondary forest (Engbring et al. 1986). Although Aguiguan has not been inhabited, the understory of its native forest has been completely removed through years of grazing by feral goats (Cruz et al. 2000b).

The native forests of the northern islands where endemic tree snails have been reported, are not in good shape either, but for different reasons. Anatahan has been described as "an ecological disaster in progress" (Cruz et al. 2000f). On Anatahan, feral ungulates have removed the understory, resulting in severe erosion on the island's steep slopes. Many large overstory trees in Anatahan's native forests have disappeared due to erosion, which uncovers their roots, thereby killing them. Anatahan's volcano began to erupt on May 10, 2003, sending steam, ash and rocks over the majority of the island (Cruz et al. 2003a), and most likely removing most of the forest. Because the volcano continues to erupt, landing on the island is prohibited for safety reasons, making it impossible to discern the state of the island's forests (V. Camacho, personal communication, October 2004).

On Sarigan, a feral animal removal campaign undertaken in the late 1990s has been successful. Although the vegetation is recovering to some degree, as indicated by an increase in the number of species, extent of ground cover and the number of seedlings in the understory, the species composition tends toward species of the weedy and opportunistic variety. Of special concern is the introduced vine, wood rose (*Operculina ventricosa*), which has begun to grow over the fragmented forest canopy (Cruz et al. 2000e). It is not known how these recent vegetation changes have affected endemic snail habitat.

The native forests of Alamagan have been adversely affected by feral animal destruction, as evidenced by low seedling densities and degrading tree species diversity. However, Alamagan is at a crossroads, as the destruction of the forest is not as severe as on Anatahan and Pagan, and an opportunity is still afforded to prevent deterioration of the forests if action is taken soon to remove feral animals. If feral animals are not eradicated, the remaining forests will slowly begin to degenerate, a new generation of trees will not be produced, older trees will die due to soil erosion, and grasslands will take over (Cruz et al. 2000d).

Pagan's face was changed by the 1981 volcanic eruption which sent lava over much of the island, including the air strip. Pagan's bigger problem, however, is in the presence of large numbers of feral animals that are widely distributed on the island. The natural vegetation has been removed through browsing in many places, leaving the land open and susceptible to erosion. The remaining forests of Pagan are patchy and fragmented (Cruz et al. 2000g).

**Problems which adversely affect endemic tree snails and their habitats**

Populations of endemic tree snails have become disassociated geographically from each other, and have fallen off to precariously low numbers. Factors attributed to these declines are: collecting of snails, degradation and reduction in extent of suitable habitat, and introduction of predators.

Collecting of snails

In the past, collecting of tree snails by naturalists and explorers may have been a major contributing factor to their decline (Hopper and Smith 1992). Crampton alone took 2,666 adult *Partula gibba* snails from eight sites on Saipan in just six days in 1920 (Crampton 1925). When Smith and Hopper resurveyed six of these sites in 1991, they found no live Partulids (Smith 1995). Snail shells have also been collected for ornaments and jewelry (Smith 1995).

Degradation and reduction in extent of suitable habitat

As discussed above, the extent of ideal snail habitat consisting of native forests with continuously moist understory conditions has been shrinking in the Northern Mariana Islands, due to land clearing for agricultural and urban development, damage by feral animals, and volcanic activity. Individual snail colonies have become isolated from each other, resulting in increased vulnerability to habitat loss, either by human activity or by natural disasters (such as typhoons). Hopper and Smith (1992) could not determine the degree to which habitat fragmentation has affected Partulid populations, but observed on Guam that even adjacent populations may be isolated from one another.

Introduction of predators

Researchers agree that the single most important threat to the continued existence of endemic tree snails is the introduction of predators to the islands. Crampton (1925) observed no animals in the Mariana Islands whose presence or activities influenced the lives or numbers of Partulids. Even rats and mice, which might have preyed on snails, were limited to settlements and plantations where snails did not live.

Between 1936 and 1938, giant African snails, *Achatina fulica*, were introduced to Saipan, Tinian and Rota. In 1939, these snails were taken to Pagan to be used for medicinal purposes, and although no published record exists, they were also introduced to Aguiguan. Unfortunately, the giant African snails became agricultural pests, and in an effort to control them, the Insect Control Committee for Micronesia of the Pacific

Science Board decided to test the introduction of a carnivorous snail, *Gonaxis kibweziensis*, on the island of Aguiguan. Over 400 individuals of *G. kibweziensis* were released at a site on the southwest coast of Aguiguan on May 31, 1950. The experiment was deemed 60% successful, as field surveys in 1951 and 1954 showed decreasing numbers of *A. fulica*, and increasing numbers of its predator, *G. kibweziensis* (Eldredge 1988). However, *Gonaxis* was seen feeding not only on *A. fulica*, but also on other *Gonaxis*, and on native species of snails. Thirty years later, in 1984, a field team from the University of Guam found no living snails of either species, and found hermit crabs carrying well worn *Achatina* shells (*ibid*.).

Another predator, the flatworm *Platydemus manokwari*, a native of western New Guinea, appeared mysteriously on Guam in 1978, and shortly thereafter on Saipan. During a field survey of flora and fauna on Tinian during 1984-85, numerous individuals of this flatworm were found in the jungle some distance from human habitation or agricultural fields (Eldredge 1988). *P. manokwari* apparently arrived on Aguiguan through potted plants brought in from Tinian for a reforestation project, probably in 1990 or 1991 (Smith 1995). It is not known how the flatworm entered the Mariana Islands (Eldredge 1988).

This flatworm can climb trees, and has been observed feeding on juvenile Partulids on Guam (Hopper and Smith 1992). The dense aggregation of *P. manokwari* found in leaf litter and rocks in an area littered with the still lustrous shells of dead *Partula gibba*, *Partula langfordi*, *Gonaxis kibweziensis*, and other snail species on Aguiguan in 1992, coupled with the fact that the flatworm probably arrived about 1-1/2 years earlier, attests to the devastating effect this predator can have in wiping out whole colonies of snails (Smith 1995). This association of the presence the live flatworm with the shells of dead Partulids has also been observed on Rota (*ibid.*). The flatworm has unquestionably reduced populations of native snails throughout the southern Mariana Islands, and poses a risk to endemic snails in Palau and Pohnpei if dispersed beyond the Marianas (Smith and Hopper 1994).

## Priority research and survey efforts

### Endemic tree snail population surveys

The most recent data on the abundance and distribution of endemic tree snails for the islands of Rota, Aguiguan, Saipan, Anatahan, Sarigan, Alamagan, and Pagan dates back to field work conducted a decade or more ago (Smith 1995). The most recent data for the island of Tinian comes from 1970 but consists of a passing mention of the presence of *Partula gibba* there (Kondo 1970). A marked decline in population levels of Partulids since the time of Crampton's 1920 research has certainly occurred, but it is uncertain if any of the Partulid populations still exist in the Mariana Islands.

Before any concerted conservation action can be directed toward endemic tree snails, population surveys need to be conducted. Such surveys should be undertaken on all of the islands where these snails have been documented in the past, i.e. Rota, Aguiguan, Tinian, Saipan, Anatahan, Sarigan, Alamagan and Pagan. Additionally, surveys of the other islands in the archipelago should be made. Kondo (1970) theorized that *Partula* *gibba* has been distributed northward from Guam to Rota, Aguiguan, Tinian, Saipan, Alamagan and Pagan, possibly through the action of typhoons; it is therefore possible that surveys of other forested islands in the Northern Marianas, including Guguan, Agrihan, Asuncion and Maug, may result in the discovery of previously unknown colonies of endemic tree snails.

**Conservation actions**

Conservation actions that could enhance the likelihood of the continued survival of endemic tree snails in the wild are as follows. Descriptions and priority rankings for these conservation actions are given in Chapter 6.

For the Humped Tree Snail

| |
|---|
| Captive rearing and breeding of Partulid snails, and reintroduction to the wild |
| Conserve habitat for endangered bird species on Rota through an island-wide habitat conservation plan |
| Decrease deer numbers on the Sabana of Rota |
| Cull goats from the island of Aguiguan |
| Conserve remnant native limestone forest on Tinian by establishing a conservation area |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition |
| Improve management of terrestrial conservation areas in the southern islands |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Reforest disturbed areas with native tree species on the southern islands |
| Remove feral ungulates from the northern islands of Anatahan, Alamagan, Pagan and Agrihan |
| Prevent the introduction of invasive species to the northern islands |

For the Langford's Tree Snail

| |
|---|
| Captive rearing and breeding of Partulid snails, and reintroduction to the wild |
| Cull goats from the island of Aguiguan |
| Prevent further introductions of invasive species to the southern islands |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Reforest disturbed areas with native tree species on the southern islands |

For the Fragile Tree Snail

| |
|---|
| Captive rearing and breeding of Partulid snails, and reintroduction to the wild |
| Conserve habitat for endangered bird species on Rota through an island-wide habitat conservation plan |
| Decrease deer numbers on the Sabana of Rota |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition |
| Improve management of terrestrial conservation areas in the southern islands |
| Reforest disturbed areas with native tree species on the southern islands |

**Monitoring**

No monitoring is currently being undertaken for Partulid snails in the CNMI. Monitoring would be an important part of any conservation actions, such as captive breeding and re-introduction, which may be funded and implemented in the future.

# GECKOS and SKINKS

The terrestrial reptilian and amphibian fauna of the Northern Mariana Islands is comprised of two species of frogs and toads, two species of snakes, one species of monitor lizard, one species of anole lizard, six species of geckos, and seven species of skinks (Fritts et al. *n.d.*) Species native to the Mariana Islands occur only among the geckos and skinks. Out of thirteen species of geckos and skinks, eleven are native (Rodda et al. 1991). Two species of geckos – the Micronesian Gecko and the Rock Gecko -- and two species of skinks – the Tide-pool Skink and the Slevin's Skink -- are of particular conservation concern in the CNMI.

# MICRONESIAN GECKO

Figure 63. Micronesian Gecko.
Photo credit: Gordon Rodda.

**Common Name**
Micronesian Gecko

**Scientific Name**
*Perochirus ateles*

**Chamorro Name**
Guali'ek

**Carolinian Name**
Galuuf

**Listing Status**
The Micronesian Gecko is locally protected from take by regulation. It is the only lizard listed locally as a threatened and endangered species (CNMI 2000). It is not federally listed under the Endangered Species Act.

**Reasons for selecting the Micronesian Gecko as a species of special conservation need**
This gecko has been reported only from the islands of Rota, Tinian and Saipan. Although found to predate human colonization of the islands, it has notably declined in abundance in the Marianas and is now rare, especially when compared to other gecko species (Rodda and Dean-Bradley 2000). This species is at high risk of extirpation by the Brown Treesnake.

**Unique characteristics**
The Micronesian Gecko is the only gecko in the Marianas that has a conspicuously reduced toe and finger; the innermost digit lacks a claw and is partially fused with the adjacent digit. The toes are webbed (Fritts et al. *n.d.*). (See Figure 63.)

**Distribution and abundance of the Micronesian Gecko in the CNMI**
In the CNMI, the distribution of the Micronesian Gecko is restricted. In recent years, it has only been found on three of the southern islands of the archipelago, Rota, Tinian and Saipan. A single specimen was collected on Tinian in 1946, most likely from a narrow strip of inland forest below Mt. Lasu (Wiles et al. 1989a). After then, it was thought to have disappeared from Tinian (Wiles and Guerrero 1996), Rodda 1992). However, *Perochirus ateles* was again collected on Tinian in native forest by Haldre Rogers in 2003 (N. Hawley, pers. comm., September 2005). During field trips to Aguiguan in 1995 and to the northern islands of Guguan, Alamagan, Sarigan, Anatahan, Pagan and Agrihan in 2000, this species was not detected (Campbell 1995; Cruz et al. 2000c, 2000d, 2000e, 2000f, 2000g, 2000h).

This species does, however, occur on other Pacific islands, including Cocos Island (off Guam), the Caroline Islands, the Marshall Islands and far-flung Marcus Island (Rodda et al. 1991). It has been extirpated from Guam, presumably due to predation by Brown Treesnakes (Wiles and Guerrero 1996).

Compared to other gecko species, the Micronesian Gecko is rare. Wiles and Guerrero (1996) conducted field surveys for lizards and toads in 1991 and 1992 in a variety of habitats on the island of Saipan. They encountered only five individuals of *Perochirus ateles*, and found them only in native forest and secondary forest. This species was observed at a rate ranging from 0.1 to 0.2 animals per hour, whereas Mutilating Geckos (*Gehyra mutilata*) were observed at a rate ranging from 0.1 to 9.4 animals per hour, and Mourning Geckos (*Lepidodactylus lugubris*) were observed at a rate ranging from 0.1 to 5.0 animals per hour. (Ranges varied with habitat.)

Rodda and Dean-Bradley (2000) conducted a survey of lizard species on the island of Rota using total removal technology. Seven 10 x 10 meter patches of forest were surrounded by a lizard- proof barrier and all above-ground vegetation was removed and inspected minutely for lizards. Two plots were in limestone forest, two in pandanas forest, and three in tangantangan forest. Only one specimen of *Perochirus ateles* was found, in native forest. Compared to other geckos in the native forest plots, Micronesian Geckos were observed at a density of 50 per hectare, whereas Mutilating Geckos (*Gehyra mutilata*) were observed at a density of 1350 per hectare and Mourning Geckos (*Lepidodactylus lugubris*) were observed at a density of 2650 per hectare.

**Location and relative condition of key habitats for the Micronesian Gecko**

The Micronesian Gecko has only been found in native forest on Rota (Rodda and Dean-Bradley 2000), in native forest on Tinian (N. Hawley, pers. comm., September 2005), and in native forest and secondary forest on Saipan (Wiles and Guerrero 1996). It is notably absent from disturbed areas, including urbanized habitats, where other gecko species, especially the House Gecko (*Hemidactylus frenatus*), are abundant. However, Wiles and Guerrero (1996) noted that museum specimens of an unspecified collection date were taken from the inside of a house and from an old Japanese bunker, suggesting that the Micronesian Gecko may be widely distributed on the island of Saipan. In contrast, Rodda and Dean-Bradley (2000) suggest that the Micronesian Gecko may have been underestimated on Rota, because it probably is restricted to the tree canopies of undisturbed native forest, where herpetological samples are seldom taken.

The condition of native forests and secondary forests, key habitats for the Micronesian Gecko, is discussed in Chapter 4.

**Problems which adversely affect the Micronesian Gecko and its habitats**

Threats to the Micronesian Gecko include competition with other species, loss of habitat, and predation.

Competition with other gecko species

The Micronesian Gecko is a species of great antiquity in the Mariana Islands, having colonized the Marianas before human settlement. It has apparently abandoned its former habitats that have been overtaken by other, larger gecko species, such as the Island Gecko (*Gehyra oceanica*), which subsequently colonized the Marianas and which adapt more easily to disturbed habitats. Faced with competition from other gecko species, both native and introduced, the Micronesian Gecko has been forced to retreat to the restricted habitat of tree tops of undisturbed native forest (Rodda and Dean-Bradley 2000). The Mariana Islands have experienced the introduction of 9 – 11 species of reptiles and amphibians, resulting in a destabilization of resident herpetological communities. With continued man-induced alterations on the landscape, it is unlikely that an equilibrium will ensue in the foreseeable future (Rodda et al. 1991).

Loss of native forest habitat

Native forest cover has declined in extent on the islands of Rota, Tinian and Saipan since human settlement. During the Japanese administration (1914 – 1944), most of the native forest on Tinian and much on Rota and Saipan was converted to sugar cane fields. After World War II, virtually all native forest was removed on Saipan and Tinian (Engbring et al. 1986). Based on black-and-white aerial photos taken in 1976, Falanruw et al. (1989) reported limestone forest covering less than 7% of Tinian, about 4% of Saipan, and 57% of Rota. These estimates are based on photos now nearly three decades old, and although no new inventories on native forest extent have been made, recent economic growth has only accelerated habitat loss (Wiles and Guerrero 1996). The contraction of native forest, the primary habitat for the Micronesian Gecko, may account for the rarity of this species.

Predation by the Brown Treesnake

The extirpation of the Micronesian Gecko from Guam is probably the result of predation by the Brown Treesnake (*Boiga irregularis*). This gecko is larger than all other gecko species on Guam except *Gehyra mutilata* and is appropriately sized for most Brown Treesnakes (Rodda and Fritts 1992). In the event that this snake species establishes a breeding population on either Saipan or Rota, the Micronesian Gecko will likewise be extirpated from these islands.

## Priority research and survey efforts

Rodda and Dean-Bradley (2000) theorized that if the Micronesian Gecko has retreated to the canopies of trees in undisturbed areas, that it may have gone unobserved. It may exist in larger numbers in this undersampled habitat. It is also possible that this species occurs on the northern islands, but has simply not been observed during the few and infrequent expeditions to these remote islands. More study of the ecology of this species is needed to establish its habitat needs.

## Conservation actions

Until more is understood about the ecology and habitat requirements of the Micronesian Gecko, conservation actions cannot be specifically tailored to this species. Conservation of the Micronesian Gecko could be accomplished in a broader sense through the following conservation actions aimed at habitat protection.  Descriptions and priority rankings for these conservation actions are given in Chapter 6.

| |
|---|
| Conserve habitat for endangered bird species on Rota through an island-wide habitat conservation plan |
| Decrease deer numbers on the Sabana of Rota |
| Eradicate scarlet gourd (*Coccinia grandis*) from Saipan |
| Interdiction of the Brown Treesnake (*Boiga irregularis*) |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on the southern islands through avoidance and mitigation conditions placed on land development proposals |
| Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition |
| Improve management of terrestrial conservation areas in the southern islands |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Reforest disturbed areas with native tree species on the southern islands |

**Monitoring**

DFW has not incorporated systematic monitoring of reptiles in any of its programs, and lacks the funding at the present time to initiate a reptile monitoring program.  Program priorities are currently dedicated to conservation of forest and water birds (especially endangered species) and interdiction of Brown Treesnakes; other reptiles take the "lower rung" on the priority ladder.  Any monitoring of the Micronesian Gecko is likely to occur on an opportunistic basis, as funding and staffing is made available, and as priorities dictate.

# ROCK GECKO

Figure 64. Rock Gecko.
Photo credit: Gordon Rodda.

**Common Name**
Rock Gecko. Also, Pacific Slender-toed Gecko.

**Scientific Name**
*Nactus pelagicus*

**Chamorro Name**
Guali'ek

**Carolinian Name**
Galuuf

**Listing Status**
The Rock Gecko is not protected by regulation. It is not listed locally and not listed federally.

**Reasons for selecting the Rock Gecko as a species of special conservation need**
This gecko species is rare and very little is known about its ecology. It is difficult to study due to its vigilant and evasive behavior. It is afforded no regulatory protection.

**Unique characteristics**
This gecko prefers rocky habitats (Rodda et al. 1991). All individuals of the species are females, and lay eggs that are clones of themselves. No males are known from the Marianas (CNMI Division of Fish and Wildlife *n.d.*; Fritts et al. *n.d.*). It is alert and actively runs on the ground when approached. Although it may rely on its patterned coloration to blend into the background of rocks or litter, if threatened it will scurry into rock crevices and holes for refuge. It hides under objects on the ground during the day, but forages at night on the ground and on rough rock surfaces (Fritts et al. *n.d.*). (See Figure 64.)

**Distribution and abundance of the Rock Gecko in the CNMI**
Rodda et al. (1991) reported the Rock Gecko to occur only the southern islands in the Marianas archipelago, on Guam, Rota, Tinian and perhaps Saipan. In the early 1990s, this species had not been sighted in some time on Guam or Tinian (Wiles et al. 1989a, Rodda 1992), leading Wiles et al. (1990) to believe that the Rota population may have represented the only extant population remaining in the island chain. However, during field work conducted in 2000 and 2002, this species was newly discovered on the northern islands of Alamagan and Anatahan (Cruz et al. 2000d, 2003a). Because relatively few herpetological surveys have been conducted on the remote northern

islands, it is possible that the Rock Gecko occurs on other northern islands, but has not yet been detected.

Wiles et al. (1990) theorized that the presence of *Nactus pelagicus* on Rota, its absence from Guam and Tinian, and its presence on Saipan being only conjectural, could be explained by several factors. Rota remains in a relatively pristine condition, with native and secondary forests covering 60% of the island. Rota is free of feral pigs (which have disrupted lizard habitat on Guam), Brown Treesnakes (which have preyed on lizards on Guam), and two species of introduced skinks (which compete with or occasionally feed on native lizards on neighboring islands). Predation by musk shrews could severely impact lizard populations, but the shrew population on Rota has died out (Wiles and Guerrero 1989).

The Rock Gecko is believed to be rare in abundance when compared to other gecko species. During reptile surveys on Rota in 1988, Wiles et al. (1990) detected only 7 Rock Geckos, whereas numbers of other gecko species detected ranged from 14 to 23. Wiles et al. (*ibid.*) thought that the abundance of *Nactus pelagicus* at certain sites was probably somewhat greater than recorded in their survey, because these geckos often fled to crevices and rock openings before positive species identification could be made. On Alamagan in 2000, 1 Rock Gecko was collected; other gecko species collected ranged from 2 to 5 in number (Cruz et al. 2000d). On Anatahan in 2002, 2 Rock Geckos were collected; other gecko species collected ranged from 2 to 8 in number (Cruz et al. 2003a).

Rodda and Dean-Bradley (2000) studied gecko densities through total removal technology on Rota. Compared to other geckos in the limestone forest plots, Rock Geckos were observed at a density of 100 per hectare, whereas Mutilating Geckos (*Gehyra mutilata*) were observed at a density of 1350 per hectare, Island Geckos (*Gehyra oceanica*) were observed at a density of 950 per hectare, and Mourning Geckos (*Lepidodactylus lugubris*) were observed at a density of 2650 per hectare. Similar trends of rarity of the Rock Gecko were observed in the pandanus and tangantangan plots when compared to other gecko species.

**Location and relative condition of key habitats for the Rock Gecko**

Very little is understood about the ecology of the Rock Gecko. It apparently prefers a rocky habitat. During nighttime reptile surveys made on Rota in 1988, Wiles et al. (1990) found Rock Geckos in native forest on rock outcrops, boulders or limestone karst formations, or on the bare ground foraging next to rocks. However, some Rock Geckos were also discovered during daytime under sheets of plywood and other debris at a blown down shack next to a large opening dominated by *Mimosa invisa*, with no rocks nearby, suggesting that this species may inhabit a wider range of habitats than previously thought. The Rock Gecko from Alamagan was captured on the ground underneath a dead tree fern (Cruz et al. 2000d). Two Rock Geckos were collected on Anatahan in a decomposing *Neisosperma oppositifolia* tree (Cruz et al. 2003a).

Rodda and Dean-Bradley (2000) found the Rock Gecko to be widely distributed on the island of Rota, although having a preference for undisturbed sites, including limestone forest and pandanus forest. Too few samples were collected to determine the species' ecological requirements.

**Problems which adversely affect the Rock Gecko and its habitats**

Introduction and irruption of the shrew *Suncus murinus*

Rodda (1992) noted that the Rock Gecko had disappeared from Guam and Tinian, but was abundant in rocky habitats on Rota, an island that differs from Guam and Tinian in not having experienced the introduction and irruption of the shrew *Suncus murinus*. No recent data on shrew densities is available to determine if shrews may still be a factor in affecting Rock Gecko populations on Rota, Alamagan or Anatahan.

Predation by the Brown Treesnake (*Boiga irregularis*)

The disappearance of the Rock Gecko from Guam is probably attributable to the irruptions of both the musk shrew and the Brown Treesnake (Rodda and Fritts 1992). If the Brown Treesnake establishes breeding populations on any of the Mariana Islands, all gecko and skink species will face the threat of predation and extirpation.

**Priority research and survey efforts**

Ecology and life history study

The distribution, habitat requirements and ecology of the Rock Gecko are poorly understood. It is a difficult species to study, due to its vigilant and evasive habits. It was only very recently discovered on Anatahan and Alamagan, indicating that it may occur on others of the remote and relatively inaccessible northern islands as well. More comprehensive wildlife surveys would be required, both on the accessible, populated southern islands, and on the remote northern islands, to establish baseline data for this species.

**Conservation actions**

Until more is understood about the ecology and habitat requirements of the Rock Gecko, conservation actions cannot be specifically tailored to this species. Conservation of the Rock Gecko can be accomplished in a broader sense through the following conservation actions aimed at habitat protection. Descriptions and priority rankings for these conservation actions are given in Chapter 6.

| |
|---|
| Conserve habitat for endangered bird species on Rota through an island-wide habitat conservation plan |
| Decrease deer numbers on the Sabana of Rota |
| Interdiction of the Brown Treesnake (*Boiga irregularis*) |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition |
| Improve management of terrestrial conservation areas in the southern islands |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Reforest disturbed areas with native tree species on the southern islands |

| |
|---|
| Remove feral ungulates from the northern islands of Anatahan, Alamagan, Pagan and Agrihan |
| Prevent the introduction of invasive species to the northern islands |

**Monitoring**

DFW has not incorporated systematic monitoring of reptiles in any of its programs, and lacks the funding at the present time to initiate a reptile monitoring program. Program priorities are currently dedicated to conservation of forest and water birds (especially endangered species) and interdiction of Brown Treesnakes; other reptiles take the "lower rung" on the priority ladder. Any monitoring of the Rock Gecko is likely to occur on an opportunistic basis, as funding and staffing is made available, and as priorities dictate.

# TIDE-POOL SKINK

**Common Name**
Tide-pool Skink

**Scientific Name**
*Emoia atrocostata*

**Chamorro Name**
Unknown

**Carolinian Name**
Unknown

Figure 65. Tide-pool Skink on Saipan.
Photo credit: Gordon Rodda

**Listing Status**
The Tide-pool Skink is not protected by regulation. It is not listed locally and not listed federally.

**Reasons for selecting the Tide-pool Skink as a species of special conservation need**
This skink occupies a specialized habitat, in areas immediately adjacent to salt water. It is known from only five islands, Rota, Aguiguan, Forbidden Island (an islet off Saipan), Guguan and Alamagan. It may have gone undetected on other islands due to its wary nature. It is afforded no regulatory protection.

**Unique characteristics**
The Tide-pool Skink is an ecological specialist, occupying only areas immediately adjacent to salt water. It climbs among rocks and dense beach scrub vegetation, sometimes seeking refuge in tide pools (Fritts et al. *n.d.*). (See Figure 65.)

**Distribution of the Tide-pool Skink in the CNMI**
During the 1988 field survey at Rota conducted by Wiles et al. (1990), the Tide-pool Skink had been observed only on Cocos Island (a small islet off the coast of Guam); it was found for the first time on Rota during this survey. It was documented for the first time at Isleta Maigo Luao (Forbidden Island) off the southeastern coast of Saipan in 1992 and 1994 (Wiles and Guerrero 1996). It was found for the first time on the island of Aguiguan in 1995 (Campbell 1995).

Prior to 2000, it was thought that this species was limited to the southern islands of the archipelago. Consequently, during DFW's expedition in 2000 to six of the northern islands, adhesive traps were intentionally set at the shore in rocky strand and grassy habitats in an attempt to capture Tide-pool Skinks. *Emoia atrocostata* was discovered for the first time on Guguan and Alamagan (Cruz et al. 2000c, 2000d).

Elsewhere in the world, *Emoia atrocostata* is distributed from Japan to Taiwan, down the Malayan Peninsula to Australia and in the Pacific islands (Tan 2001).

**Abundance of the Tide-Pool Skink in the CNMI**

Abundance of the Tide-pool Skink in the CNMI has not been quantified. Wiles et al. (1990) described it as uncommon on Rota, due to its limited distribution. Wiles and Guerrero (1996) found this skink on Forbidden Island (adjacent to Saipan) to be common among the boulders and dense zone of *Pemphis* shrubs next to the shoreline, becoming less abundant with an increase in elevation. On Guguan, Tide-pool Skinks were trapped at a rate of 7.5 animals per trap hour in the strand habitat. Compared to other lizards in all other habitats, this was the highest trap rate, and may indicate a relative abundance of this species (Cruz et al. 2000c). On Alamagan, a single Tide-pool Skink was captured, at a calculated trap rate of 2.5 animals per trap hour. By comparison, ground trapping for other lizards yielded 148 captures, at a calculated trap rate of 7.55 animals per trap hour (Cruz et al. 2000d).

**Location and relative condition of key habitats for the Tide-pool Skink**

The Tide-pool Skink occupies a very limited habitat, never living far from salt water on rocky shorelines. This habitat is characterized by the presence of rocky bare ground, boulders, tide pools, the shrub *Pemphis acidulus*, tufts of coastal grasses, and other scrubby littoral vegetation (Wiles et al. 1990, Rodda et al. 1991, Wiles and Guerrero 1996). On Forbidden Island (an islet off Saipan), these skinks were also found adjacent to the shoreline, on a soil slope covered with *Wollastonia* vines, up to 25 meters in elevation (Wiles and Guerrero 1996). The shoreline habitat occupied by the Tide-pool Skink occurs in an extremely narrow and discontinuous strip. The extent or condition of this habitat for this species has not been mapped or quantified.

**Problems which adversely affect the Tide-pool Skink and its habitats**

Introduction of exotic reptile species

Rodda et al. (1991) pointed out that the Tide-pool Skink, as the most ecologically specialized of native lizards in the Marianas, and limited in distribution to the southern islands, might be more prone to population declines associated with the introduction of exotic reptile species. (However, since then, Cruz et al. (2000c, 2000d) found the Tide-pool Skink on two of the northern islands, Guguan and Alamagan.)

On Saipan, the Tide-pool Skink is known only from Forbidden Island, which is separated from the main island by a narrow channel. Wiles and Guerrero (1996) found the Tide-pool Skink to be common on Forbidden Island, but also found *Carlia fusca* (an aggressive, larger introduced skink) to be common on the Saipan-side of the channel. Apparently, the breaking water and tidal surge through the narrow channel is sufficient to keep *C. fusca* from crossing over to Forbidden Island, thereby creating a natural sanctuary for the Tide-pool Skink (*ibid.*). The introduction of *C. fusca* to the southern Marianas coincided with, and may be directly linked to, the possible local extirpation of *E. atrocostata* from the larger southern islands (*ibid.*). Insufficient data exist to prove the hypothesis that competition with exotic reptiles have resulted in declines in Tide-pool Skink populations on the southern islands of the Marianas, and more study is needed.

Predation by the Brown Treesnake

The Tide-pool Skink has never been documented on Guam (Steadman 1999; Rodda and Fritts 1992); therefore, a pattern connecting the introduction of the Brown Treesnake to Guam and the extirpation of the Tide-pool Skink cannot be asserted. The snake is implicated in the extirpation of several other native lizard species on Guam (Rodda and Fritts 1992), and it is reasonable to believe that, once a breeding population of Brown Treesnakes is established on any of the Mariana Islands, all gecko and skink species will be threatened with predation and probable extirpation.

**Priority research and survey efforts**

Survey of distribution on islets and northern islands

The wary Tide-pool Skink is difficult to study, because it eludes detection and capture. It is possible that this species has a wider distribution than already documented, and may exist on the other islets surrounding the southern islands (e.g. Bird Island and Mañagaha Island) (Wiles and Guerrero 1996), as well as on more of the northern islands (Fritts et al. *n.d.*).

Mapping of strand habitat

Habitat extent for the Tide-pool Skink is unknown and has not been mapped. The strand was too narrow for Falanruw et al. (1989) to map and quantify when studying the habitats of the southern islands. The strand habitat is important for the Tide-pool Skink, and should be considered if and when a CNMI-wide habitat mapping project is undertaken.

**Conservation actions**

Conservation of the Tide-pool Skink could be accomplished through the following conservation actions, aimed at protecting its specialized habitat. Descriptions and priority rankings for these conservation actions are presented in Chapter 6.

| |
|---|
| Translocate the Tide-pool Skink to the islets of Bird Island and Mañagaha Island |
| Conserve habitat for endangered bird species on Rota through an island-wide habitat conservation plan |
| Interdiction of the Brown Treesnake (*Boiga irregularis*) |
| Prevent further introductions of invasive species to the southern islands |
| Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition |
| Improve management of terrestrial conservation areas in the southern islands |
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Eradicate rats and other predators on islets |
| Prevent the introduction of invasive species to the northern islands |

**Monitoring**

DFW has not incorporated systematic monitoring of reptiles in any of its programs, and lacks the funding at the present time to initiate a reptile monitoring program. Program priorities are currently dedicated to conservation of forest and water birds (especially endangered species) and interdiction of Brown Treesnakes; other reptiles take the "lower rung" on the priority ladder.  Any monitoring of the Tide-pool Skink is likely to occur on an opportunistic basis, as funding and staffing is made available, and as priorities dictate. Studies to detect Tide-pool Skinks will be undertaken as a part of any expeditions to the northern islands.

# SLEVIN'S SKINK

Figure 66. Slevin's Skink.
Photo credit: Gordon Rodda

**Common Name**
Slevin's Skink

**Scientific Name**
*Emoia slevini*

**Chamorro Name**
Unknown

**Carolinian Name**
Unknown

**Listing Status**
The Slevin's Skink is not protected by regulation. It is not listed locally and not listed federally.

## Reasons for selecting the Slevin's Skink as a species of special conservation need

*Emoia slevini* is the only lizard endemic to the Mariana Islands. The ecology of this poorly understood species needs further study. The Slevin's Skink is easily confused with the Blue-tailed Skink (*Emoia caeruleocauda*) and the Tide-pool Skink (*Emoia atrocostata*). (See Figure 66.) It is uncommon on the southern islands of the archipelago, for unknown reasons (McCoid et al. 1995).

## Unique characteristics

Unlike other lizard species that occur in the Marianas but are also distributed throughout other parts of the Pacific and Asia, the Slevin's Skink is the only lizard species that is endemic to the Marianas.

## Distribution and abundance of the Slevin's Skink in the CNMI

Southern islands distribution and abundance

The Slevin's Skink appears to have previously occurred on the southern islands of the archipelago, but is probably now extirpated. During paleontological excavations in caves and rock shelters, Steadman (1999) found bones of Slevin's Skink at Tinian, Aguiguan and Rota. A very few specimens were collected from Guam, Rota and Tinian in the 1940s, but none have been seen on these islands since then. The reasons for this decline of *Emoia slevini* on the southern islands are not known (McCoid et al. 1995).

Northern islands distribution and abundance

Information on the distribution and abundance of Slevin's Skink in the northern islands of the archipelago is sparse, and qualitative in nature. Herpetological studies conducted in the 1980s and 1990s detected the Slevin's Skink on the northern islands of Alamagan and Asuncion, with the greatest abundance on Alamagan probably being explained by the substantial quantities of dung deposited by feral ungulates (McCoid et al. 1995). Rodda et al. (1991) hypothesized that, based on species richness / island-size relationships, Slevin's Skink should also occur on three additional northern islands, Anatahan, Pagan and Agrihan.

Slevin's Skink was found on Sarigan in 1997. Capture rates on Sarigan have greatly increased since the eradication of feral animals (Kessler 2002). Further studies are needed to determine if the Sarigan population is actually increasing (Cruz et al. 2000e). During DFW's expedition to the northern islands in 2000, Slevin's Skink was not captured on Guguan, Anatahan or Agrihan; was occurring "in relatively high numbers" on Alamagan; and was not captured on Pagan, although it had been found there for the first time in 1999 (Cruz et al. 2000c, 2000d, 2000f, 2000g, 2000h). Falanruw (1989) found three large *E. slevini* at Asuncion in the 1970s; the current status of Slevin's Skink on Asuncion is unknown.

**<u>Location and relative condition of key habitats for the Slevin's Skink</u>**

The habitat requirements of Slevin's Skink are not well known. Captures of Slevin's Skinks on the northern islands have all occurred in forested habitats, including ravine forests, native forests, coconut forests, and mixed secondary forest (McCoid et al. 1995; Cruz et al. 2000d, 2000e). The location and condition of forested habitats is discussed in Chapter 4.

**<u>Problems which adversely affect the Slevin's Skink and its habitats</u>**

<u>Probable competition with and predation by introduced species</u>

Reasons for the decline of or failure to develop denser populations on the southern islands of Guam, Rota and Tinian are unknown. Rodda et al. (1991) suggested that introduced species, including rats, shrews (*Suncus murinus*) and other reptiles, negatively impact native reptile populations, by aggressively competing for habitat and food resources and through predation. McCoid et al. (1995) saw no discernable pattern of introduced species having island-wide effects on populations of Slevin's Skinks. The Brown Treesnake (*Boiga irregularis*) was introduced to Guam after the apparent extirpation of Slevin's Skink from Guam. The Curious Skink (*Carlia fusca*), an aggressive kleptoparasitic skink, was introduced to the southern islands (including Guam) in the 1960s. On Cocos Island, where it was introduced in the 1980s, *C. fusca* lives sympatrically with *E. slevini* in forested areas. On Rota, however, *C. fusca* is absent, but *E. slevini* is still rare (McCoid et al. 1995).

<u>Forest habitat degradation and loss</u>

The ecology of the Slevin's Skink has not been studied sufficiently or for a long enough period of time to determine if the loss of forested habitats on the southern islands is cause for this species' decline. However, this Mariana endemic, once widespread across the entire archipelago, has been extirpated from the southern islands during the same period of time that native forests have been degraded and removed.

Predation by the Brown Treesnake

The Brown Treesnake may have played a role in the disappearance of the Slevin's Skink from Guam, although data is too scant to evaluate the loss for this species (Rodda and Fritts 1992). McCoid (1995) points out that the Brown Treesnake was introduced to Guam after the capture of the only specimen of *E. slevini*, but also, that herpetological studies for the period after snake introduction are lacking. Lizards made up a major portion of the smaller snakes' diets on Guam, in areas where birds and small mammals have already declined (Savidge 1987). Once a breeding population of Brown Treesnakes is established on any of the Mariana Islands, all gecko and skink species will be threatened with predation and probable extirpation.

**Priority research and survey efforts**

The ecology, habitat requirements, and life history of this species should be studied to determine the causes for its decline in the southern islands, and to design appropriate conservation measures for its continued survival in the northern islands.

**Conservation actions**

In the absence of ecological and life history information about the Slevin's Skink, it is not possible to design conservation actions specifically tailored to the conservation of this species. Conservation of the Slevin's Skink can be accomplished in a broader sense through the following conservation actions aimed at protecting habitats on the northern islands. Descriptions and priority rankings for these conservation actions are given in Chapter 6.

| |
|---|
| Develop island-wide habitat conservation plans for all islands in the archipelago |
| Assess the suitability of Sarigan Island to receive translocated birds and monitor forest succession and wildlife population trends on Sarigan following the eradication of feral ungulates |
| Remove feral ungulates from the northern islands of Anatahan, Alamagan, Pagan and Agrihan |
| Prevent the introduction of invasive species to the northern islands |

**Monitoring**

Monitoring of Slevin's Skink populations or study of its ecology and life history will be expensive due to the remoteness of the northern islands. Therefore, monitoring is likely to occur on an opportunistic basis, as funding and staffing is made available, and as priorities dictate.

# Chapter 6:
# CONSERVATION ACTIONS for TERRESTRIAL WILDLIFE of the CNMI





DIVISION OF FISH & WILDLIFE
CNMI






# Chapter 6: CONSERVATION ACTIONS FOR TERRESTRIAL WILDLIFE OF THE CNMI

## Key to Conservation Actions

Conservation actions for terrestrial species of special conservation need and their habitats are presented in this chapter, in a three-part series:

- Conservation actions that are specific to particular species or species groups. These are organized in order of species groups – cave dwellers first, followed by native forest birds, freshwater birds, seabirds, mammals, invertebrates and finally, reptiles.
- Conservation actions that apply to the southern islands. These are organized in order of islands from south to north – Rota first, followed by Aguiguan, Tinian, Saipan, and finally, groups of southern islands.
- Conservation actions that apply to the northern islands. These are organized in order of islands from south to north – Anatahan first, followed by Sarigan, Pagan, and finally, groups of northern islands.

Each conservation action is described by attributes: Conservation Action, Priority, Description, and Species and Habitats Conserved. Attributes are explained as follows.

**Conservation Action**

A brief title of the conservation action is given. This title corresponds to the same entry made for conservation actions in each species profile (Chapter 5). Because a given conservation action may apply to more than one species, there may be many corresponding entries in the various species profile. For example, "Interdiction of the Brown Treesnake (*Boiga irregularis*)" is one conservation action, but it benefits 19 different species of special conservation need. The title of this conservation action is therefore listed 19 times, once under each of those 19 species profiles in Chapter 5, but the full description of this conservation action is given in this chapter.

**Priority**

A priority ranking for the conservation action is given. Conservation Actions were ranked by priority of implementation. Priority ranking was done by a team consisting of DFW's three Wildlife Biologists and the Natural Resources Planner. Priority ranking was based on a point system, ranging from one point to five points, as follows.

- 5 points if a conservation action must be addressed within three to five years in order to prevent imminent degradation or loss of a species of special conservation need or its habitats
- 4 points if a conservation action must be addressed within five to ten years in order to prevent imminent degradation or loss of a species of special conservation need or its habitats
- 3 points if a conservation action is important, but other conservation actions are much more urgent and take precedence; or if a conservation action is desired, but not urgently needed within the next decade

- 2 points if a conservation action is desired, but is not imperative in preventing degradation or loss of a species of special conservation need or its habitats
- 1 point if a conservation action has been proposed for which the cost or effort expended would far exceed the conservation benefits to be gained, or for which successful achievement is doubtful

**Description**

A description of the conservation action is given. Conservation actions are generally described as broad and comprehensive goals. In this Comprehensive Wildlife Conservation Strategy, descriptions of conservation actions were not written as detailed objectives or project designs. The description explains why a conservation action is needed, what needs to be done, and how it can be accomplished.

**Species and Habitats Conserved**

Those species of special conservation need which will be conserved or benefited by implementation of the conservation action are listed. Any habitats which will be conserved or restored by implementation of the conservation action are then listed.

# Conservation actions that are specific to a particular species or to a group of species with similar habitat requirements

## Cave dwellers

| **Conservation Action**:<br>Protect limestone caves on Rota, Aguiguan, Tinian and Saipan from disturbance by people | **Priority**:<br>2 |
|---|---|
| **Description**: Mariana Swiftlets roost and nest exclusively in limestone caves, and are currently found only on the islands of Saipan and Aguiguan. The Sheath-tailed Bat requires limestone caves and crevices for roosting, and is found only on the island of Aguiguan. The largest Sheath-tailed Bat colonies are found in caves on cliffs that are inaccessible to humans and ungulates. Sheath-tailed Bats share five out of seven caves on Aguiguan with Mariana Swiftlets. In the future, Sheath-tailed Bats and Mariana Swiftlets may be translocated to caves on other southern islands where they do not now live. People should be kept out of caves where bats or swiftlets roost, or where translocations may occur in the future.<br><br>This conservation action can be accomplished through the following steps.<br>1. Public education. A public education campaign should be developed which explains the importance of not disturbing limestone caves for these two endangered species. Targeted public would include hunters, eco-tourism business ventures, hikers, spelunkers and recreationists.<br>2. Regulatory means. Current CNMI hunting regulations make it illegal to harass these two endangered species. The Tinian Mayor's Office regulates travel to Aguiguan; conditions should be placed on visitor permits to inform visitors not to disturb swiftlet or bat colonies in caves and crevices.<br>3. Signage at caves. Some swiftlet caves at Saipan have been marked with temporary signs to indicate the endangered status of swiftlets to visitors. More permanent signage is needed, especially at caves that are easily accessible by hikers, hunters, spelunkers and other visitors. Additional signs should be placed at Aguiguan caves as well, to notify visitors of the extreme risk of extinction of the Sheath-tailed Bat. | |
| **Species and Habitats Conserved**: Mariana Swiftlet, Sheath-tailed Bat. Limestone caves and crevices. | |

| **Conservation Action**:<br>Continue to control predation by cockroaches in swiftlet caves | **Priority**:<br>4 |
|---|---|
| **Description**: Cockroaches are known to devour swiftlet nests and molest swiftlet chicks in caves, causing nest failure and chick mortality. DFW has instituted a project to place cockroach traps in swiftlet caves on a regular basis on Saipan, and on an opportunistic basis on Aguiguan. These efforts will be continued as a regular part of DFW's operations. | |
| **Species and Habitats Conserved**: Mariana Swiftlet | |

| **Conservation Action**:<br>Translocate Mariana Swiftlets from Saipan to Rota | **Priority**:<br>4 |
|---|---|
| **Description**: Historically, swiftlets were once abundant on the island of Rota, as evidenced by presence of prehistoric swiftlet bones, deep guano deposits found in some caves, old nests and the remains of a fledgling found at Vampire Bat Cave and reports of senior residents. Swiftlets were last recorded on Rota in 1976 and have not been observed since then. Relocation of swiftlets to caves formerly used on Rota remains an objective of the recovery plan.<br><br>DFW has hired the Institute for Wildlife Studies to conduct a swiftlet diet study with ESA Section 6 funding. Insect availability will be studied at swiflet caves and foraging grounds on Saipan. Potential swiftlet cave sites on Rota will also be assessed for suitable swiftlet food availability. The results of these surveys will determine whether translocation of swiftlets from Saipan to Rota is feasible, and is the last remaining task before obtaining a permit from USFWS for the translocation. DFW is targeting 2007 as the year to start translocation of swiftlets to Rota. | |
| **Species and Habitats Conserved**: Mariana Swiftlet | |

**Native forest birds**

| **Conservation Action**:<br>Implement the Rota Agricultural Homestead Habitat Conservation Plan | **Priority**:<br>4 |
|---|---|
| **Description**: A Habitat Conservation Plan (HCP) has been written for proposed issuance of an incidental take permit under Section 10 of the ESA, for an agricultural homestead development proposed by the Marianas Public Land Authority on the island of Rota (Schroer 2005b). Currently, the HCP is under review by the U.S. Fish and Wildlife Service. Once this HCP is approved, it needs to be implemented.<br><br>Management goals of the Rota Agricultural Homestead HCP in the version currently under review are:<br>• Establishment of a 160 ha conservation mitigation area, for Mariana Crows and their habitat, located on the eastern end of Rota, to be held, managed and protected by DLNR.<br>• Develop and enforce regulations for the conservation area.<br>• Monitor populations of Mariana Crows, their habitats and their predators within the HCP conservation area.<br>• Educate the public and CNMI agencies about the HCP conservation area, its regulations, and the importance of conserving the Mariana Crow.<br>• Allow and encourage homesteaders to retain native forests on their homesteads.<br>• Report the HCP implementation progress.<br><br>There is an urgent need to provide a mitigation option for the agricultural homesteads demanded by the public on Rota. This HCP has been under development for many years and completion is needed without delay. | |
| **Species and Habitats Conserved**: Mariana Crow. Native forest; secondary forest. | |

**Freshwater birds**

| **Conservation Action**:<br>Take appropriate management action to reverse the decline in numbers of moorhen eggs and nests at Lake Hagoi on Tinian | **Priority**:<br>1 |
|---|---|
| **Description**: A priority research and survey effort has been identified, to determine the causes for the recent dramatic decline in numbers of moorhen nests and eggs at Lake Hagoi. Once the causes are determined, management actions to reverse the decline can be designed and implemented. | |
| **Species and Habitats Conserved**: Mariana Common Moorhen. (Not an action directed toward Habitats.) | |

**Seabirds**

| **Conservation Action**:<br>Conserve nesting habitat for Wedge-tailed Shearwaters at Mañagaha Island | **Priority**:<br>2 |
|---|---|

**Description**: A nesting colony of Wedge-tailed Shearwaters was discovered at Mañagaha Island in 2001. This is currently the only known nesting site for Wedge-tailed Shearwaters in the CNMI. This unique nesting habitat should be conserved to ensure continued nesting success of the shearwaters.

This conservation action can be accomplished by taking the following steps:

- Continue to monitor nesting success -- Surveys should be conducted at Mañagaha Island each nesting season to determine: number of banded birds returning to breed and nest; nesting success in terms of trends in numbers of burrows where eggs and chicks are found; juvenile and adult mortality rates; vegetation characteristics of preferred burrowing habitat; and whether predators have been re-introduced. Survey results should be used to establish trends in nesting success, and to determine whether additional management actions (e.g. predator control, increased public awareness) are warranted.
- Maintain cat- and rat-free status at Mañagaha Island -- Cats (*Felis cattus*) were humanely removed from Mañagaha Island during 2003 with help from Pet Assistance and Welfare Services, a non-profit pet advocacy group. DFW's use of rodenticide and snap traps during 2003 and 2004 succeeded in removing most, if not all, rats (*Rattus spp.*) from the islet, with the directly observable result that numbers of active nest sites of Wedge-tailed Shearwaters have increased from 46 in 2003, to 75 in 2004 (Kremer 2005c). Rats can be easily and accidentally re-introduced, however, by boats coming from Saipan and landing at the dock or beaching on the islet. Monitoring of the islet for the presence of cats and rats should continue. Rodent snap-trapping and rodenticide baiting should be conducted twice yearly for a two-week period to remove any rats that may have become established on Mañagaha Island (Schroer 2005a).
- Foster public awareness about the Wedge-tailed Shearwater nesting site at Mañagaha Island -- The nesting site for Wedge-tailed Shearwaters at Mañagaha Island was first confirmed in 2001. Since then, efforts have been made to inform the public about the importance of this site. DFW has encouraged the participation of various private and public groups in the management actions undertaken to protect the nesting site, including: students from the Northern Marianas College, youth employed through the Workforce Investment Agency, TREES (a non-profit group), individual volunteers, Tasi Tours, CNMI Coastal Resources Management Office, MPLA, CNMI Carolinian Affairs Office and Marianas Visitors Authority. It is expected that continued participation by these and other groups will engender local public awareness and support for continued shearwater conservation. It is more difficult to relay the message about the importance of the nesting site to foreign visitors. Mañagaha receives from 500 to 800 visitors per day (Schroer 2005a), and most of them do not speak or read English. An informative poster has been developed, explaining the shearwater

nesting site and the deleterious effects of predators. This poster still needs to be translated into the several languages used by tourists who visit the island, and then displayed on the transport ferries and at the landing dock. A nature trail circling the island that used to bisect the nesting area has been re-routed with the help of Workforce Investment Agency personnel so that it now goes around the shearwater nesting habitat. The old trail has been re-vegetated, both to increase nesting habitat, and to discourage tourists from walking through the area and trampling burrows. The habitat is demarcated with permanent cording and laminated paper signs. Additional permanent cording and multi-lingual signage are needed.

- Address shoreline erosion problems – The north and east sides of Mañagaha's shoreline have eroded since the removal of two partially submerged wrecks in 1995. Although the shoreline may be stabilizing, continued erosion should be monitored and appropriate management actions, such as revegetation, undertaken.

**Species and Habitats Conserved**: Wedge-tailed Shearwater. (Not an action directed toward Habitats.)

| **Conservation Action**: Continue to monitor seabird populations on FDM | **Priority**: 3 |
|---|---|
| **Description**: Seabird populations are monitored on a monthly basis at FDM by helicopter surveys, paid for by the U.S. Navy. The ordnance load at FDM makes it unsafe to conduct ground surveys; this is not likely to ever change. Survey results indicate that seabird populations remain stable, with expected seasonal fluctuations during nesting periods (Vogt 2005c, 2005d). Although the Navy is committed at the present time to funding a wildlife biologist to conduct surveys and track population trends, funding priorities for continued monitoring may change in the future in response to the military's needs. | |
| **Species and Habitats Conserved**: Masked Booby. (Not an action directed toward Habitats.) | |

| **Conservation Action**:<br>Establish a seabird recovery colony on Saipan | **Priority**:<br>1 |
|---|---|
| **Description**: During the development of the Integrated Natural Resources Management Plan for Military Lease Areas by the U.S. Navy (Helber Hastert and Fee 2003), DFW proposed the establishment of seabird recovery colonies at Saipan: a mixed colony of Brown Boobies and Masked Boobies on Forbidden Island, and a Red-footed Booby colony in the Marpi region of Saipan. The proposal called for consultation with experts on methods of establishment, development of an experimental design and protocols for colony establishment, contract of a biologist and technicians, allocation of monies and annual monitoring by the Navy. The Navy responded to this proposal by stating that a Memorandum of Understanding was being developed to address migratory bird issues, and specific projects would be considered at a later time. The proposed project was projected to cost $179,800, which exceeds the amount of an entire year's funding to the CNMI under SWG; therefore, the likelihood of the DFW carrying out this project is nil. The Navy has not committed to this project. | |
| **Species and Habitats Conserved**: Masked Booby. (Not an action directed toward Habitats.) | |

**Mammals**

| **Conservation Action**:<br>Translocate Sheath-tailed Bats to caves formerly occupied on Rota, Tinian and Saipan | **Priority**:<br>3 |
|---|---|
| **Description**: The Sheath-tailed Bat formerly occurred on Guam, Rota, Aguiguan, Tinian, Saipan and possibly Anatahan and Maug. Today, it occurs only on the island of Aguiguan. It is rare and in extreme danger of extinction. Priority research and survey efforts for this species would aid in determining if Sheath-tailed Bats could possibly be translocated to caves that they formerly occupied on the islands of Rota, Tinian and Saipan. Life history studies would yield information on foraging needs, cave habitat requirements and limiting factors. Pesticide studies may help determine if pesticide use contributed to the extirpation of the Sheath-tailed Bat from all Mariana Islands except Aguiguan. Paleobiological studies may identify formerly occupied caves on the remaining southern islands and provide sites for translocation. If results of these studies indicate that translocation is feasible, then a project can be designed to capture bats in caves at Aguiguan, transport them safely to caves at Saipan, Rota or Tinian, and release them. | |
| **Species and Habitats Conserved**: Sheath-tailed Bat. (Not an action directed toward Habitats.) | |

## Invertebrates

<table>
<tr><td>Conservation Action:<br>Improve hunter report card quality control and data analysis</td><td>Priority:<br>5</td></tr>
<tr><td colspan="2">Description: Hunter report cards are often submitted with incomplete or inaccurate entries. For example, the area hunted may be missing, or the number of hours hunted may show a start time, but no ending time. Some hunters fail to turn in report cards at all. Report cards have not been systematically analyzed for many years. With data missing or inaccurate, and data analysis not being done routinely, it is not possible to determine trends in take of hunted species, including coconut crabs.<br><br>This conservation action can be accomplished by:<ul><li>Examining hunter report cards for completeness before they are accepted by the Enforcement Section for submission.</li><li>Contacting licensed hunters at the end of each hunting season to remind them to submit their hunter report cards, as required by regulation.</li><li>Entering data from hunter report cards at the end of each season into a database and performing a simple analysis to determine trends in coconut crab harvest and hunter effort expended.</li></ul></td></tr>
<tr><td colspan="2">Species and Habitats Conserved: Coconut Crab. (Not an action directed toward Habitats.)</td></tr>
</table>

| Conservation Action: Captive rearing and breeding of Partulid snails, and reintroduction to the wild | Priority: 4 |
|---|---|

**Description**: Populations of endemic tree snails have become disassociated geographically from each other, and have fallen off to precariously low numbers. The most recent data on the abundance and distribution of endemic tree snails for the islands of Rota, Aguiguan, Saipan, Anatahan, Sarigan, Alamagan, and Pagan dates back to field work conducted a decade or more ago (Smith 1995). Before any concerted conservation action can be directed toward endemic tree snails, population surveys need to be conducted; State Wildlife Grant funding has been applied for, to complete a survey for Partulid snails on Aguiguan during 2006.

Once surveys are complete and the continued presence of endemic tree snails in the CNMI is known, a conservation action can be undertaken to rear and breed snails in captivity, and eventually release them to the wild. This conservation action can be accomplished by taking the following steps:

- <u>Captive rearing and breeding of Partulid snails</u> -- Captive propagation of Partulid snails could provide these animals with a reprieve from extinction (Smith and Hopper 1994). A captive rearing and breeding program for endemic tree snails occurred at the Marine Laboratory at the University of Guam, but had to be shut down recently due to lack of funding (B. Smith, pers. comm., September 2004). If it is determined from surveys of endemic snail populations in the Northern Mariana Islands that insufficient numbers of snails or small colony sizes exist and would benefit from the introduction of captive snails, then funding should be secured to re-establish this captive rearing and breeding program. Partulids are easy to maintain in the laboratory (Cowie 1992), and it is likely that such a program would be highly successful if given adequate financial support and if managed by qualified personnel.
- <u>Re-introduction of endemic tree snails to the wild, but in an exclosure</u> -- An experimental release of Partulids into a protected area of natural habitat was recently undertaken on the island of Moorea, Society Islands, in French Polynesia (Coote et al. 2004). A 20 by 20 meter exclosure surrounding natural vegetation was constructed of wooden posts set in concrete onto which were attached walls 75 cm in height, of galvanized iron roof panels. The barrier was further fortified against predators with a trough full of salt water at the bottom, and a pair of charged electric wires at the top. Partulids were released inside the exclosure. After four years of observation and maintenance, it was concluded that such an exclosure would allow Partulids to survive in wild conditions, but only if monitoring and maintenance of the barrier's mechanical, electric and chemical defenses were infallible. The Moorea experiment was discontinued after four years due to serious problems with maintenance. Similar exclosures could be established in the Northern Mariana Islands to enhance the numbers of the three Partulid species now in decline, and to allow natural speciation to occur in the wild. Such an undertaking would require unfailing attention to keeping predators out of the exclosures through regular and frequent monitoring and maintenance.
- <u>Eradication of predatory flatworms and re-introduction of endemic tree snails to</u>

| |
|---|
| the wild -- If the exclosure method proves to be successful in the Northern Mariana Islands, the conservation strategy could be applied to larger areas. According to Barry Smith (pers. comm., Sept. 2004), it would be imperative to remove all terrestrial flatworms from the selected habitat, by attracting them into a localized area and exterminating them. Once flatworms and other predators of Partulids were removed, the snails could be introduced and left to do their job of reproducing, in the absence of predators. Such a proposal would be labor intensive, especially in the beginning. Smith has proposed such a project for Guam, and although it received a good technical rating, it was not funded by the U.S. Fish and Wildlife Service. Such a project is proposed here for the Northern Mariana Islands, with the hope of being funded by continuing State Wildlife Grants. |
| **Species and Habitats Conserved**: Humped Tree Snail, Langford's Tree Snail, Fragile Tree Snail. (Not an action directed toward Habitats.) |

**Reptiles**

| **Conservation Action**: Translocate the Tide-pool Skink to the islets of Bird Island and Mañagaha Island | **Priority**: 1 |
|---|---|
| **Description**: With the exception of Forbidden Island, the distribution of the Tide-pool Skink on islets off the southern islands of the CNMI is unknown. The wary Tide-pool Skink is an ecological specialist, occupying the strand habitat only. Islets may provide refuges for the Tide-pool Skinks, and protect them from competition with and predation by introduced reptiles and mammals. More study is required to determine if the Tide-pool Skink already occupies Bird Island and Mañagaha Island, and if these islets are suitable for receiving translocated Tide-pool Skinks. Prior to translocation, any predators would have to be eradicated. (See conservation action "Eradicate rats and other predators on islets".) | |
| **Species and Habitats Conserved**: Tide-pool Skink. (Not an action directed toward Habitats.) | |

## Conservation actions that apply to the southern islands

### Rota

| **Conservation Action**: Conserve habitat for endangered bird species on Rota through an island-wide habitat conservation plan | **Priority**: 5 |
|---|---|
| **Description**: Most major development projects on Rota have been restricted from moving forward due to direct and indirect impacts that they may have on the endangered Mariana Crow. The Mariana Crow is threatened by human persecution and unregulated clearing of forested habitat. An adversarial relationship has resulted between developers and conservationists. An incidental take permit under Section 10 of the ESA for all proposed uses on the entire island of Rota would provide an avenue of reconciliation. An island-wide habitat conservation plan (HCP) would provide a practical, efficient and effective way to settle land use and endangered species issues on Rota. It is expected that important forest habitat will be conserved, not only for the Mariana Crow, but also for other species of special conservation need (CNMI Division of Fish and Wildlife 2005).<br><br>DFW has submitted a project proposal to the U.S. Fish and Wildlife Service to develop an island-wide HCP for Rota, under Non-Traditional Section 6 funding. DFW is waiting for approval of the project from the USFWS before proceeding with the hiring of a contractor to write the HCP. | |
| **Species and Habitats Conserved**: Particularly the Mariana Crow, but also all other species of special conservation need occurring on Rota will benefit: Mariana Fruit Dove, Rota Bridled White-eye, Rufous Fantail, White-throated Ground Dove, Mariana Common Moorhen, Mariana Fruit Bat, Coconut Crab, Fragile Tree Snail, Humped Tree Snail, Micronesian Gecko, Rock Gecko, Tide-pool Skink. Habitats: Native forest; secondary forest. | |

| **Conservation Action**:<br>Decrease deer numbers on the Sabana of Rota | **Priority**:<br>3 |
|---|---|

**Description**: Browsing by deer (*Cervus mariannus*) is one of the causes of forest habitat degradation on the Sabana of Rota. Deer are not native to the Mariana Islands, but are popular game animals. To prevent further forest degradation, deer should be reduced in number.

One approach would be to liberalize hunting regulations. Current regulations for deer hunting include (CNMI 2000):

- A license costing $10 is required to hunt deer.
- Only a limited number of licenses will be issued each year, to a pool of registered hunters.
- Only residents are allowed to hunt deer.
- The bag limit is 1 deer, the season limit is 1 deer, and the season is from September 1 to November 30 each year.
- Hunters must obtain registered deer tags, and if deer are taken, tags must be immediately attached to the carcass.
- After gutting, a hunter must bring the deer to the DFW designated deer check station for inspection, weighing and recording of the tag number.
- Any hunter who brings any part of a deer to another CNMI island must first obtain a Certificate of Origin and present it to Customs or Quarantine officials upon entering another CNMI island.
- Only antlered, male deer may be taken.
- Captive or domesticated deer may be kept, but must be registered and marked with a numbered tag issued by DFW.
- The Director of DFW shall have the authority to direct DFW staff to destroy feral deer which are damaging threatened or endangered species or habitat essential for the survival of endangered or threatened species.

Regulations could be amended and liberalized to encourage greater take of deer by hunting. Amendments could include:

- increasing bag limits
- increasing season limits
- lengthening the season
- not restricting the number of deer hunting licenses issued
- removing the requirement to tag deer
- allowing hunting of does
- opening deer hunting to non-residents
- disallow keeping of captive or domesticated deer

Any proposal to reduce deer numbers would probably be met with some degree of opposition from the public. A public outreach program needs to be developed to educate the public about the ecological damage caused by deer and the need to reduce their numbers on the Sabana.

**Species and Habitats Conserved**: Particularly the Rota Bridled White-eye and the Mariana Crow, but also other wildlife inhabiting the forests of the Sabana: Mariana Fruit Dove, Rufous Fantail, White-throated Ground Dove, Mariana Fruit Bat, Coconut Crab, Fragile Tree Snail, Humped Tree Snail, Micronesian Gecko, Rock Gecko. Habitats: Native forest; secondary forest.

**Aguiguan**

| **Conservation Action**: Cull goats from the island of Aguiguan | **Priority**: 5 |
|---|---|
| **Description**: The large population of feral goats on the island of Aguiguan is severely limiting regeneration of most tree species. From a wildlife conservation standpoint, the desired objective would be to completely eradicate goats from Aguiguan, but complete eradication is locally opposed. Aguiguan is called "Goat Island" because of the presence of goats which people enjoy hunting. There is public support for removing goats from Aguiguan. Access to the island is controlled through the Tinian Mayor's Office through a landing permit program. Hunting is managed by the Resident Director of the Tinian DLNR.<br><br>In 2005, a special hunting season was opened in January by the Resident Director of the Tinian DLNR, and was closed in July after 500 goats had been harvested (J. San Nicolas, pers. comm., August 2005). The regular hunting season will open again in September.<br><br>Special hunts for culling goats should be continued in the future. Successful implementation of this conservation action will depend on the continued dedication of the Resident Director for Tinian DLNR to declare special open hunts as a management tool, and on the Mayor of Tinian to grant landing permits to hunters for access to Aguiguan. Forest seedling regeneration should be monitored to determine if rates of culling goats are sufficient. | |
| **Species and Habitats Conserved**: Native forest birds of Aguiguan: Golden White-eye, Mariana Fruit Dove, Mariana Swiftlet, Micronesian Megapode, Nightingale Reed-warbler, Rufous Fantail, Saipan Bridled White-eye, White-throated Ground Dove. Also, both the Mariana Fruit Bat and the Sheath-tailed Bat; Coconut Crab; Humped Tree Snail and Langford's Tree Snail. Habitats: Native forest; secondary forest. | |

| **Conservation Action**: Eradicate rats, cats and other predators from Aguiguan Island | **Priority**: 4 |
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| **Description**: Cruz et al. (2000b) noted that the increase in rat numbers and the abundance of monitor lizards on Aguiguan is cause for concern as they may have a future impact on native bird species and, in conjunction with the effects of feral animals, could impede recovery efforts. During the public participation phase of this plan, respondents stated that the greatest threat to Coconut Crabs on Aguiguan appears to be from monitor lizard predation. Cats and dogs may also be present on Aguiguan. These are anecdotal observations; the status of predators on Aguiguan has not been studied. A predator study is needed to determine what the most destructive predators are, the extent of their effect on avian populations and on the Sheath-tailed Bat, and what control measures can be undertaken that are feasible and cost-effective. A program could then be designed and implemented for the eradication of predators from Aguiguan Island. | |
| **Species and Habitats Conserved**: Native forest birds of Aguiguan: Golden White-eye, Mariana Fruit Dove, Mariana Swiftlet, Micronesian Megapode, Nightingale Reed-warbler, Rufous Fantail, Saipan Bridled White-eye, White-throated Ground Dove. Also, the Sheath-tailed Bat and Coconut Crab. (Not an action directed toward Habitats.) | |

**Tinian**

| **Conservation Action**:<br>Conserve remnant native limestone forest on Tinian by establishing a conservation area | **Priority**:<br>5 |
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**Description**: Whereas Tinian was historically heavily forested, less than 5% of the island's land is now in native limestone forest. This habitat is the most productive for the Tinian Monarch, and should be protected. A homestead development is currently being planned for the Carolinas region, and it appears that it will encompass native forest habitat.

In 1998, Senate Local Bill 11-2 was introduced to establish a wildlife conservation area on the southeast side of Tinian, in the Kastiyu, Barangka and Piña areas. The proposed conservation area would have encompassed a great part of the remaining native limestone forest on Tinian, with the goals of protecting the region's bird species, coconut crabs, reptiles and diverse flora, as well as protecting an aquifer and providing eco-tourism opportunities. Unfortunately, the Governor vetoed this measure, citing the need for a biological assessment of the area and the inadequacy of naming the conservation for only five years. The biological assessment has since been completed; findings are published in a technical report (Cruz et al. 2000a). In the three subsequent CNMI Legislatures, no similar measure has been passed. However, there is public support for pursuing the establishment of this conservation area. (See Chapter 9.)

Public Law 14-19 was passed on July 13, 2004 (Fourteenth Northern Marianas Commonwealth Legislature, First Regular Session, 2004). This new law dictates, in Section 2:

> Such areas of public land on the island of Tinian as may be suitable for village and/or agricultural homesteads, specifically the Kastiyo and Carolinas areas, and which are not required for government use or other purposes by any other provision of law, is hereby designated on behalf of the people of Tinian who are of Northern Marianas descent and reserved for village and/or agricultural homestead purposes.

It is not clear whether the lands designated for homesteads under this new law encompass the native limestone forest areas.

In a letter dated February 22, 2005, the Marianas Public Lands Authority requested release of ten village house lots within the Carolinas Heights Subdivision from permit conditions preventing their development due to the presence of the endangered Tinian Monarch, because delisting had occurred. DFW responded that such release could not be granted, because although the Tinian Monarch had been delisted federally, this species is still locally listed as a threatened and endangered species under CNMI regulations.

The remaining native limestone forest on Tinian is under threat of development. There is an immediate need for DFW and/or DLNR to intervene and attempt to halt MPLA's plan to develop this area into homestead lots, and to advocate for the establishment of a conservation area. This conservation action requires the talent of a wildlife policy

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| advocate who can be successful in negotiating with MPLA and the Legislature to change the direction of development proposals. DFW currently has no staff dedicated to policy matters. |
| **Species and Habitats Conserved**: Particularly the Tinian Monarch, but also other native forest birds of Tinian: Mariana Fruit Dove, Rufous Fantail, Saipan Bridled White-eye and White-throated Ground Dove. Also, Mariana Fruit Bat and Coconut Crab. Potentially, the Humped Tree Snail. Habitat: Native forest. |

**Saipan**

| **Conservation Action**: Eradicate scarlet gourd (*Coccinia grandis*) from Saipan | **Priority**: 5 |
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**Description**: The most rapidly spreading invasive plant at Saipan is the scarlet gourd, *Coccinia grandis*. This aggressive vine climbs over trees, smothering the canopy, choking out sunlight and eventually killing the forest. Efforts to eradicate this pest should be substantially increased.

DLNR's Division of Agriculture has been working cooperatively with Dr. Rangaswamy Muniappan at the University of Guam, College of Agriculture and Life Science on a spectrum of biological control agents. *Acythopeus cocciniae* is a weevil native to Africa that has been introduced and successfully established on Saipan in a few locales. The adult weevils feed on the leaves of the scarlet gourd plant, causing numerous holes in the lamina of the leaves. The weevils then lay eggs in the holes. Eggs hatch, and the larvae mine the leaves. Adult feeding and larval mining can cause drying of the leaves and eventually defoliate scarlet gourd vines (U.S. Department of Agriculture 2003). During the dry season, *A. cocciniae* has been successful at defoliating large patches of scarlet gourd vines in the locales in which they are released, but the scarlet gourd can out-grow the weevils' damage during the rainy season (Dr. Muniappan, pers. comm., July 2005).

*Acythopeus burkhartorum* is another weevil that lays its eggs singly by inserting them into the young petioles or tendrils of the scarlet gourd plant. Eggs hatch, and the larvae form galls during the pupation stage. Adult feeding on the leaves and larval galling of petioles and tendrils can cause drying of the leaves and eventual defoliation of the vines (U.S. Department of Agriculture 2004). *A. burkhartorum* has also been released on Saipan, but it has been difficult to establish in the field (Dr. Muniappan, pers. comm., July 2005).

A third biological control is *Melittia oedipus*, a stem and root-boring moth (U.S. Department of Agriculture 2003). A permit has not yet been obtained from the U.S. Department of Agriculture, Animal and Plant Health Inspection Service (APHIS) to release this moth in the CNMI; host specificity testing is being conducted currently, and an Environmental Assessment must be written and approved (Dr. Muniappan, pers. comm., July 2005).

All three of these biological controls – *A. cocciniae*, *A. burkhartorum* and *M. oedipus* – have resulted in successful control of scarlet gourd in Hawaii (U.S. Department of Agriculture 2004), and it is hoped that a high degree of success will be achieved for controlling scarlet gourd in Saipan using the same three agents. Some obstacles must be overcome:

- *A. burkhartorum* is difficult to rear and to keep alive once field-released.
- It will be some time – at least a year -- before the permit from the U.S. Department of Agriculture APHIS will be issued for introducing and establishing *M. oedipus* on Saipan.

- Releases of *A. cocciniae* and *A. burkhartorum* to date have been made in small locales, near residential or agricultural developments. Now that the scarlet gourd vine is spreading at an aggressive and alarming rate, even into Saipan's conservation areas, there is a need to ramp up the production of biological control agents and to disperse them across wider areas on the island.
- Difficulties have been encountered in rearing weevils on Saipan in the laboratory. There is a need to improve or construct new rearing facilities on Saipan, to reduce the dependence on the University of Guam to supply weevils for field release.
- Difficulties have been encountered in finding weevils on Saipan after typhoons, and new introductions have had to be made from Guam.

Still another option is available for controlling scarlet gourd vines. They can be removed mechanically and/or treated with chemical herbicides. This option is not very workable, because the extent of the spread of the vines is too large for manual removal, and because chemical herbicides are too expensive. On Rota, however, mechanical and chemical removal of the vines is being undertaken (Dr. Muniappan, pers. comm., July 2005), because the area affected is small enough to employ these more expensive and labor intensive eradication efforts.

This conservation action consists of pursuing the following steps:

- DFW should work with DLNR – Div. of Agriculture to prioritize the release of weevils in areas where scarlet gourd vines are beginning to encroach on the limited native forest and secondary forests of Saipan that are important wildlife habitat. Assistance by DFW staff could be offered to disperse weevils.
- DFW should investigate the possibility of chemical treatment of scarlet gourd vines in areas where they are beginning to encroach on the limited native forest and secondary forests of Saipan that are important for wildlife habitat; and should identify funding sources for chemical control.
- DFW should support the efforts of DLNR – Div. of Agriculture and University of Guam in writing the Environmental Assessment and obtaining the U.S. Department of Agriculture APHIS permit to release *M. oedipus* on Saipan, through offering technical assistance.

**Species and Habitats Conserved**: Native forest birds on Saipan: Golden White-eye, Mariana Fruit Dove, Mariana Swiftlet, Micronesian Megapode, Nightingale Reed-warbler, Rufous Fantail, Saipan Bridled White-eye, White-throated Ground Dove. Also, Mariana Fruit Bat, Coconut Crab, Micronesian Gecko. All forested habitats: native forest, secondary forest, tangantangan forest, agricultural forest, urban.

## Groups of southern islands

| **Conservation Action**:<br>Interdiction of the Brown Treesnake (*Boiga irregularis*) | **Priority**:<br>5 |
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**Description**: A concise description of the threat posed by the Brown Treesnake to avian populations in the CNMI is given by Colvin et al. (2005):

> BTS clearly poses a significant, immediate, and regional threat to natural resources and economics that should not be underestimated, and this risk is spreading through transportation routs. The risk is greatest for Saipan, but Hawaii and other islands in the Pacific Basin are vulnerable. Repeated BTS sightings on Saipan indicate that an incipient population is now present there. Unlike Guam, where BTS has decimated avian populations, CNMI still harbors many native bird species.

A total of 75 confirmed sightings of snakes matching the description or behavior of Brown Treesnakes have been reported in the CNMI since 1982. A total of eleven Brown Treesnakes have been captured on Saipan, and two snakes have been captured on Rota (Hawley 2005).

It is absolutely crucial that the Brown Treesnake be interdicted on the islands of the CNMI, and prevented from establishing breeding populations.

The DLNR - DFW Brown Treesnake Program, with the help of numerous federal agencies, implements several strategies and programs to effectively prevent and control the entry, establishment, and spread of the Brown Treesnakes into the CNMI.

- Trapping Program – Approximately 400 traps, which are designed to attract and capture Brown Treesnakes, have been strategically placed around high-risk areas (ports of entry, recent snake sighting locations, and construction sites) within the CNMI since 1991. There is no recorded capture of a Brown Treesnake using the trap in the CNMI, but it is currently the effective way of capturing snakes in high-density areas on Guam, where 4,000 to 6,000 snakes are captured per year (N. Hawley, pers. comm., June 2005).
- Detector Dog Teams – The use of detector dog teams was first introduced in the CNMI in 1997 due to its success in Guam. The CNMI currently employs five operational detector dog teams (four Jack Russell Terriers and one German Shepherd) that inspect Guam-based cargo as it arrives at Saipan and Tinian ports of entry. Although the CNMI has not captured any Brown Treesnakes with detector dogs, they have been tested to be 60% to 70% effective in finding snakes in cargo. Wind scent training has been added to the Detector Dog Program to aid staff in locating a snake during a rapid response effort following a snake sighting. It is estimated that the CNMI would need to acquire an additional four detector dog teams to inspect 100% of all Guam-based cargo entering the CNMI. Currently, only Saipan and Tinian have detector dog teams, however future plans including the procurement of a detector dog team for Rota.
- Containment Barriers – Containment barriers are utilized to quarantine high-risk

cargo at the port of entry before the cargo is moved to its final location. A containment barrier consists of a snake-proof wall made of pre-stressed concrete that is four feet high with a one-foot overhang to prevent a snake from breeching the wall. To be effective, the pre-stressed concrete must be extremely smooth to prevent the snake from establishing a "foot hold" to leverage itself over the wall. A stainless steel gate made in the same design allows cargo handlers to move cargo in and out of the containment area. Several designs have been tested for containment barriers, but Saipan's is considered the prototype, found to be the most advanced and provides the greatest resistance to typhoon-force winds. It is being used as a Brown Treesnake quarantine facility for high-risk cargo, i.e. cargo that has not been inspected in Guam before coming to Saipan. The cargo is put under quarantine for up to 72 hours to ensure it is snake free. Clearing of high-risk cargo may be expedited by utilizing detector dogs, 100% unpacking, and possibly thermal control. Construction of the containment barrier at Saipan's commercial seaport was difficult to accomplish due to forfeiture by the initial construction contractor, but construction was completed in June 2004. Plans are underway to construct containment barriers for Tinian and Rota; the U.S. Fish and Wildlife Service obligated $200,000 for Tinian's containment barrier in August 2004 (Colvin et al. 2005; Hawley 2005; N. Hawley, pers. comm., June 2005).

- Public awareness and outreach – DFW's public outreach program has been lauded for its partnership with private industry (Colvin et al. 2005). Public awareness of the BTS threat has been enhanced by using popular media – including bumper stickers, frig magnets, can cozies, and a custom paint job on the BTS pick-up truck – and the establishment of a BTS hotline – call 28-SNAKE! The effectiveness of the outreach effort can be measured by the response time elapsing between a snake sighting and its being reported to DFW: 126 hours before the hotline was established, and 2 hours after (Hawley 2005).

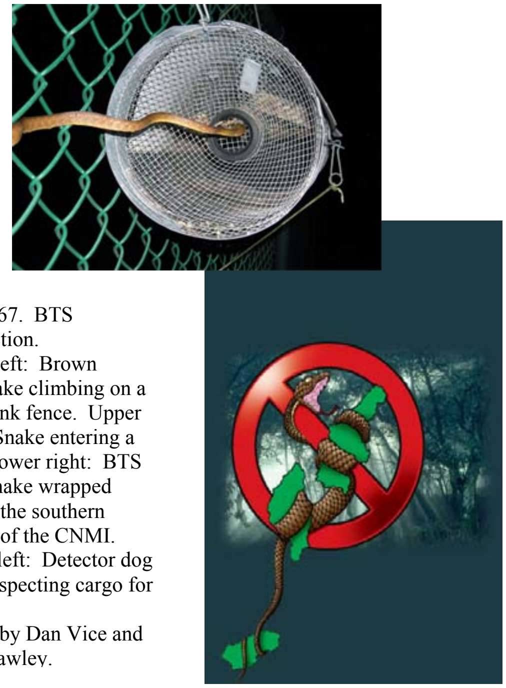

Figure 67. BTS interdiction.
Upper left: Brown Treesnake climbing on a chain link fence. Upper right: Snake entering a trap. Lower right: BTS logo, snake wrapped around the southern islands of the CNMI.
Lower left: Detector dog team inspecting cargo for snakes.
Photos by Dan Vice and Nate Hawley.

In spite of these ongoing efforts to interdict Brown Treesnakes in the CNMI, the sentiment toward success was appropriately expressed by BTS Program Supervisor Nate Hawley, "I feel like the little Dutch boy with his finger in the dike." Infestation of the islands of the CNMI is a very likely probability.

This ongoing conservation action can be enhanced by taking the following steps:

- Increase the number of BTS traps at all CNMI Ports of Entry and other high-risk areas.
- Increase the amount of visual night searching activities to identify and contain possible introductions.
- Implement Integrated Pest Management Programs at all CNMI Ports of Entry that specifically address BTS and prey species (*Rattus spp*.).
- Establish a program that works directly with the BTS Research Node of USGS/USDA-Wildlife Services to implement containment, control, and eradication methodologies into the CNMI BTS Interdiction Program.
- Increase the number of canine teams to address the increase of cargo shipped to the CNMI.
- Establish a containment barrier and protocol for the island of Rota.
- Continuation of awareness efforts across the CNMI Archipelago.

**Species and Habitats Conserved**: All native forest birds occurring on the southern islands: Golden White-eye, Mariana Crow, Mariana Fruit Dove, Mariana Swiftlet, Micronesian Megapode, Nightingale Reed-warbler, Rota Bridled White-eye, Rufous Fantail, Saipan Bridled White-eye, Tinian Monarch, White-throated Ground Dove. Freshwater bird: Mariana Common Moorhen. Seabirds: Masked Booby and Wedge-tailed Shearwater. Mammals: Mariana Fruit Bat and Sheath-tailed Bat. Reptiles:

Micronesian Gecko, Rock Gecko, Tide-pool Skink. (Not an action directed toward Habitats.)

| **Conservation Action**:<br>Translocation of native forest birds from the southern islands to the northern islands and establishment of a captive breeding program | **Priority**:<br>5 |
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**Description**:
Based on funding reductions in Guam's Brown Treesnake (BTS) program, the number of BTS sightings in the CNMI, and the rapid decline in avifauna populations experienced with Brown Treesnake (*Boiga irregularis*) introduction, it is imperative that measures be taken to ensure the future of the CNMI's endemic birds. There are two viable options for conserving endemic birds before Brown Treesnake infestation results in their demise on the southern islands of Saipan, Rota and Tinian: 1) translocate endemic birds to the northern islands; and 2) establish a captive breeding program for endemic birds.

Successful implementation of this conservation action will require multiple steps, as follows:

- <u>Survey the northern islands for suitability to receive translocated birds</u>. DFW has selected Sarigan Island for the first of these suitability studies. Sarigan Island is a good candidate for receiving translocated birds because: 1) feral animals have been entirely eradicated; 2) recovery of native forests is occurring; and 3) transportation cost and time to Sarigan is less than for other more remote northern islands.
- <u>Prioritize the order in which bird species will be selected for translocation and captive breeding</u>. DFW has selected the Saipan Bridled White-eye (*Zosterops conspicillatus saypani*) as the first avian species to be translocated to Sarigan. The Saipan Bridled White-eye is a good candidate species for translocation to Sarigan because: 1) it is the most abundant endemic bird species in the southern islands of the CNMI; 2) it is not endangered, but its distribution is limited to only three islands; 3) white-eyes were the first avian species to become extinct from Guam as a result of Brown Treesnake infestation (Savidge 1987); and 4) success in translocation of this one species will drive translocation plans for other species in the future. Non-endangered bird species including the Mariana Fruit Dove, the White-throated Ground Dove, and the Saipan Bridled White-eye will likely be the first species selected for captive breeding (Luscomb and Roberts 2005). The next priority species, both for captive breeding and for translocation, will be the Rufous Fantail, Tinian Monarch and Golden White-eye, because these are not endangered species. Endangered bird species will likely be selected later for captive breeding and translocation because they are rare, more limited in distribution, and will require permits from the U.S. Fish and Wildlife Service to capture and move.
- <u>Study the needs of individual species and develop appropriate handling methods.</u> Before translocation or captive breeding programs are developed, there is a need develop and refine techniques to capture birds, acclimate birds to captivity, hold them for various lengths of time, and safely transport them.
- <u>Pursue cooperative agreements with the U.S. Fish and Wildlife Service and zoos.</u> The Marianas Avifauna Conservation (MAC) Project is currently being drafted between DFW, the U.S. Fish and Wildlife Service and the American Association

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| of Zoos and Aquariums (AZA). The draft agreement lays out the roles for each agency to carry out conservation actions, namely: develop techniques to capture, hold, transport, and breed select species; translocation species between islands; develop captive populations; and develop community support for conservation through public education (Luscomb et al. 2005). |
| **Species and Habitats Conserved**: Native forest birds of the southern islands: Golden White-eye, Mariana Fruit Dove, Nightingale Reed-warbler, Rota Bridled White-eye, Rufous Fantail, Saipan Bridled White-eye, Tinian Monarch, White-throated Ground Dove. (Not an action directed toward Habitats.) |

| **Conservation Action**:<br>Prevent the introduction of West Nile Virus to the Mariana Islands | **Priority**:<br>5 |
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**Description**: The mosquito-borne West Nile Virus has infected most of the states of the U.S. If it reaches the CNMI, it will pose a significant threat to avian species, especially the Mariana Crow (Amidon 2005a) and Rota Bridled White-eye (Amidon 2005b). It is not known if West Nile Virus could affect either of the native bats of the CNMI, but it has been reported in other bat species (Centers for Disease Control 2003).

To respond to the impending threat of West Nile Virus, the CNMI Department of Lands and Natural Resources issued an Emergency Order of Quarantine on October 2, 2002, prohibiting the import of birds or poultry (except hatching eggs of chickens and day-old chicks of chickens) from the Mainland United States (CNMI Department of Lands and Natural Resources 2002). The order was amended on January 27, 2003, to also allow import of chickens over 4 weeks of age, and to require both a CNMI Animal Quarantine Entry Permit and a West Nile Virus – Emergency Rule Import Permit (CNMI Department of Lands and Natural Resources 2003).

This conservation action can be accomplished by taking the following steps:

- DLNR should continue to enforce the amended Emergency Order of Quarantine.
- Public outreach efforts should be made to educate the public about the threat of West Nile Virus: why it is a problem, and why live birds cannot be imported to these islands.

**Species and Habitats Conserved**: Particularly the Mariana Crow and the Rota Bridled White-eye. Also, all other avian species: Golden White-eye, Mariana Fruit Dove, Mariana Swiftlet, Micronesian Megapode, Nightingale Reed-warbler, Rufous Fantail, Saipan Bridled White-eye, Tinian Monarch, White-throated Ground Dove. Mammals: Mariana Fruit Bat and Sheath-tailed Bat. (Not an action directed toward Habitats.)

| **Conservation Action**: Prevent further introductions of invasive species to the southern islands | **Priority**: 5 |
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| **Description**: The Commonwealth of the Northern Mariana Islands fully appreciates the scale of economic and natural resource degradation presented by the established number of invasive species present in our ecosystems. However, the potential threat of other invasive species that have already taken a foot hold in some of our neighboring islands might in fact be cause for a much greater alarm.<br><br>The CNMI receives several pest warnings per month on new invasive species that have been introduced to Hawaii, Guam, and Asia. Therefore it is critical to establish programs and protocols to address these potential threats. Regional coordinated efforts that outline awareness, rapid response, containment, eradication, quarantine, and legislative protocols are needed to address invasive species issues.<br><br>This conservation action can be accomplished by:<br>• Increase public awareness about the threats posed by invasive species.<br>• Establish rapid response teams and training programs.<br>• Establish containment and quarantine protocols.<br>• Coordinate regional legislation that addresses potential invasive threats. | |
| **Species and Habitats Conserved**: Native forest birds: Golden White-eye, Mariana Crow, Mariana Fruit Dove, Mariana Swiftlet, Micronesian Megapode, Nightingale Reed-warbler, Rota Bridled White-eye, Rufous Fantail, Saipan Bridled White-eye, Tinian Monarch, White-throated Ground Dove. Freshwater bird: Mariana Common Moorhen. Mammals: Mariana Fruit Bat and Sheath-tailed Bat. Invertebrates: Coconut Crab, Fragile Tree Snail, Humped Tree Snail, Langford's Tree Snail. Reptiles: Micronesian Gecko, Rock Gecko, Tide-pool Skink. Habitats: native forest, secondary forest, tangantangan forest, agricultural forest, grasslands and savanna, wetlands, strand, limestone caves and crevices. | |

| **Conservation Action**: Conserve remaining forest and wetland habitats on the southern islands through avoidance and mitigation conditions placed on land development proposals | **Priority**: 4 |
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**Description**: The Division of Fish and Wildlife reviews applications for Coastal Resources Management permits, Division of Environmental Quality Earthmoving permits, and U.S. Army Corps of Engineers Dredge and Fill permits. In addition, DFW reviews environmental documents, including environmental impact statements and assessments, for both CNMI and federal activities. DFW also provides expertise, field assistance and guidance to the public and provides comments on proposed land use and development projects.

In these capacities, DFW is the lead agency to detect an endangered wildlife species in a proposed development. The Division is then responsible for delineating the boundaries necessary to avoid the endangered species, thereby conserving the species and habitat or facilitating the introduction of the developer to the appropriate USFWS personnel. DFW also provides comments on legislation, associated literature, and project sites in order to avoid negative impacts to wild plant and animal species. DFW's goals are: 1) to minimize impacts by development projects through avoidance of removing wildlife species and their important habitats; 2) to implement proper mitigation measures for the removal of wildlife species and their habitats when avoidance is impossible; and 3) to enhance species and their habitats.

This conservation action is currently being carried out through DFW's routine permit review process. Recently, however, the volume of permit requests has increased dramatically. For example, a number of small companies or individuals have recently requested permits for clearing tangantangan for production of charcoal. A mitigation measure must be made available to these charcoal producers, because the endangered Nightingale Reed-warbler is often found in the tangantangan stands to be harvested.

To enhance DFW's ability to respond to these permit requests, a Natural Resources Planner will be hired to work in the Wildlife Section, partially funded by the State Wildlife Grant. The new Planner will be responsible for the following.

- Project proposal review and development of conditions
- Maintenance of an accomplishment log showing: number of land use development projects reviewed; number of site reviews made; estimated number of hectares of wetlands protected through compliance with conditions; and number of hectares of endangered species habitat protected through compliance with conditions.
- Coordination with federal and local government agencies concerning issues involving species of special conservation need, by participating on interagency committees and boards.
- Develop, in conjunction with other Wildlife Section staff, standard procedures for reviewing, commenting on, and writing conditions for proposed development projects, and write a manual of these procedures.

- Assist the public by providing expertise, field assistance and guidance on an as-needed basis as required by law.

**Species and Habitats Conserved**: Locally listed endangered or threatened species. Native forest birds: Mariana Crow, Mariana Swiftlet, Micronesian Megapode, Nightingale Reed-warbler, Rota Bridled White-eye, Tinian Monarch. Freshwater bird: Mariana Common Moorhen. Mammals: Mariana Fruit Bat and Sheath-tailed Bat. Reptile: Micronesian Gecko. All habitats where locally listed endangered or threatened species occur: native forest, secondary forest, tangantangan forest, agricultural forest, grassland and savanna, wetlands, strand, limestone caves and crevices, urban.

| **Conservation Action**:<br>Conserve remaining forest and wetland habitats on Rota, Tinian and Saipan through land acquisition | **Priority**:<br>4 |
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**Description**: Despite a lagging local economy, clearing of land for various developments on the southern islands of Rota, Tinian and Saipan continues, with the consequent removal of wildlife habitat. With a growing local populace, there is a demand for village and agricultural homesteads; one proposed homestead development in the Carolinas and Kastiyu region is situated in or proximate to the only remaining native limestone forest on Tinian. Mitigation for take of endangered species is required for large projects such as golf courses; this was the purpose for the establishment of the Saipan Upland Mitigation Bank area in Marpi. Proposals for large developments have curtailed in recent years due to the economic downturn in the Mariana Islands, however smaller operators continue to clear tangantangan forest on Saipan, for construction of buildings, development of farm plots, or harvest for charcoal. Land clearing continues on both public lands and private lands.

There is a need to conserve the remaining forest and wetland habitats on the southern islands, by acquiring land and designating it for conservation purposes.

This conservation action can be accomplished by pursuing the following options.

- <u>Existing grants</u> -- Continue to pursue the acquisition of private lands through the Non-Traditional Section 6 Recovery Land Acquisition Grant. DFW and DLNR are working under this grant to acquire private lands around Lake Susupe, the largest wetland in the Commonwealth. If additional funding under this grant is made available in the future, valuable wildlife habitat lands on Rota and/or Tinian will be identified for acquisition as well.
- <u>Seek additional funding</u> -- Identify other funding sources for the acquisition of private or public lands, through outright purchase, negotiations for land exchanges, and negotiations for easements.
- <u>Inventory public lands</u> -- DLNR and DFW should identify and prioritize public lands that are important to conserve for wildlife habitat.
- <u>Negotiate with MPLA</u> – Once important public lands are identified, then DLNR and DFW should assertively negotiate with the Marianas Public Lands Authority to place these important public lands into conservation status, through Grant of Public Domain Land, or Designation of Use of Public Land, or a similar instrument. This is one way that the only remaining mangrove forest in Saipan can be protected.
- <u>Lobby the Legislature</u> -- Once important public lands are identified, then DLNR and DFW should draft clear legislation for protection of these lands in conservation status, e.g. conservation areas, nature reserves, or public parks, and continue to lobby for passage of the legislation.

This conservation action requires the talent of a land policy expert who can be successful in negotiating with MPLA and the Legislature to encourage the acquisition of land for wildlife habitat purposes. DFW currently has no staff dedicated to policy matters.

**Species and Habitats Conserved**: Native forest birds: Golden White-eye, Mariana Crow, Mariana Fruit Dove, Mariana Swiftlet, Micronesian Megapode, Nightingale Reed-warbler, Rota Bridled White-eye, Rufous Fantail, Saipan Bridled White-eye, Tinian Monarch, White-throated Ground Dove. Freshwater bird: Mariana Common Moorhen. Mammals: Mariana Fruit Bat. Invertebrates: Coconut Crab, Fragile Tree Snail, Humped Tree Snail. Reptiles: Micronesian Gecko, Rock Gecko, Tide-pool Skink. Forest and wetland habitats: native forest, secondary forest, tangantangan forest, wetlands.

| **Conservation Action**:<br>Improve management of terrestrial conservation areas in the southern islands | **Priority**:<br>3 |
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**Description**: Terrestrial conservation areas have been established through various laws and regulations for the southern islands. (See Table 2.) Management plans for only two of these conservation areas have been written and adopted – the Saipan Upland Mitigation Bank, and the Mañagaha Marine Conservation Area. Management plans need to be written and adopted for the remaining conservation areas of the southern islands. State Wildlife Grant funding was used to contract the writing of the Mañagaha Marine Conservation Area Management Plan in 2005 (Schroer 2005a); the remaining funding allocated for this purpose will next be spent on developing management plans for the Bird Island Wildlife Preserve, Bird Island Sanctuary, Kagman Wildlife Conservation Area and Forbidden Island Sanctuary on Saipan. It is anticipated that the current level of funding may not be sufficient to finish management plans for all of the conservation areas, and additional funding will need to be sought in the near future. Rota's conservation areas should not be forgotten either.

Once management plans are written and adopted, they need to be implemented. The Saipan Upland Mitigation Bank (SUMB) was established to provide a mitigation measure for large-scale developers, whereby developers could buy "credits" in the bank, with one credit representing immediate protection of sufficient habitat to support two existing Nightingale Reed-warbler male territories in the protected area (Commonwealth of the Northern Mariana Islands and U.S. Fish and Wildlife Service 2002). The SUMB was established in early 2002 and a management plan was adopted in late 2002, yet, to date, no credits have been sold. It was intended that revenue from the sale of credits would help pay for the carrying out of management activities, but there is no money to hire the managers called for in the management plan. Similarly, the Mañagaha Marine Conservation Area Management Plan calls for levying fees for Special Use Permits and Commercial Services Permits to pay for conservation of wildlife and habitat resources (Schroer 2005a). Yet, no mechanism has yet been instituted to collect these fees. As management responsibilities for an increasing number of conservation areas grows, the need for funding for management also grows, but this funding need has not been met.

Regulations need to be developed for all terrestrial conservation areas, but especially for the Mañagaha Marine Conservation Area, because of the islet's cultural, recreational and wildlife habitat importance, and the impact of high numbers of tourists visiting the island daily. The writing of regulations is not funded by any of the grants supporting DFW's operations. Consequently, this task keeps getting "put on the back burner", and has not been fulfilled. Enforcement efforts to protect wildlife species and their habitats in the conservation areas from actions such as poaching or destruction of vegetation cannot progress without concise, clear regulations.

Public awareness about the restrictions on activities within conservation areas is lacking and needs to be improved. For example, a Motorized Vehicle Management Zone is designated for part of the waters of the Mañagaha Marine Conservation Area. Motorized boats are supposed to stay within this zone; motoring outside of this zone will threaten marine resources. Yet, no marker buoys have been placed to show the boundaries of this zone, and on any given day, one can see boats motoring through any water that is deep enough all around Mañagaha Island. The management plan also specifies that no animals, fish, coral or plants may be collected or removed; yet tourists do take home treasures they find on Mañagaha. Funding and a manager specifically responsible for this conservation area are needed to implement the management plan.

This conservation action can be successfully implemented by taking the following steps.

- Complete the management plans for all conservation areas, using State Wildlife Grant and other funding sources.
- Contract for the professional writing of concise, clear, easily understood and enforceable regulations for each of the conservation areas
- Mark the boundaries, both terrestrial and marine, of all conservation areas, with markers that can withstand tropical storms and typhoons, and that can be easily sighted by the public.
- For each conservation area, or set of contiguous conservation areas, hire a Manager who will be responsible for implementing management plans, patrolling and directing enforcement efforts as needed, and developing signage, educational materials, and media to educate the public about the "do's and don'ts" of the conservation area.

**Species and Habitats Conserved**: Native forest birds: Golden White-eye, Mariana Crow, Mariana Fruit Dove, Mariana Swiftlet, Micronesian Megapode, Nightingale Reed-warbler, Rota Bridled White-eye, Rufous Fantail, Saipan Bridled White-eye, White-throated Ground Dove. Seabird: Wedge-tailed Shearwater. Mammals: Mariana Fruit Bat. Invertebrates: Coconut Crab, Fragile Tree Snail, Humped Tree Snail. Reptiles: Micronesian Gecko, Rock Gecko, Tide-pool Skink. Habitats: native forest, secondary forest, tangantangan forest, strand.

| **Conservation Action**:<br>Develop island-wide habitat conservation plans for all islands in the archipelago | **Priority**:<br>5 |
|---|---|
| **Description**: Issues of habitat loss and adverse impacts on endangered species as a result of land clearing can be resolved through developing island-wide habitat conservation plans for all islands in the archipelago. Currently, DFW is experiencing an increase in permit requests for land clearing and other developments that affect endangered species, and is responding in a piece-meal fashion. This fragmented approach to resolving endangered species vs. development conflicts is not practical or effective. Island-wide habitat conservation plans would provide developers with mitigation options and allow development to proceed in a controlled way, while still conserving valuable endangered species habitat.<br><br>Habitat conservation plans should first be developed for the southern islands, where development pressures are the highest. Saipan would be the highest priority after Rota's HCP is completed. HCPs are also needed for the northern islands, especially on Anatahan, Sarigan, Alamagan, Pagan and Agrihan, where habitats have been damaged by feral animals, and where homestead developments have been proposed. | |
| **Species and Habitats Conserved**: All species of special conservation need would benefit, other than those species of Rota, for which an HCP is currently being developed. Native forest birds: Golden White-eye, Mariana Fruit Dove, Mariana Swiftlet, Micronesian Megapode, Nightingale Reed-warbler, Rufous Fantail, Saipan Bridled White-eye, Tinian Monarch, White-throated Ground Dove. Freshwater bird: Mariana Common Moorhen. Seabirds: Masked Booby, Wedge-tailed Shearwater. Mammals: Mariana Fruit Bat, Sheath-tailed Bat. Invertebrates: Coconut Crab, Humped Tree Snail, Langford's Tree Snail. Reptiles: Micronesian Gecko, Rock Gecko, Tide-pool Skink, Slevin's Skink. Habitats: native forest, secondary forest, tangantangan forest, agricultural forest, grassland and savanna, wetlands, strand, limestone caves and crevices. | |

| **Conservation Action**:<br>Reforest disturbed areas with native tree species on the southern islands | **Priority**:<br>3 |
|---|---|

**Description**: The southern islands of Rota, Aguiguan, Tinian and Saipan were formerly forested. Native forest on these islands has been mostly cleared through burning by aboriginal man, introduction of exotic animals and cattle ranching during the Spanish administration, sugar cane growing during the Japanese era, and bombing and leveling of nearly all vegetation during World War II. Following the war, extensive areas were reseeded with tangantangan. Native forest extent was estimated in the early 1980s to be 60% for Rota, 47% for Aguiguan, 5% for Saipan and 5% for Tinian (Engbring et al. 1986). Disturbed areas consist of weedy fields formerly planted in sugar cane or formerly used for cattle grazing and now overtaken by invasive plants (Saipan, Tinian and Aguiguan), forests lacking regeneration in the understory due to feral ungulates (Aguiguan) and forests degraded by clearing due to agriculture, residential development and typhoon damage (Rota).

Disturbed areas need to be reforested with native tree species. This conservation action can be accomplished in a stepwise manner.

1. <u>Determine which native tree species to propagate</u>. A list of native tree and shrub species that are appropriate to use in restoring wildlife habitat appears as Appendix I to DFW's Aguiguan 2000 Technical Report #2 (Cruz et al. 2000b). Some native species are easier than others to propagate in nurseries.
2. <u>Determine areas to be reforested</u>. Disturbed sites having the potential for reforestation should be researched, prioritized and selected. Potential sites include: disturbed areas within CNMI's conservation areas (because they are already in a protected status and are publicly owned); small experimental plots near schools, the college or the Kagman Agricultural Station (to test propagation and planting success and for educational and training purposes); lands that have been cleared or are being proposed for clearing wildlife habitat (as a mitigation measure); lands being restored by other government agencies for watershed management (to encourage the use of native species for wildlife habitat enhancement); and tracts of patchy, degraded forest in need of restoration for endangered species habitat (such as the Sabana of Rota).
3. <u>Determine propagation, site preparation, planting and monitoring methods</u>. Research on successful reforestation efforts in the Pacific should be conducted to determine which methods are likely to succeed in the southern islands of the CNMI. Experimental plots should be established and regularly monitored.
4. <u>Coordinate efforts with other environmental agencies</u>. Other government agencies are involved in revegetation projects. For example, the Coastal Resources Management Office is currently spearheading the Lau Lau Bay Watershed Restoration Project, to re-plant the "badlands" area of acidic soils on steep slopes above Lau Lau Bay eroded during recent typhoon events (R. Brooks, pers. comm., August 2005). Another example is the recommendation made by Cruz et al. (2000b) that the CNMI Division of Forestry and the Mayor of Tinian cooperate to develop a plan to remove *Lantana camara* from portions of Aguiguan and replant those areas with native tree species. DFW should become

involved with other agencies on projects such as these, to encourage the use of native tree species and to pool grant monies and staff resources. Of particular importance is the political challenge to persuade the DLNR Division of Agriculture to start propagating native trees species, and stop using ornamentals and non-natives for revegetation in wildland areas.

Successful implementation of this conservation action will require hiring of a forester or vegetation specialist with experience in tropical regions. This action will be long term.

**Species and Habitats Conserved**: Native forest birds: Golden White-eye, Mariana Crow, Mariana Fruit Dove, Mariana Swiftlet, Micronesian Megapode, Rota Bridled White-eye, Rufous Fantail, Saipan Bridled White-eye, Tinian Monarch, White-throated Ground Dove. Mammals: Mariana Fruit Bat and Sheath-tailed Bat. Invertebrates: Coconut Crab, Fragile Tree Snail, Humped Tree Snail, Langford's Tree Snail. Reptiles: Micronesian Gecko, Rock Gecko. Habitats that can be restored or enhanced: Native forest, secondary forest, tangantangan forest, agricultural forest, grassland and savanna, urban.

| **Conservation Action**:<br>Eradicate rats and other predators on islets | **Priority**:<br>2 |
|---|---|
| **Description**: Consistent efforts carried out over time could be made to trap rats (*Rattus spp.*) cats, monitor lizards (*Varanus indicus*), musk shrews (*Suncus murinus*) and other predators on the islets of Naftan Rock, Bird Island and Forbidden Island. Eradication of these predators, which eat eggs, nestlings and skinks, would allow higher nesting success for seabirds, as well as allowing Tide-pool Skink populations to increase. With the exception of Naftan Rock, these islets are close enough to Saipan to facilitate frequent site visits for deployment and inspection of traps. | |
| **Species and Habitats Conserved**: Masked Booby, Wedge-tailed Shearwater, Tide-pool Skink. (Not an action directed toward Habitats.) | |

| **Conservation Action**: Improve enforcement of hunting regulations on the southern islands | **Priority**: 5 |
|---|---|

**Description**: Overharvesting and illegal hunting of coconut crabs is known to occur on the populated southern islands, by hunting out of season, taking undersized crabs, exceeding legal bag limits, and taking crabs in protected areas. In addition, endangered species (such as the Micronesian megapode on Saipan, and the Mariana Crow and the Mariana Fruit Bat on Rota) are sometimes poached. Nesting sea turtles and their eggs are disturbed and poached to an unknown extent. DFW's Enforcement Section relies on local funding, and is not supported by USFWS grants. The Enforcement Section needs a bigger presence in the field (there are only two Conservation Officers on Rota), properly working equipment (there is only one vehicle on Rota, and it barely runs), and training (a "Conservation Officers Institute" was held four years ago and should be repeated), and a bigger presence in the field. There is public support for "giving teeth" to DFW's enforcement efforts.

This conservation action can be accomplished by:

- Supplementing DFW's Enforcement Section funding with sources other than local funds. These funds should be used to hire additional Conservation Officers and purchase needed equipment.
- Assessing the training needs of Conservation Officers, and providing training.

**Species and Habitats Conserved**: Terrestrial species: Coconut Crab, Micronesian Megapode, Mariana Crow, Mariana Fruit Bat. Also marine species: Green Sea Turtle and Hawksbill Sea Turtle. (Not an action directed toward Habitats.)

## Conservation actions that apply to the northern islands

### Sarigan

| **Conservation Action**: Assess the suitability of Sarigan Island to receive translocated birds and monitor forest succession and wildlife population trends on Sarigan following the eradication of feral ungulates | **Priority**: 4 |
|---|---|

**Description**:
Before a bird translocation program can be instituted for Sarigan, a survey of wildlife and vegetation needs to be conducted to determine: 1) if sufficient forest habitat exists to support native forest birds translocated from the southern islands; 2) if avian diseases are present on Sarigan; 3) the status of predators; and 4) if there are sufficient food resources (invertebrates) to translocated birds.

DFW intends to take a field trip to Sarigan during the early months of 2006 to update baseline vegetation and wildlife surveys, collect blood and fecal samples from passerines to assess avian disease, and study invertebrate species and abundance. The results of the vegetation surveys will demonstrate how plant succession has progressed since the eradication of feral animals from Sarigan in 1997. The results of the wildlife surveys will determine the status of predators of birds, and population trends for avian species. The results of the avian disease assessment and the invertebrate species and abundance study will demonstrate whether Sarigan provides suitable conditions for the successful translocation of forest birds from the southern islands of the CNMI.

In addition to vegetation and wildlife surveys, the avian disease assessment and the invertebrate availability assessment, the new Coconut Crab survey protocol developed by Dr. de Cruz (2005b) will be employed on this field trip.

**Species and Habitats Conserved**: Native forest birds: Micronesian Megapode; Saipan Bridled White-eye (for translocation potential); White-throated Ground Dove. Mammal: Mariana Fruit Bat. Invertebrate: Coconut Crab. Reptile: Slevin's Skink. Habitats: native forest, secondary forest, agricultural forest, grasslands and savannah.

**Pagan**

| **Conservation Action**:<br>Establish a fenced nature reserve on the southern peninsula of Pagan | **Priority**:<br>2 |
|---|---|
| **Description**: The southern peninsula of Pagan seems to hold most of the remaining species of special conservation need. A fence should be constructed across the isthmus on Pagan, separating the southern peninsula from the remainder of the island. Feral animals (pigs, cows, goats and fowl) should be eradicated from the southern peninsula. A natural reserve would thereby be created. This action will allow wildlife populations to recover from the effects of feral ungulates (Cruz et al. 2000g). | |
| **Rationale for Priority Ranking**: Urgency = 2; Ease = 1; Cost = 1. Certain obstacles must be overcome before this action can become a reality. Funding must be secured, both for building the fence and for feral animal removal. Residents of Pagan, both former and current, would want to have a voice in this proposal. Establishment of a reserve would require authorization from the MPLA. | |
| **Species and Habitats Conserved**: Forest birds: Micronesian Megapode and White-throated Ground Dove. Mammal: Mariana Fruit Bat. Invertebrate: Coconut Crab. Habitats: native forest, secondary forest, agricultural forest. | |

**Groups of northern islands**

| **Conservation Action**: Remove feral ungulates from the northern islands of Anatahan, Alamagan, Pagan and Agrihan | **Priority**: 5 |
|---|---|
| **Description**: The destruction of native and secondary forest habitat by feral animals is well documented. Removal of understory vegetation results in degraded wildlife habitat and increased soil erosion. Invasive, introduced plant species colonize disturbed areas, and replace native forest species. The complete removal of goats, pigs and cattle from the northern islands is necessary for native forest to regenerate.<br><br>The status of feral animal removal is as follows:<br>Anatahan -- The U.S. Navy, USFWS and DFW cooperate in an ongoing project to eradicate goats and pigs from Anatahan by aerial shooting. Shooting of animals from the ground is unsafe due to continuing volcanic action. This project is funded by the U.S. Navy.<br>Pagan and Agrihan – Unless feral animals are removed from Pagan and Agrihan soon, native forest species may be lost. No project for removing feral animals has been funded.<br>Alamagan – Forest condition is better on Alamagan than on Pagan, Agrihan or Anatahan, so there may be a little more time to initiate an eradication program on Alamagan. No project for removing feral ungulates has been funded.<br><br>Eradication of feral animals on the remote northern islands is a very expensive proposition. Aerial shooting requires helicopter time that can run into the tens of thousands of dollars per sortie. Ground shooting is also expensive, because transportation costs from Saipan to the northern islands are high, whether the transport is by air (helicopter) or by sea (vessel charter). The CNMI lacks the financial resources to conduct eradication efforts. Successful implementation of this conservation action will depend on securing large amounts of money from outside funding sources, most likely the federal government. | |
| **Species and Habitats Conserved**: Forest birds: Micronesian Megapode, Nightingale Reed-Warbler, White-throated Ground Dove. Mammal: Mariana Fruit Bat. Invertebrates: Coconut Crab, Humped Tree Snail. Reptiles: Rock Gecko, Slevin's Skink. Habitats: native forest, secondary forest, agricultural forest. | |

| **Conservation Action**: Prevent the introduction of invasive species to the northern islands | **Priority**: 5 |
|---|---|

**Description**: The southern islands of the archipelago are afflicted with numerous invasive species. Predatory flatworms (*Platydemus manokwari*), and the carnivorous snail (*Gonaxis kibweziensis*) threaten endemic tree snails. Hermit crabs utilize the shells of the giant African snail (*Achatina fulica*) and compete with coconut crabs for food. The scarlet gourd vine (*Coccinia grandis*) covers forest vegetation and smothers it, killing available wildlife habitat. On Rota, the introduced black drongo (*Dicrurus macrocercus*) preys on other forest birds. The endemic Slevin's Skink has been extirpated from the southern islands, most likely by competition with and predation by introduced reptiles and mammals. In the southern islands, the Tide-pool Skink is limited to small islets, probably due to competition with introduced reptiles (including *Carlia fusca*). The musk shrew (*Suncus murinus*) is probably responsible for the disappearance of the Rock Gecko from Guam and Tinian. The Brown Treesnake (*Boiga irregularis*) threatens all birds and reptiles of special conservation need with extirpation.

These and other invasive species must be prevented from entering any and all of the northern islands. It is especially important to protect the pristine ecosystems on the islands of Guguan, Asuncion, Maug and Uracas from invasive species, and to promote forest succession in the absence of invasive species on the islands of Sarigan and Anatahan, where feral ungulates have been, or are being removed.

This conservation action can be accomplished through:

- Increasing public awareness about the threats posed by invasive species to northern island ecosystems, targeting fishermen, homesteaders and other visitors to the northern islands.
- Enforcing the existing hunting regulations, which require any vessel leaving for, or returning from, the northern islands to report to DFW and be inspected.
- Research current quarantine laws and regulations regarding travel to the northern islands and determine if they need to be amended to provide for stricter controls over invasive species.

**Species and Habitats Conserved**: Native forest birds of the northern islands: Micronesian Megapode, Nightingale Reed-warbler, White-throated Ground Dove. Seabirds: Masked Booby and Wedge-tailed Shearwater. Mammal: Mariana Fruit Bat. Invertebrates: Coconut Crab and Humped Tree Snail. Reptiles: Rock Gecko, Tide-pool Skink, Slevin's Skink. Habitats: native forest, secondary forest, agricultural forest, strand.

# Chapter 7:

# LITERATURE CITED for CHAPTERS 1 through 6











# Chapter 7: LITERATURE CITED for CHAPTERS 1 through 6

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# Chapter 8:

# PROFILES OF MARINE SPECIES

# Chapter 8: PROFILES OF MARINE SPECIES

**How to use the profiles**
Detailed information on each of the 20 marine species of special conservation need is presented in the series of profiles in this chapter. Profiles are presented in the same order in which the species of special conservation need are listed in Table 4. The layout of the profiles was designed to address Elements 1 through 5 for each species. Underlined headings were used to facilitate easy recognition of the Elements.

**Finding the Elements**
For purposes of providing the reader a link between the headings in the profiles to the Elements, a generic list of headings is given here, with the Element number indicated in parentheses and in blue type.

## SPECIES TITLE

**Common Name**
**Scientific Name**
**Chamorro Name**
**Carolinian Name**
**Listing Status**
**Reasons for selecting the [species] as a species of special conservation need**
**Unique characteristics**
**Distribution of the [species] in the CNMI** (Element 1)
**Abundance of the [species] in the CNMI** (Element 1)
**Location and relative condition of key habitats for the [species] in the CNMI** (Element 2)
**Problems which adversely affect the [species] and its habitats** (Element 3)
**Priority research and survey efforts** (Element 3)
**Conservation actions** (Element 4)
**Monitoring** (Element 5)
**Literature Cited for the [species]**

**Literature Cited**
Full citations of literature cited for each marine species is given at the end of each respective profile. This approach of separating literature citations by species was intended to permit each profile to stand alone, facilitating ease of research for the reader.

**Authorship**
Marine species profiles were researched and written by John Gourley, Micronesian Environmental Services, Saipan CNMI, under independent contract.

## SPINNER DOLPHIN

Figure 68. Spinner dolphins (*Stenella longirostris)*
Photo Credit: Donna Turgeon, NMFS

**Common Name**
spinner dolphin

**Scientific Name**
*Stenella longirostris (Gray 1828)*

**Chamorro Name**
dofen

**Carolinian Name**
dofen

**Listing Status**
The spinner dolphin is listed as a protected species as shown in Table 3 found in Part 4, Section 30.4 of the CNMI Division of Fish and Wildlife Non-Commercial Fishing and Hunting Regulations that were promulgated on 20 April 2000 (CR Vol.22(04).

The 2004 IUCN Red List of Threatened Species identifies the spinner dolphin as a Threatened species and has categorized the species as LR/cd (i.e., Lower Risk, Conservation Dependent).

**Reasons for selecting the spinner dolphin as a species of special conservation need**
The spinner dolphin, *Stenella longirostris*, is the only known species of cetacean to reside year-round in coastal areas of the CNMI (Trianni & Kessler 2002). During 1995 a number of strandings and rescues were necessary as spinner dolphins were becoming trapped in Tanapag Lagoon during the height of main channel dredging activities (Trianni and Kessler 2002). During the period that these strandings were taking place, many residents living along the Tanapag Lagoon had remarked that the dolphins entered the northern navigable reaches of the lagoon every summer (M.Trianni per comm.). No other cetacean found in the waters of the CNMI has been known to routinely enter Tanapag Lagoon.

The spinner dolphin inhabiting the CNMI probably conforms to the pelagic western pacific species found around Japan, Taiwan, Philippines as well as the south Pacific and Indian Ocean (Perrin et al. 1999), although this has not been verified.

**Unique characteristics**
The spinner dolphin is the only cetacean species that is known to be a year-round coastal resident in the CNMI.

**Distribution of the spinner dolphin in the CNMI**
They are believed to occur throughout the CNMI. No verified sightings of the spinner dolphin exist from the West Mariana Ridge.

**Abundance of the spinner dolphin in the CNMI**
Unknown, although probably less than 1,000 permanent residents.

**Location and relative condition of key habitats for the spinner dolphin in the CNMI**
The key habitat of the spinner dolphin around Saipan appears to be the north and northeast aspects of the island. There have been numerous uncorroborated sightings, as well as many verified sightings, of spinner dolphins in those two areas on Saipan. No consistently verifiable sightings exist that would provide insight into, or verification of, any similar habitat preferences at any other island in the CNMI. The identified key habitats appear to be in good condition.

**Problems which adversely affect the spinner dolphin and its habitats**
Not enough is known about the spinner dolphin in the CNMI to determine any problems that might adversely impact its presence here. Trianni (pers. comm.) has not noticed any substantial changes with regard to the number of spinner dolphins observed during DFW FRS excursions to sampling grounds around Saipan. Spinner dolphins have been observed at Farallon de Medinilla (FDM), which serves as the only live fire range available for use by the US Military in the Pacific Region. It is not known whether these live fire military exercises have had an adverse impact on spinner dolphins that utilize the fisheries-rich FDM area (M.Trianni pers. comm.).

**Priority research and survey efforts**
Coordinate with the appropriate federal entities to enhance the knowledge of spinner dolphins in the CNMI. Continue to obtain data from monthly US Navy aerial surveys of FDM, as well as from other opportunistic sources, to monitor the relative frequency of spinner dolphins at FDM over time.

**Conservation actions**
Create a Marine Mammal Stranding Network in the CNMI to provide rapid response to spinner dolphin strandings or rescue needs.

**Monitoring**
Continue to obtain data from monthly US Navy aerial surveys of FDM, as well as from other opportunistic sources, to monitor the relative frequency of spinner dolphins at FDM over time.

**Literature Cited for the spinner dolphin**
Perrin, W.F., M.L.L. Dolar, and D. Robineau. 1999. Spinner dolphins (*Stenella longirostris*) of the western Pacific and Southeast Asia: Pelagic and shallow water forms. Marine Mammal Science vol. 15, no. 4, pp. 1029-1053

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# GREEN SEA TURTLE

Figure 69. Green sea turtle (*Chelonia mydas*)
Photo Credit: NMFS - dshea@sunvalley.net

**Common Name**
green sea turtle

**Scientific Name**
*Chelonia mydas* (L. 1758)

**Chamorro Name**
haggan

**Carolinian Name**
wong mool

**Listing Status**
In response to a decline in population levels, most green sea turtle populations were listed as threatened under the Endangered Species Act (ESA) on 28 July 1978 (43 FR 32800). In contrast, the Florida and Pacific coast of Mexico breeding populations were listed as endangered. Critical habitat was designated by the National Marine Fisheries Service (NMFS) on 2 September 1998 (Volume 63, Number 170) as occurring in waters extending seaward 3 nm from the Mean High Water Line of Isla de Culebra (Culebra Island), Puerto Rico. Accordingly, there is no critical habitat designated in the Marianas archipelago. Management and enforcement authority is shared between the U.S. Fish and Wildlife Service (USFWS) and the NMFS.

The green sea turtle was recognized as a threatened/endangered species by the CNMI Government through legislation passed on 15 January 1991. Management and enforcement authority lies with the CNMI Division of Fish and Wildlife (DFW).

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), of which the United States is a party, has listed the green sea turtle on Appendix I. Wildlife and/or plant species included in Appendix I receive the highest level of regulatory protection in international commercial trade between parties (i.e., members). Within Micronesia, the Territory of Guam (US), the Commonwealth of the Northern Mariana Islands (US) and the Republic of Palau are parties to CITES, while the Republic of Marshall Islands and the Federated States of Micronesia have refrained from joining at this time.

The 2004 IUCN Red List of Threatened Species identifies the green sea turtle as a Threatened species (category EN A2bd); Endangered with a (A) population reduction in the form of either (2) a reduction of at least 50%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer, based on (b) an index of abundance appropriate for the taxon and (d) actual or potential levels of exploitation.

**Reasons for selecting the green sea turtle as a species of special conservation need**
Green sea turtles have a circumglobal distribution with the greater part of any one turtles life span spent primarily in a pelagic state in oceanic waters that inevitability crosses numerous international borders This fact, coupled with a dearth of knowledge relating to the understanding of population dynamics and genetics, more so in the Marianas archipelago, can make for complex management decisions being based on incomplete understanding of the issues. In order to address these shortcomings regional knowledge on local levels is in great need. This is especially true in the southern islands of the CNMI as Kolinski, et al. (2001, 2004) and Pultz, et al. (1999) has shown that the sea turtle populations are primarily comprised of juveniles or sub-adult green turtles. These preliminary population assessments make the southern CMNI island sea turtle populations particularly unique.

Not including traditional management schemes, sea turtles have been actively managed in the CNMI since at least 1916 when the islands were under Japanese control (Navy Department 1944). Commercial fishing activities, including the catching of sea turtles, were regulated through a series of ordinances from the Governor. The hawksbill sea turtle was managed as a distinct fishery during the Japanese mandated period. Though management measures were directed primarily at the hawksbill sea turtle, one conservation measure focused on the protection of the reproductive vigour of the all sea turtle populations and non-mature juveniles. There was a year-round prohibition for "*hawk-billed turtles and sea turtles of less than 60 centimeters in length and their eggs, as well as any such turtles found on shore."* (Navy Department 1944).

After World War II ended, the U.S. Navy was appointed as the administrative authority over the Trust Territory area, which included the Marianas archipelago. The following interim regulation, promulgated in 1949, addressed the taking of sea turtles:

> "*No hawk's bill turtle or sea turtle shall be taken or intentionally killed while on shore, nor shall their eggs be taken. No hawk's bill turtles or sea turtles shall be taken or intentionally killed in the water, except those whose shells are twenty-four (24) inches or more in length. No hawk's bill turtles of any size shall be taken or intentionally killed from June 1st to August 31st inclusive, nor from December 1st to January 31st inclusive* (McCoy 1997).

When the CNMI officially became a Commonwealth of the United States in 1986, the ESA took precedence over local laws that previously authorized the limited take of sea turtles. With the ESA in place, a total prohibition on take of any federally protected sea turtle species became the decree and it is still in full effect today.

Though certainly not the least important, consumption of the green sea turtle is a cultural aspect of the indigenous island communities that has not been practiced legally for the past 19 years. Green sea turtles are considered a delicacy and are generally reserved for special cultural occasions, primarily by the Carolinian community. From a local perspective, it is hoped that the green sea turtle population will be able to recover to a point whereby the indigenous Pacific Island communities will again be allowed limited take of sea turtles for cultural events.

**Unique characteristics**

After leaving the nesting beach, young green sea turtles are believed to occupy open ocean pelagic habitat, perhaps associated with sargassum rafts. It is generally assumed that at this life stage they are omnivorous with a strong tendency toward carnivory. An ontogenetic shift from a pelagic life form to benthic foraging occurs after reaching a carapace size of 20 to 25cm in the Western Atlantic or 35cm carapace length in Hawaii and Australia. A change to a herbivorous diet also occurs during this time, primarily sea grasses and algae, although they also consume jellyfish, salps and sponges (Lutz and Musick 1997).

Though based on limited data, juvenile green sea turtles were found to dominate the in-water population of Tinian Island by Pultz, et al. (1999). Aquatic and cliff line observations recorded 36 sea turtles with 92% being classified as sub-adults. Similarly on Saipan, aquatic and cliff line observations by Kolinski, et al. (2001) recorded 169 green sea turtles with 60% being classified as juveniles, 22% as juvenile/adult, and 12% appeared to be of adult size. Kolinski, et al. (2004) later noted the predominance of juvenile sea turtles identified from the various surveys and suggested further research in tagging and size differentiation be pursued.

Green sea turtles show a high degree of nest site fidelity (Lutz and Musick 1997). In general, female green sea turtles usually nest during darkness, usually have a mean carapace length of 99.1 cm., a mean of 2.93 clutches per season with a mean 112.8 eggs, the mean renesting interval of 12 days, and a mean remigration interval of 2.86 years (Lutz and Musick 1997). Sexual differentiation of sea turtle embryos is determined by nest temperatures; cooler temperatures produce a higher percentage of males, while warmer temperatures produce a preponderance of females (Lutz and Musick 1997).

In contrast to their protected status, it appears that green sea turtle colonies are increasing and are nesting on beaches that had no recent nesting activities, such as Rancho Nuevo (Tamaulipas, Mexico) and along the mid-Atlantic coast of Florida. Patrolling nesting beaches in other areas of the world has also had a positive effect on nesting populations. It is believed by some that the green sea turtle is not faced with imminent extinction (Lutz and Musick 1997).

**Distribution of the green sea turtle in the CNMI**

Distribution of the green sea turtle is wide ranging and throughout the CNMI in the near shore waters of all islands (Starmer 2005, Kolinski, et al. 2004). However, due to the expected habitat limitations among the various islands, abundance is expected to differ.

**Abundance of the green sea turtle in the CNMI**

In an assessment of green turtle populations in the southern five islands of the CNMI, Kolinski, et al. (2004) found that Tinian contained the highest densities of sea turtles, followed by Saipan, Rota, Aguijan and Farallon de Medinilla. Interestingly, sea turtle densities were not found to be significantly correlated with island and reef perimeters. For example, Tinian has a 54.6-kilometer perimeter coastline and nearly twice the number of sea turtles when compared with the much longer 75.2-kilometer coastline of Saipan. The near shore sea turtle population around the southern CNMI islands was estimated at 1,000 to 2,000 individuals

Elsewhere in the Marianas archipelago, NOAA conducted limited sea turtle surveys on seven isolated reefs, including Guam (Kolinski, et al. 2005) during August/September of 2003 of the Mariana Island cruise aboard the R/V Oscar Sette. One green sea turtle was observed at Supply Reef, Zealandia Bank and Arakane Reef; no sea turtles were observed at Stingray Shoals, Pathfinder Reef, Tatsumi reef and Santa Rosa Reef. These surveys are believed to be the first surveys for these reefs.

**Location and relative condition of key habitats for the green sea turtle in the CNMI**

In an island wide sea turtle survey for Saipan, Kolinski, et al. (2001) recorded six nesting events for the 1999 nesting season; Unai Obyan (4), Unai Fanonchuluyan (1) and Unai Halaihai (1). The first organized sea turtle research that focused on Tinian nesting females was conducted by the USFWS (1996; see also Pultz, et al. 1999). Survey results showed during the August 1994-August 1995 survey period, 8 of 13 beaches experienced nesting activity. An assessment of all beaches on Tinian found that they all were potential nesting sites. Nesting events elsewhere in the Marianas are anecdotal, but appears logical that nesting events are more prevalent in the southern islands where sandy beaches are more common.

Nesting in the northern islands is not believed to occur as there are no sandy beach habitats. An exception are the black sand beaches of Pagan Island, however those beaches get very hot during the daytime and have no beach vegetation (McCoy 1997). Additionally, Pagan sandy beaches generally have a larger gain size and are not as stable as the beaches on the southern islands. A stable beach environment is important for maintaining egg orientation as the embryo develops (M. Trianni pers. comm..).

A variety of known food resources utilized by the green sea turtle in other regions of the world were also found in Saipan's near shore benthic habitats. Potential forage species included two seagrass species and 29 algal species (Kolinski, et al. 2001). No other sea turtle habitat data is available for the other CNMI islands, however one could assume that Rota and Tinian would have benthic habitat similar to Saipan's.

**Problems which adversely affect the green sea turtle and its habitats**

The green sea turtle continues to be threatened on several fronts in the CNMI. A long list of threats to the green sea turtle population has been developed over a wide range of situations, however the most relevant current threat in the CNMI is direct take primarily for consumption. Take of sea turtles in the CNMI are believed to be associated with cultural practices (McCoy 1997). In other areas of the world, such as certain areas of Mexico, the wholesale exploitation of turtle eggs and meat has been elevated to commercial ventures (J. Gourley pers. comm.).

The effects of poaching activities on existing populations can include:

● Reproductive success is suddenly interrupted when female nesting turtles are captured as they haul out and crawl ashore to nest, or investigate the beach (i.e., false crawls).

● Nesting success is terminated early when nests are excavated and the eggs taken.

● Juvenile turtles, which comprise the bulk of the southern islands near-shore green sea turtle population (Pultz, et al. 1999 and Kolinski, et al. 2001) are captured in-water before having the opportunity to breed.

Non-poaching threats include:

● Vehicular access to known turtle nesting beaches has the potential of driving over turtle nests resulting in compaction of sand and subsequent problems by the hatchlings digging their way to the surface upon hatching. Heavy beach traffic may cause tire ruts that can be problematic for hatchlings attempting to enter the ocean.

Despite these threats, the above issues are well known and are presently being addressed by the Division of Fish and Wildlife and the Coastal Resources Management Office.

**Priority research and survey efforts**

Green sea turtle population studies

Basic biological information is lacking, especially for those populations inhabiting the Mariana archipelago. Until only recently, sea turtle research consisted primarily of superficial observations and anecdotal evidence.

Investigate population genetics of Marianas green sea turtles with other populations

The genetic relationship between the green sea turtles inhabiting the Marianas and those found elsewhere in the world is completely unknown. Ongoing sea turtle research presently being conducted by the DFW may require additional funds to continue taking genetic material from turtles that are tagged and subsequent laboratory analysis by NMFS.

Tagging of green sea turtles; flipper and satellite

The migratory relationship between the green sea turtles inhabiting the Marianas and those found elsewhere in the world is completely unknown. Ongoing sea turtle research presently being conducted by the DFW will likely require additional funds to continue the tagging programs, especially with sophisticated satellite tags (Kessler and Vogt 2002). With most of the southern islands near shore sea turtle population comprised of sub-adult turtles, migration patterns, if migration takes place, is an integral part of the overall management scheme.

**Conservation actions**

Conservation actions recommended in the CNMI should include providing appropriate beach environments for female nesting sea turtles. This would include the indirect protection of turtle nests from vehicular traffic that may compact sand overlying the nest and cause tire ruts on beach that may pose an impediment to hatchlings attempting to reach the ocean. People's natural curiosity, if uncontrolled, may also be detrimental to the behavior of female nesting turtles.

Public education should be continued at all levels within the educational system and enforcement of local existing laws should be maintained. A working relationship should be developed between the DFW and NMFS and USFWS with respect to regulatory compliance with federal laws or international agreements that pertain to sea turtles, for example the ESA and CITES.

Create a Sea Turtle Stranding and Salvage Network in the CNMI to provide rapid response to sea turtle strandings or rescue needs. This network would also provide another source of data to be used in making management decisions.

**Monitoring**

Monitoring on Saipan

Nesting beach monitoring is currently being conducted by the DFW during the nesting season at all the known sea turtle beaches while near shore in-water population abundance monitoring is conducted monthly. This monitoring program needs to be continued.

Monitoring on Tinian and Rota

Nesting beach monitoring and near shore in-water population abundance monitoring is being conducted by the DFW in two five-day periods during nesting season. A more intensive monitoring program similar to that which is being conducted on Saipan needs to be implemented.

Monitoring on the northern islands

No nesting beach monitoring or near shore in-water turtle abundance monitoring is being conducted a this time.

**Literature Cited for the green sea turtle**

Kessler, C.C. and S.R. Vogt. 2002. Report on Attaching Satellite Transmitters to Green Turtles (*Chelonia mydas*) on Tinian, Commonwealth of the Northern Mariana Islands. U.S. Fish and Wildlife Unpublished Report, P.O. Box 8134, MOU-3, Dededo, Guam 96912.

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Pultz, S., D. O'Daniel, S. Krueger, H. McSharry and G. Balazs. 1999. Marine Turtle Survey on Tinian, Mariana Islands. *Micronesica* 31(2):85-94

U.S. Fish and Wildlife Service. 1996. Part III: Status and Distribution of Marine Turtles on the Island of Tinian, Commonwealth of the Northern Mariana Islands - 1994 and 1995. USFWS Wildlife Research Report prepared for the Department of the Navy, PACNAVFACENGCOM, Pearl Harbor, Honolulu, Hawaii. 20 pp.

# HAWKSBILL SEA TURTLE

Figure 70. Hawksbill sea turtle (*Eretmochelys imbricate*)
Photo Credit: NOAA

**Common Name**
hawksbill sea turtle

**Scientific Name**
*Eretmochelys imbricate* (L. 1766)

**Chamorro Name**
haggan karai

**Carolinian Name**
wong maaw

**Listing Status**
Population declines resulted in the hawksbill turtle being listed as endangered under the Endangered Species Act (ESA) on 2 June 1970 (35 FR 8495). Critical habitat was identified by the National Marine Fisheries Service (NMFS) on 2 September 1998 (Volume 63, Number 170) as occurring in waters extending seaward 3 nm from the Mean High Water Line of Isla de Culebra (Culebra Island), Puerto Rico. Accordingly, there is no critical habitat designated in the Marianas archipelago. Management and enforcement authority is shared between the U.S. Fish and Wildlife Service (USFWS) and the NMFS.

The hawksbill sea turtle was recognized as a threatened/endangered species by the CNMI Government through legislation passed on 15 January 1991. Management and enforcement authority lies with the CNMI Division of Fish and Wildlife (DFW).

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), of which the United States is a party (i.e., member), has listed the hawksbill sea turtle on Appendix I. Wildlife and/or plant species included in Appendix I receive the highest level of regulatory protection in international commercial trade between parties (i.e., members). Within Micronesia, the Territory of Guam (US), the Commonwealth of the Northern Mariana Islands (US) and the Republic of Palau are parties to CITES, while the Republic of Marshall Islands and the Federated States of Micronesia have refrained from joining at this time.

The 2004 IUCN Red List of Threatened Species identifies the hawksbill sea turtle as a Threatened species ( category CR A1bd); Critically Endangered with a (A) population reduction in the form of (1) an observed, estimated, inferred or suspected reduction of at least 80% over the last 10 years or three generations, whichever is the longer, based on (b) an index of abundance appropriate for the taxon and (d) actual or potential levels of exploitation.

**Reasons for selecting the hawksbill sea turtle as a species of special conservation need**

Hawksbill sea turtles have a circumglobal distribution with the greater part of any one turtles life span spent primarily in a pelagic state in oceanic waters that inevitability crosses numerous international borders This fact, coupled with a dearth of knowledge relating to the understanding of population dynamics and genetics, more so in the Marianas archipelago, can make for complex management decisions being based on incomplete understanding of the issues. In order to address these shortcomings regional knowledge on local levels is in great need. This is especially true in the southern islands of the CNMI as Kolinski, et al. (2001, 2004) and Pultz, et al. (1999) has shown that hawksbill sea turtles are extremely rare.

Not including traditional management schemes, sea turtles have been actively managed in the CNMI since at least 1916 when the islands were under Japanese control. Commercial fishing activities, including the catching of sea turtles, were regulated through a series of ordinances from the Governor. The hawksbill sea turtle was managed as a distinct fishery during the Japanese mandated period. All commercial ventures that wished to be involved in "*the catching of hawk-billed turtles*" paid a ¥10 fee and submitted an application that provided pertinent information about the proposed fishery. Ultimate issuance of a commercial licence was with the approval of the Governor. In addition to licensing fishing activities, the Japanese also implemented several conservation measures focusing on the protection of the reproductive vigour of the population and non-mature juveniles. The first measure involved closing specific seasons for the hawksbill sea turtle; from June 1 to August 31 and again from December 1 to January 31. There was an additional year-round prohibition for "*hawk-billed turtles and sea turtles of less than 60 centimeters in length and their eggs, as well as any such turtles found on shore.*" Penalties included "*Penal labor for not more than six months, or a fine of not more than ¥200….*". (Navy Department 1944).

After World War II ended, the U.S. Navy was appointed as the administrative authority over the Trust Territory area, which included the Marianas archipelago. The following interim regulation, promulgated in 1949, addressed the taking of the hawksbill sea turtle as well as other sea turtle species:

> "*No hawk's bill turtle or sea turtle shall be taken or intentionally killed while on shore, nor shall their eggs be taken. No hawk's bill turtles or sea turtles shall be taken or intentionally killed in the water, except those whose shells are twenty-four (24) inches or more in length. No hawk's bill turtles of any size shall be taken or intentionally killed from June 1st to August 31st inclusive, nor from December 1st to January 31st inclusive* (McCoy 1997).

Regardless of how or by whom this species was managed, the remaining population appears to be recognized by all authorities as being in serious trouble. The hawksbill sea turtle used to be fished commercially in the CNMI, therefore the few specimens that are observed in the near shore waters is cause for alarm. This species should be given careful consideration in developing conservation measures and included in any research project addressing sea turtles in the CNMI.

**Unique characteristics**
Although certain authors (Carr 1952) separate the species into two subspecific populations (Indo-Pacific and Atlantic subspecies), the USFWS is treating the recovery of this species as a single taxonomic entity.

Hawksbill turtles have a circumtropical distribution, occurring from $30^0$N to $30^0$S latitude within the Atlantic, Pacific, and Indian oceans. Along the eastern Pacific rim, hawksbills were apparently common to abundant as recently as 50 years ago in near shore waters from Mexico to Ecuador, particular the east coast of Baja California Sur in the vicinity of Concepcion Bay and Paz Bay, Mexico. Presently, the hawksbill is considered rare in most localities as there are no known nesting beaches remaining on the Pacific coast of Mexico (Cliffton, et al. 1982, as cited in USFWS 1998).

What appears to be a better situation occurs in the Central Pacific; nesting is widely distributed and in very low numbers. Foraging hawksbills are observed from virtually all the island groups in Oceania, from the Galapagos Islands in the eastern Pacific to the Republic of Palau in the Western Pacific. Hawksbills nest on the islands and mainland of southeast Asia, from China and Japan, throughout the Philippines, Malaysia, and Indonesia, to Papau New Guinea, the Solomon Islands and Australia (USFWS 1998).

As with other sea turtle species, after leaving the nest the turtle is pelagic. The ontogenetic change to benthic foraging occurs in the Caribbean at a carapace length between 20 to 25 cm (straight) and in Australia at a carapace length of 35 cm (curved). Data indicates that Hawksbills forage most often over coral reef areas and rock outcroppings although they also feed in seagrass meadows in mangrove-fringed bays. Although generally accepted that hawksbill sea turtles are primarily spongivores, other items consumed include: sea grasses, tunicates, bryozoans, coelenterates, molluscs and soft corals. Hawksbills are believed to undergo a period of omnivorous feeding in benthic habitats prior to adopting the specialized spongivory known from larger juveniles and adults (Lutz and Musick 1997).

Although the *Recovery Plan for the U.S. Pacific Populations of the Hawksbill Turtle* (USFWS 1998) reports no nesting of hawksbill turtles in the Northern Mariana Islands, recent nesting evidence on Rota and Saipan supports their inclusion into the USFWS jurisdictional listing (USFWS-Part III, 1996).

**Distribution of the hawksbill sea turtle in the CNMI**
Distribution of the hawksbill sea turtle is wide ranging and likely to be throughout the CNMI in the near shore waters of all islands. However, due to limited coral reef habitat in the more volcanic northern islands, abundance is expected to differ between islands.

**Abundance of the hawksbill sea turtle in the CNMI**
No hawksbill turtles were documented by Pultz, et.al. (1999), Kolinski, et al. (2001), Kolinski, et al. (2004) in their sea turtle surveys of the southern islands and by Kolinski, et al. (2005) for several northern sea mounts. It should be noted that the 2005 in-water

surveys for Saipan recorded one hawksbill sea turtle out of a total of 32 sea turtle observations (Ilo, et al. 2005). However, there is anecdotal and documented evidence of hawksbill sea turtles in the Northern Marianas, as discussed by Kolinski, et al. 2001.

Based on negative data, abundance of the hawksbill turtle throughout the CNMI appears to be very low.

**Location and relative condition of key habitats for the hawksbill sea turtle in the CNMI**

Though "coral reef habitat" is utilized by the hawksbill sea turtle, specific habitat requirements in the CNMI are not clearly defined.

Resources Northwest Consultants (1998) reports that hawksbill turtles are believed to have historically nested on at least six of Rota's beaches: Talakhaya, Two Brother's Point, Mochong, Lalayak, Coconut Village, Teteto and the adjacent Santa Margarita Beaches. However, they have not been seen for "*approximately the last ten years*".

**Problems which adversely affect the hawksbill sea turtle and its habitats**

The hawksbill sea turtle is not normally consumed by the island's indigenous population. Historical fisheries were usually based more on utilization of its shell for the ornamental and curio trade. With the protective authority of the ESA in the CNMI, the sale of hawksbill jewelry (or curios) in open markets is rare, mostly non-existent. This is in contrast with the markets in the Republic of Palau and the Federated States of Micronesia, where sea turtle shell jewelry is openly sold (J. Gourley pers. comm.). Since take of the hawksbill sea turtle in these countries is locally regulated the commercial turtle shell industry is legal. Despite prohibitions under the ESA, local customs relating to the wearing of hawksbill sea turtle jewelry by the Micronesian community is respected in the CNMI.

There appear to be two potential and relevant threats to the hawksbill sea turtle in the CNMI; poaching and nest disturbance.

The effects of poaching activities on existing populations can include:

- Reproductive success is suddenly interrupted when female nesting turtles are captured as they haul out and crawl ashore to nest, or investigate the beach (i.e., false crawls).
- In-water turtles are taken for subsequent sale in the ornamental or curio trade, thus decreasing the number of reproducing turtles.

Non-poaching threats include:

- Vehicular access to known turtle nesting beaches has the potential of driving over turtle nests resulting in compaction of sand and subsequent problems by the hatchlings digging their way to the surface upon hatching. Heavy beach traffic may cause tire ruts that can be problematic for hatchlings attempting to enter the ocean.

- On a smaller scale, in-situ detonation activities associated with World War II unexploded ordinance within the marine environment can pose lethal effects to sea turtles. Case in point was the loss of one hawksbill sea turtle when unexploded ordinance was detonated by the U.S. Navy in Coral Gardens, Rota in 1996 (Trianni 1998).

Despite these threats, the above issues are well known and are presently being addressed by the Division of Fish and Wildlife and the Coastal Resources Management Office.

**Priority research and survey efforts**

Hawksbill sea turtle population studies

Basic biological information is lacking, especially for those populations inhabiting the Mariana archipelago. Until only recently, sea turtle research consisted primarily of superficial observations and anecdotal evidence.

Investigate population genetics of Marianas hawksbill sea turtles with other populations

The genetic relationship between the hawksbill sea turtles inhabiting the Marianas and those found elsewhere in the world is completely unknown. Ongoing sea turtle research presently being conducted by the DFW may require additional funds to continue taking genetic material from turtles that are tagged and subsequent laboratory analysis by NMFS.

Tagging of green sea turtles; flipper and satellite

The migratory relationship between the hawksbill sea turtles inhabiting the Marianas and those found elsewhere in the world is completely unknown. Ongoing sea turtle research presently being conducted by the DFW will likely require additional funds to continue the tagging programs, especially with sophisticated satellite tags (Kessler and Vogt 2002).

**Conservation actions**

Conservation actions recommended in the CNMI should include providing appropriate beach environments for nesting sea turtles. This would include the indirect protection of turtle nests from vehicular traffic that may compact sand overlying the nest and cause tire ruts on beach that may pose an impediment to hatchlings attempting to reach the ocean. People's natural curiosity, if uncontrolled, may also be detrimental to the behavior of female nesting turtles.

Public education should be continued at all levels within the educational system and enforcement of local existing laws should be maintained. A working relationship should be developed between the DFW and NMFS and USFWS with respect to regulatory compliance with federal laws or international agreements that pertain to sea turtles, for example the ESA and CITES.

Create a Sea Turtle Stranding and Salvage Network in the CNMI to provide rapid response to sea turtle strandings or rescue needs. This network would also provide another source of data t be used in making management decisions.

**Monitoring**

Monitoring on Saipan

Nesting beach monitoring is currently being conducted by the DFW during the nesting season at all the known sea turtle beaches while near shore in-water population abundance monitoring is conducted monthly. This monitoring program needs to be continued.

Monitoring on Tinian and Rota

Nesting beach monitoring and near shore in-water population abundance monitoring is being conducted by the DFW in two five-day periods during nesting season. A more intensive monitoring program similar to that which is being conducted on Saipan needs to be implemented.

Monitoring on the northern islands

No nesting beach monitoring or near shore in-water turtle abundance monitoring is being conducted a this time.

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# GRAY REEF SHARK

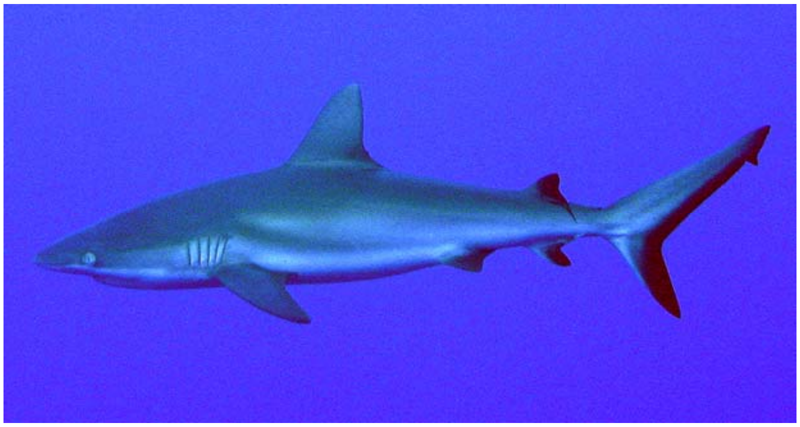

Figure 71: Gray reef shark (*Carcharhinus amblyrhynchos*) Big Drop, Republic of Palau
7 August 2002
Photo credit: Kate Moots.

**Common Name**
gray reef shark (also black-vee whaler, blacktail reef shark, bronze whaler, grey reef shark, grey shark, grey whaler, longnose blacktail shark, shortnose blacktail shark, whaler shark)

**Scientific Name**
*Carcharhinus amblyrhynchos* (Bleeker 1856)

**Chamorro Name**

**Carolinian Name**

**Listing Status**
In 2000, the IUCN listed the gray reef shark as LR/nt (of lower risk, but near threatened) (Smale, 2000).

**Reasons for selecting the Gray reef shark as a species of special conservation need**
The gray reef shark is considered a nuisance species by bottomfishers as the shark will attack the catch before it gets to the boat. Occasionally, local fishers will fish the sharks out of an area before commencing bottomfishing. Targeting gray reef sharks, even when initially abundant, can dramatically decrease their populations in a few years (Anderson, et al. 1998). If not closely monitored, finning may become a problem in the CNMI, given its prevalence in the Pacific and Guam (note that the 1st US conviction for shark finning was in Guam [US Department of Commerce 2004]). Small litter size, late onset of maturity, restricted habitat choice throughout its distribution, site fidelity, inshore distribution and willingness to take a baited hook make the gray reef shark especially vulnerable.

**Unique characteristics**
Body color is grayish-brown dorsally, fading gradually to white on the venter. Distinctive markings include a broad black trailing edge of the caudal fin, especially the lower lobe, which fades into the color of the rest of the tail. The 2nd dorsal, anal, and pelvic fins and the tips of the pectoral fins are also dusky or black with the pigment fading towards the body. Although the 1st dorsal may occasionally have a slight white edge, it is never tipped or edged with black.

Females usually reproduce every other year (Wetherbee, et al. 1997). Gestation is about 12 months long, with litters of 1 to 6 pups. The pups are 45 to 60 cm at birth. Sex ratios at birth are 1:1 (Johnson 1978). Males mature at 120 to 140 cm and females mature at 125 to130 cm, with males believed to reach 2 m and females believed to reach 2.3 m (Johnson 1978, Wetherbee, et al. 1997, Ferrari and Ferrari 2002). Individuals over 1.9m are rare. In the wild, gray reef sharks grow at about 22 to 39 mm/yr (Johnson 1978, Wetherbee, et al. 1997). DeCrosta, et al. (1984) reported life expectancies of gray reef sharks to be 10 years. However, all subsequent estimates suggest that this species appears to mature at about 7 years and is estimated to live about 25 years.

Up to 85% of their diet is teleost fishes, up to 29% is squid and octopi and about 5% is crabs, lobster and shrimp (Wetherbee, et al. 1997). Larger sharks (>100 cm) eat proportionally more cephalopods (Wetherbee, et al. 1997) and less teleosts. They generally feed about every 6 to 12 days (Wass in Johnson 1978). Large individuals in the Marshalls have been observed following carangids, and acting as both scavengers and predators (Au 1991).

Although this species is active during the day, they are still considered a nocturnal species, tending to disperse and be more solitary at night (Johnson 1978, McKibben and Nelson 1986). Adults seem to prefer depths of 20 to 70 m (Ferrari and Ferrari 2002), but have been found in depths up to 1000 m. gray reef sharks may develop daily routines and occupy relatively limited areas (Johnson 1978, McKibben and Nelson 1986), with resident social groups or packs living in the same area for years at a time (Johnson and Nelson in Johnson 1978). Females aggregate in groups of up to 150 individuals during the day in shallow lagoonal waters off Johnston Atoll from late February through early May (Economekis and Lobel 1998, Lobel 2003) and in the North West Hawaiian Islands (Taylor 1994). In the Marshall Islands, this species has been reported from near ocean drop-offs in loose aggregations of 20 individuals, just above bottom in polarized schools of 33 individuals, over shallow reefs and lagoon pinnacles as lone individuals (McKribben and Nelson 1986). Females prefer slightly shallower waters than males (Wetherbee, et al. 1997). Juveniles are frequently found in inshore areas, including bays, seagrasses and lagoonal flats and prefer more turbid waters (Western Pacific Fishery Management Council 2001). This species has been reported to swim many km offshore at depth of 100m or less, even though the bottom may be much deeper (Johnson 1978).

Gray reef sharks have a “reputation” for being aggressive and are territorial. This species has very distinct and obvious threat displays. They should not be approached if displaying these behaviors (with the head raised, the back arched, exaggeratedly slow and jerky swimming, pectoral fins lowered and grinding its teeth) (Johnson 1978). Attacks tend to be very fast and brief, and are rarely fatal (Johnson 1978).

Predators of gray reef sharks (other than humans) include the Silver-tip, Tiger and Galapagos sharks (Johnson 1978, Springer and Gold 1989).

**Distribution of the gray reef shark in the CNMI**
Historically gray reef sharks were found from the Red Sea and Indian Ocean to the western and central Pacific, and are therefore expected throughout the CNMI.

Southern Populated Islands of the CNMI
Gray reef sharks have been reported from Rota, Aguijan, Tinian and Saipan (Jones, et al. 1974, Bryan, et al. 1988, Trianni and Ostazeski 1996, Flores 1998, Flores 1999, Moots, et al. 2000).

Northern Islands of the CNMI
Gray reef sharks have been reported from Farallon de Medinilla, Anatahan, Sarigan, Pagan, Agrihan, Asuncion, and Maug (Eldredge et al. 1977, Ludwig 1978, Bryan, et al. 1988, Flores 1998, Flores 1999, Trianni and Ostazeski 1996, Trianni 1998, Moots, et al. 2000), and from Zealandia Bank by Amesbury (1984 ms).

**Abundance of the gray reef shark in the CNMI**
Estimates of population levels of gray reef sharks are unknown, except as anecdotal reports. However, the 2003 NOAA/NMFS MARAMP research cruise reported that sharks occurred in relatively higher densities (biomass/numbers) around the northernmost islands of the Mariana Archipelago (Schroeder, et al. 2004).

**Location and relative condition of key habitats for the gray reef shark in the CNMI**
Adult gray reef sharks, especially males, are generally found along the outer limits of reefs (Ferrari and Ferrari 2002) and show a preference for areas adjacent to strong currents (Johnson 1978). Females seem to prefer shallower areas and may enter lagoonal habitats (Wetherbee, et al. 1997, Economekis and Lobel 1998, Lobel 2003). Juveniles are frequently found in inshore areas, including bays, seagrasses and lagoonal flats and prefer more turbid waters (Western Pacific Fishery Management Council 2001). At a broader geographic scale, this species apparently also has a preference for the leeward side of small, low islands and atolls (Johnson 1978, McKibben and Nelson 1986).

Key habitats for the gray reef shark are not well defined, but likely include lagoonal areas with seagrasses, lagoonal flats, outer reefs, and areas of strong current. Within the CNMI, lagoonal reefs are only present off the west coast of Saipan. Seagrasses have been reported from the southern islands of Saipan, Tinian and Rota, but only Saipan offers expansive seagrass meadows of *Halodule*, and to a certain extent *Enhalus acoroides*. Hard and soft corals are present around all the islands of the CNMI, though coral coverage and species diversity decreases as one moves northward to the volcanic islands. Coral reef habitats are most impacted around Saipan, which has the greatest population. Overall, reef habitats are only moderately disturbed throughout the CNMI.

**Problems which adversely affect the gray reef shark and its habitats**
The primary threat facing the gray reef shark in the CNMI is associated with unsustainable fishing effort. Depending upon the magnitude of the action, the local practice for some bottomfishers to “remove” sharks from an area prior to bottom fishing may be cause for alarm.

**Priority research and survey efforts**
There are several areas of research that are achievable and important in the management of gray reef sharks. Because this species is underrepresented in standardized underwater visual census (UVC) (Sadovy, et al. 2004), survey efforts should focus on additional techniques that will improve population estimates. Sadovy, et al. (2004) suggested that survey techniques that can cover a greater area should be less biased. Manta tow or tow-board surveys would cover a greater portion of the habitat available and allow more accurate estimates of the populations.

Modify the existing Commercial Purchase data collection program to list this species separate from other sharks and reef fishes. This would necessitate reprinting of receipt books and forms, as well as educating the fishers and fish retailers about the importance of knowing the weight of each individual of this species that is bought, sold or captured.

Other needed research includes documentation of basic biological parameters including age and growth, reproductive biology, natural mortality, food habits, behavior, habitat use, spawning areas, abundance and individual home ranges.

**Conservation actions**
As part of the Magnuson-Stevens Act provisions and effective from 13 March 2002, the US prohibits shark finning activities in the US Exclusive Economic Zone (EEZ) and through US ports.

A number of actions by the DFW indirectly act to conserve gray reef sharks (in conjunction with a number of other reef fishes). The DFW has banned the use of scuba while spear-fishing, the use of poisons (including cyanide), the use of dynamite and the use of gill and surround nets. In addition, the established no-take marine protected areas around Saipan (Mañagaha Marine Conservation Area, Bird Island Marine Sanctuary and Forbidden Island Marine Sanctuary) and Rota (Sasanhaya Bay Fish Reserve) likely serve as some protection for this species.

**Monitoring**
There are no specific monitoring programs presently targeting the gray reef shark. Active monitoring programs in the CNMI include the Interagency Marine Monitoring Team, and the DFW Marine Sanctuaries Program. Both monitoring programs collect distribution and abundance data on gray reef sharks. However, whether the databases are compatible with respect to obtaining any qualified estimate of population densities is questionable. In addition, DFW participates in the biannual NOAA cruise which surveys all the islands of the CNMI using both UVC and tow-board surveys.

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# NAPOLEON WRASSE

**Common Names**
Napoleon wrasse (also double-head wrasse, giant wrasse, humphead wrasse, Maori wrasse, truck wrasse, undulate wrasse)

Figure 72. Napoleon Wrasse (*Cheilinus undulates*) Blue Corner, Republic of Palau August 2002
Photo credit: K. Moots

**Scientific Name**
*Cheilinus undulatus* Rüppell 1835

**Chamorro Name**
Tanguisson

**Carolinian Names**
Mem (also Máám, Nippwáyik, Mamiliporos)

**Listing Status**
The Napoleon wrasse was initially listed in 1996 on the IUCN Red List of Threatened Species as Vulnerable (category VU A1d+2cd). In 2004, the IUCN revised its classification to Endangered (category EN A2bd+3bd); Endangered with a (A) population reduction in the form of either (2) a reduction of at least 50%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer, based on (b) an index of abundance appropriate for the taxon and (d) actual or potential levels of exploitation.

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), of which the United States is a party (i.e., member), listed the Napoleon wrasse on Appendix II in January 2005. International commercial trade of Appendix II wildlife and/or plant species is monitored through a documentation system required for every shipment involving an Appendix II species, as long as one signatory country is involved in the transaction. Within Micronesia, the Territory of Guam (US), the Commonwealth of the Northern Mariana Islands (US) and the Republic of Palau are parties, while the Republic of Marshall Islands and the Federated States of Micronesia have refrained from joining at this time.

**Reasons for selecting the Napoleon wrasse as a species of special conservation need**
Among many Pacific Islanders, the Napoleon wrasse is a highly prized food fish. It is also in demand by many people living in various Asian countries. The CNMI's population has increased substantially over the past 2 decades (CNMI Department of Commerce 2001). In combination with an Asian-based tourist economy, there has been an increased demand for this species. In addition, as the local economy tightens, fishers will increasingly look to outside markets. If CNMI fishers begin to participate in the live reef fish food trade, the pressure on this species will likely increase dramatically due to the demand for this species by the export market.

Several factors contribute to the susceptibility of this species to fishing pressure. Natural densities of Napoleon wrasse are never high, even in areas with no fishing pressure (Sadovy, et al. 2003). Large adults appear to be wide ranging (with home ranges of at least $1000m^2$), but spend a large proportion of their time resident in a much smaller area where they may be readily visible to fishers (Donaldson in Sadovy, et al. 2003). Napoleon wrasse are also taken at night by spearfishers, because this species often hides in crevices when chased (IUCN 2002) or when resting at night (IUCN 2004). In addition, Napoleon wrasse come together in breeding aggregations that return to the same areas repeatedly (Colin, et al. in Sadovy, et al. 2003), thereby increasing their vulnerability. Age and growth studies suggest that this species requires 5 to7 years to reach sexual maturity (Pogonoski, et al. 2002) and that although some males develop directly from juveniles, most mature first as females and later mature as males (Sadovy, et al. 2003). Longevity estimates suggest that this species may reach ages greater than 30 years (Choat in Sandovy, et al. 2003). Taken together, site tenacity of large individuals and spawning aggregations (which increases accessibility) combined with relatively long life spans with late maturation and sex change (which decreases rates of replacement) results in the inability of Napoleon wrasse to overcome over-fishing and poor capacity to sustain even moderate fishing pressure (Dulvy, et al. 2003).

In the Marianas, large individuals are rarely observed. Dalzell, et al. (1996) suggest that the low population level of this species in Guam is the result of spearfishing. Hensley and Sherwood (1993) state that this species is rarely seen on the reefs of Guam or reported through inshore creel surveys, although it was once economically important. Anecdotal evidence indicates that population levels have declined substantially around the more populated southern islands of the CNMI (CNMI Division of Fish and Wildlife 2005). Green (1997) suggested that declines in sightings reported for Saipan were similar to those from Guam.

**Unique characteristics**

Adult Napoleon wrasse are among the largest of all reef fishes, reaching a maximum weight of 190.5kg (Myers 1999) and a maximum total length of 229cm (Westneat 2001). Adults have blue to blue-green heads, blue-green bodies and fins, a yellow posterior margin to the tail and may have a red margin to the rayed portion of the dorsal fin. The body scales are large, usually with black wavy lines forming narrow vertical bars. Juveniles and smaller individuals tend to be more cream to light green colored, with broader lines on the scales that may form vertical rows of spots. Each Napoleon wrasse has a distinctive set of black lines running through the eye, which may be used to distinguish individuals. Adults also develop a bulbous hump on the forehead that may extend anterior to the eye and have thick fleshy lips. Growth checks in otoliths suggest that Napoleon wrasse may live over 32 years, first reaching sexual maturity at 5–7 years and with sex reversal occurring at about 15 years of age (Choat in Sadovy, et al. 2003). The expected generation time is about 10 years, with low rates of intrinsic population increase, few natural predators and a natural mortality of 0.14 or less (Choat, et al. in Cornish 2004).

Napoleon wrasse breed in the water column in a variety of habitats, often near drop-offs or the edges of reefs (Colin, et al. in Sadovy, et al. 2003). The eggs are pelagic, with larvae settling out in nearby coral reefs. Recruitment varies significantly from year to year (Tupper in Sadovy, et al. 2003). Juveniles are most common in coral-rich areas of lagoonal reefs (among *Acropora* corals, sea grasses, and patch reefs), often in less than 5m depth (Randall, 1955; Randall, et al. 1978, Myers 1999, Sadovy, et al. 2003). Adults are more common in areas with steep slopes or channels to a depth of over 100m (Sadovy, et al. 2003).

Napoleon wrasse primarily feed on gastropods (including *Trochus* and *Turbo*), but also eat other mollusks (including sea hares and bivalves such as *Arca, Barbatia,* and *Striarca*), worms, crustaceans, sea urchins, brittle stars, starfish (including *Acanthaster planci*), and fish (including boxfishes, gobies, and morays) (Fourmanoir and Laboute 1976, Randall, et al. 1978, Laboute and Grandperrin 2000, Pogonoski et al. 2002).

Spawning of Napoleon wrasse has been reported to occur daily over extended periods with groups of up to 150 fish and 10 to15 females per male (Domeier and Colin 1997, Colin in Sadovy et al. 2003). Spawning aggregations appear to return to the same areas (sometimes with obvious topographic landmarks and sometimes without) repeatedly over a single year (Sadovy et al. 2003). Although the Napoleon wrasse is often rather wary, large adults may become accustomed to divers, with individual wrasse appearing to "wait" for divers day after day in protected areas. Donaldson (1995) reported that adults are occasionally seen in groups of 3 to 7 individuals, but are typically solitary or paired. Small juveniles (10 to 20 cm TL) have been reported in groups of 12 to 75 individuals in shallow bays in Palau (Palau Fisheries Report 1992). Napoleon wrasse tend to rest in crevices at night, as well as using crevices for escape when threatened.

Napoleon wrasse may be ciguatoxic in some areas (Lewis 1986, Gomon and Randall 1984, Dazell 1992, Wong, et al. 2005).

**Distribution of the Napoleon wrasse in the CNMI**

Given the broad distribution of this species from South Africa and the Red Sea to the Ryukyu Islands of Japan across to the Marshall Islands, American Samoa, and New Caledonia, this species would be an expected resident in shallow waters (<60m) of all the islands of the CNMI.

Southern Populated Islands of the CNMI

Napoleon wrasse have been reported from Rota, Tinian and Saipan (Amesbury, et al. 1979, Amesbury 1988, Bryan, et al. 1988, Graham 1994, Trianni and Ostazeski 1996, Flores 1998, Flores 1999, Moots, et al. 2000).

Northern Islands of the CNMI

Napoleon wrasse have been reported from Farallon de Medinilla (Flores 1998, Flores 1999, Moots, et al. 2000), Anatahan (Flores 1998, Flores 1999, Trianni and Ostazeski 1996, Trianni 1998, Moots, et al. 2000), Argihan (Bryan, et al. 1988, Flores 1998, Flores 1999, Trianni and Ostazeski 1996, Moots, et al. 2000), Asuncion (Bryan, et al. 1988, Flores 1998, Flores 1999, Trianni and Ostazeski 1996, Moots, et al. 2000), and Maug (Bryan, et al. 1988, Flores 1998, Flores 1999, Trianni and Ostazeski 1996, Moots, et al. 2000), Sarigan (M. Trianni pers. comm.), Alamagan (M. Trianni pers. comm.), and Uracas (M. Trianni pers. comm.).

**Abundance of the Napoleon wrasse in the CNMI**

Abundance surveys specifically targeting the Napoleon wrasse have not been conducted, though there is limited fish census data for the southern islands. Sadovy et al. (2003) suggests that underwater visual census techniques (UVC) are likely to result in biased underestimates of the actual densities of Napoleon wrasse. Virtually all creel census data from the CNMI do not distinguish among species taken within the family Labridae. Abundance and densities can only be inferred from other areas within the Napoleon wrasse's distribution. This species is uncommon wherever it occurs and adults appear to restrict themselves to an even smaller proportion of the available habitat (preferring outer reef slopes) (Cornish 2004).

**Location and relative condition of key habitats for the Napoleon wrasse in the CNMI**

Small post-settlement Napoleon wrasse were found in lagoonal reefs with seagrass (*Enhalys acoroides*), hard corals (three *Acropora* spp. and *Porites cylindricus*), and soft corals (*Sarcophyton* sp.) (Tupper in Cornish 2004). Juvenile Napoleon wrasse were found in thickets of *Acropora* spp., seagrasses, sandy areas adjacent to corals, and mangrove areas (Randall, 1955, Randall, et al. 1978, Myers 1999, Choat in Cornish 2004). Within the CNMI, lagoonal reefs are only present off the west coast of Saipan. Seagrasses have been reported from the southern islands of Saipan, Tinian and Rota, but only Saipan offers expansive seagrass meadows of *Halodule*, and to a certain extent *Enhalus acoroides*. Hard and soft corals are present around all the islands of the CNMI, though coral coverage and species diversity decreases as one moves northward to the volcanic islands. Mangroves are present only on Saipan and are a minor habitat, likely not imporant in the life history of the Napoleon wrasse. Coral reef and mangrove habitats are most impacted around Saipan, which has the greatest population. Overall, reef habitats are only moderately disturbed throughout the CNMI.

Larger individuals of Napoleon wrasse (including spawning individuals) are found in deeper waters of the outer reefs slopes, channel slopes, and lagoon reef slopes (Randall, et al. 1978, Winterbottom, et al. 1989, Allen and Swainston 1992, Myers 1999, Sluka 2000). These habitats are found around all the islands of the CNMI and are in moderate to very good condition, with relatively little impact from the human population.

**Problems which adversely affect the Napoleon wrasse and its habitats**

Threats facing the Napoleon wrasse or its habitat in the CNMI are associated with unsustainable fishing effort and near-shore non-point source pollution into Saipan Lagoon.

**Priority research and survey efforts**

There are several areas of research that are achievable and important in the management of Napoleon wrasse. Because this species is underrepresented in standardized underwater visual census (UVC) (Sadovy, et al. 2003), survey efforts should focus on additional techniques that will improve population estimates. Sadovy, et al. (2003) suggested that survey techniques that can cover a greater area should be less biased. Manta tow or tow-board surveys would cover a greater portion of the habitat available and allow more accurate estimates of the populations.

Modify the existing Commercial Purchase data collection program to list this species separate from other wrasses and reef fishes. This would necessitate reprinting of receipt books and forms, as well as educating the fishers and fish retailers about the importance of knowing the weight of each individual of this species that is bought, sold or captured.

Recent success by the Gondol Research Institute for Mariculture in Bali (Slamet and Hutapea 2005) in the culture of Napoleon wrasse may hold hope for local augmentation of wild populations. Given that the Northern Marianas College and CREES Extension Service are in the process of building a mariculture center on Saipan, high priority could be given to local culture and rearing of Napoleon wrasse and subsequent release of young onto local reefs.

Other needed research includes documentation of basic biological parameters including age and growth, reproductive biology, natural mortality, food habits, behavior, habitat use, spawning areas, abundance and individual home ranges.

**Conservation actions**

Increased public awareness through communication and education on the long term effects of over exploitation of sensitive reef fish stocks.

A number of actions by the CNMI Division of Fish and Wildlife (DFW) indirectly act to conserve the napoleon wrasse (in conjunction with a number of other reef fishes). The DFW has banned the use of scuba while spear-fishing, the use of poisons (including cyanide), the use of dynamite and the use of gill and surround nets. In addition, the established no-take marine protected areas around Saipan (Mañagaha Marine Conservation Area, Bird Island Marine Sanctuary and Forbidden Island Marine Sanctuary) and Rota (Sasanhaya Bay Fish Reserve) likely serve to protect this species.

**Monitoring**

There are no specific monitoring programs presently targeting the Napoleon wrasse. Active monitoring programs in the CNMI include the Interagency Marine Monitoring Team, and the DFW Marine Sanctuaries Program. Both monitoring programs collect distribution and abundance data on juvenile Napoleon wrasse. However, whether the data bases are compatible with respect to obtaining any qualified estimate of population densities is questionable. In addition, DFW participates in the biannual NOAA cruise which surveys all the islands of the CNMI using both UVC and tow-board surveys.

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# GREEN HUMPHEAD PARROTFISH

Figure 73. Green humphead parrotfish (*Bolbometopon muricatum*)
Photo credit: From E. Hanauer; Diving Across Malaysia

**Common Names**
green humphead parrotfish (also bumphead parrotfish, double-headed parrotfish, giant humphead parrotfish, humphead parrotfish)

**Scientific Name**
*Bolbometopon muricatum*
(Valenciennes 1840)

**Chamorro Names**
Pachak, Fohmo, Atuhong

**Carolinian Names**
Roow, Ghúúm, Rw (also Mamiligemasegul)

**Listing Status**
None

**Reasons for selecting the green humphead parrotfish as a species of special conservation need**
Among many Pacific Islanders, green humphead parrotfish is a highly prized food fish. The CNMI's population has increased substantially over the past two decades (CNMI Department of Commerce 2001). This increase in local growth, in combination with an Asian-based tourist economy, has indirectly increased the demand for fresh fish, including large local reef fish species.

Parrotfishes typically have low natural mortality, late maturity, relatively long life spans, slow growth rates and large maximum size (Sadovy 1996). Moreover, because green humphead parrotfish aggregate at night to rest in exposed locations on the reef or lagoonal flats and aggregate to feed in schools in relatively shallow waters (<30m, making them easy to observe) (Kuiter and Tonozuka 2001, Western Pacific Fishery Management Council 2001, Aswani and Hamilton 2004, Dulvy and Polunin 2004) large individuals are especially susceptible to fishing activities (Aswani and Hamilton 2004, Dulvy and Polunin 2004). Taken together, an aggregation of individuals when resting, feeding and spawning (which increases accessibility) combined with relatively long life spans with late maturation and sex change (which decreases rates of replacement) results in the inability of green humphead parrotfish to sustain even moderate fishing pressure (Johannes 1981, Dalzell, et al. 1996, Russ and Alcala 1998, Dulvy and Polunin 2004). In the Marianas, large individuals are rarely observed. Dulvy and Polunin (2004) report this species to be very rare and possibly extirpated in Guam. Anecdotal evidence indicates that population levels have declined substantially around the more populated southern islands of the CNMI (CNMI Division of Fish and Wildlife 2005). Dulvy and Polunin (2004) suggest that there have been extreme reduction in populations throughout its range, but that the resulting rarity of the green humphead parrotfish has been overlooked by the scientific community.

**Unique characteristics**

Adult green humphead parrotfish are the largest parrotfishes, expected to reach a maximum weight of 75kg and a maximum total length of 146cm, although the maximum documented weight is 46kg (Myers 1999) and the maximum documented total length is 130cm (Lieske and Myers 1994). Individuals greater than 20 to 25 cm develop a hump anterodorsal to the eye, which becomes very pronounced, large and renders the facial profile almost vertical in adults (Randall 1986, Myers 1999). Adults are dull green, with the leading edge of the hump, snout and chin light green to pink (Randall 1986, Myers 1999). Juveniles and smaller individuals tend to be brown to gray, with two longitudinal rows of white spots on the dorsal half of the body (Randall 1986, Myers 1999).

The expected generation time is 4.5 to 14 years (Froese and Pauly 2005). Choat and Robertson (2002) estimated low rates of intrinsic population increase (K = 0.136) and a maximum age of 33 years, but noted that these are likely to change as larger individuals are sampled. In the Solomon Islands, all females have reached sexual maturity by the time they reach 65cm (Hamilton and Adams *in* Aswani and Hamilton 2004). On the northern Great Barrier Reef, most schools are reported to be composed of 12 to 20-yr old fish (Western Pacific Fishery Management Council 2001).

This species is a protogynous hermaphrodite (Aswani and Hamilton 2004), although it is unclear whether they are monandric or diandric. Spawning of green humphead parrotfish has been reported to occur late in the full moon quarter and likely during the full moon (Hamilton and Adams *in* Aswani and Hamilton 2004), often near channels (Johannes 1981). The eggs are pelagic. Juveniles are most common in coral-rich areas of lagoonal reefs. Adults are more common in areas with steep slopes or channels to a depth of over 30m (Western Pacific Fishery Management Council 2001) and in areas with little or no fishing pressure. Schools can contain from 30 to 50 individuals (Bellwood et al. 2003).

Green humphead parrotfishes cover large areas when foraging (Johannes 1981, Dalzell, et al. 1996). They tend to aggregate to feed, rest and spawn (Myers 1999). At night, they often rest in the open on the reef surface (Western Pacific Fishery Management Council 2001), in caves and shipwrecks (Kuiter and Tonozuka 2001, Dulvy and Polunin 2004) or in sandy areas (Dulvy and Polunin 2004). They may sleep so deeply that they can be easily approached when there is no moonlight (Aswani and Hamilton 2004).

Green humphead parrotfish feed on live corals (averaging 48% of their diet on the Great Barrier Reef; Bellwood, et.al. 2003) and encrusting algae on reef matrix. Myers (1999) noted that this species uses its head to ram into corals to break them into more easily ingested pieces. Estimates from feeding adult green humphead parrotfishes on the Great Barrier Reef suggest that this species is the largest bioeroder of coral reefs, with each individual processing 2 to 5 metric tons of coral each year, but that coral growth on the preferred reef-crest habitat largely matches this erosion (Bellwood, et al. 2003, Dulvy and

Polunin 2004). Johannes (1981) reported that stomachs of green humphead parrotfish were often full of sea urchins.

**Distribution of the green humphead parrotfish in the CNMI**

Given the broad distribution of this species from Mozambique and the Red Sea to the Yaeyama Islands of Japan across to the Line Islands, American Samoa, and New Caledonia, this species is an expected resident in shallow waters (<30m) of all the islands of the CNMI.

Green humphead parrotfish have been reported throughout the Mariana Islands by Myers (1991, 1999). However, there are only a few island-specific records of this species in the CNMI; Rota (Moots, et al. 2000, M.Trianni pers. comm.) and one anecdotal report for Saipan (M. Trianni pers. comm..)

**Abundance of the green humphead parrotfish in the CNMI**

Abundance surveys specifically targeting the Napoleon wrasse have not been conducted, though there is limited fish census data for the southern islands. Sadovy et al. (2003) suggests that underwater visual census techniques (UVC) are likely to result in biased underestimates of the actual densities of the green humphead parrotfish. Virtually all creel census data from the CNMI do not distinguish among species taken within the family Scaridae. Abundance and densities can only be inferred from other areas within the green humphead parrotfishes' distribution. Hensley and Sherwood (1993) suggested that local overfishing has severely reduced the population of this species in Guam. By 1999, Myers reported that this species had nearly disappeared from Guam's reefs. By 2004, Dulvy and Polunin report that this species is very rare and possibly extirpated in Guam. It is locally abundant only where protected from exploitation (Bellwood, et al. 2003). However, it is not protected in the CNMI to the same extent that it receives on the Great Barrier Reef, and therefore is expected to be rare in the CNMI. Bellwood, et al. (2003) reports that densities of green humphead parrotfishes were extremely low across all of Micronesia.

**Location and relative condition of key habitats for the green humphead parrotfish in the CNMI**

In the Solomon Islands, only small juvenile green humphead parrotfish were found in inner lagoons, with very small individuals in nursery regions only a few meters deep (Aswani and Hamilton 2004). Juveniles were reported from lagoonal reefs by Lieske and Myers (1994). Within the CNMI, inner lagoonal habitats and lagoonal reefs are only truly present off Saipan. Coral reef habitats are most impacted around Saipan, which has the greatest population. Overall, reef habitats are only moderately disturbed throughout the CNMI.

Adult green humphead parrotfish are reported from clear outer lagoon reefs, reef crests, seaward reefs and reef passages to depths over 30m (Lieske and Myers 1994, Myers 1999, Aswani and Hamilton 2004). These habitats are found around all the islands of the CNMI and are in moderate to good condition, with relatively little impact from the human population except closest to population centers.

**Problems which adversely affect the green humphead parrotfish and its habitats**

Threats facing the green humphead parrotfish or its habitat in the CNMI are associated with unsustainable fishing effort and changes in reef composition as fast-growing, grazing-resistant coral species (such as *Pocillopora,* tabulate *Acropora,* and *Montipora*) become more common through the loss of green humphead parrotfish as a keystone species (Bellwood, et al. 2003).

**Priority research and survey efforts**

There are several areas of research that are achievable and important in the management of green humphead parrotfish. Because this species is likely underrepresented in standardized underwater visual census (UVC) (Sadovy, et al. 2004), survey efforts should focus on additional techniques that will improve population estimates. Sadovy, et al. (2004) suggested that survey techniques that can cover a greater area should be less biased. Manta tow or tow-board surveys would cover a greater portion of the habitat available and allow more accurate estimates of the populations.

Modify the existing Commercial Purchase data collection program to list this species separate from other parrotfishes and reef fishes. This would necessitate reprinting of receipt books and forms, as well as educating the fishers and fish retailers about the importance of knowing the weight of each individual of this species that is bought, sold or captured.

Other needed research includes documentation of basic biological parameters including age and growth, reproductive biology, natural mortality, food habits, behavior, habitat use, spawning areas, abundance and individual home ranges.

**Conservation actions**

Increased public awareness through communication and education on the long term effects of over-exploitation of sensitive reef fish stocks.

Given that this species is susceptible to even moderate fishing pressure, and given that it may be locally extirpated off Guam and rare throughout the rest of the CNMI, a moratorium on harvest of the green humphead parrotfish should be investigated. However, moratoriums should be considered only after an assessment has been completed for the existing state of the population and fishery.

**Monitoring**

There are no specific monitoring programs presently targeting the green humphead parrotfish. Active monitoring programs in the CNMI include the Interagency Marine Monitoring Team, and the DFW Marine Sanctuaries Program. Both monitoring programs collect distribution and abundance data on juvenile green humphead parrotfish. However, whether the data bases are compatible with respect to obtaining any qualified estimate of population densities is questionable. In addition, DFW participates in the biannual NOAA cruise which surveys all the islands of the CNMI using both underwater visual census and tow-board surveys.

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# GHOST CRAB

**Common Name**
Ghost crab

Figure 74. Ghost crab, *Ocypode* sp.
Photo Credit: unknown

**Scientific Name**
Class Decapoda
Order Brachyura
Family Ocypodidae
*Ocypode* spp.
*Uca* spp.

(Taxonomy follows Paulay, et al. 2003)

**Chamorro Name**
Hagu'ui

**Carolinian Name**
Arigh

**Listing Status**
None

**Reasons for selecting the ghost crab as a species of special conservation need**
These inter-tidal crab species are presently being harvested at some unknown level by island residents in the CNMI for consumption purposes. The collection of *Uca* crabs has been observed along Saipan Lagoon beaches (J. Gourley pers. comm.), while unsubstantiated rumors suggest that *Ocypode* ghost crabs are also consumed. There is no data on the magnitude of fishing effort that is directed toward these crabs. Possibly more disturbing, from a management perspective, is that no information is known about which species are being targeted.

There is no fishery related information on these species in the CNMI. Additionally, there is very limited biological, distributional or population information known on which to base management decisions, should the species require managing.

Fishing effort for these species may be limited to Saipan as the residential population is comprised of many different ethnic groups, primarily of Asian origin. Though *Uca* crabs where being collected for consumption, it appeared that the activity was related more to subsistence use and the gathering activity was a form of social interaction (J. Gourley pers. comm.). Further investigation is needed to fully understand who, why and how much of the resource is being taken.

**Unique characteristics**

*Ocypode*, or ghost crabs, are mainly inhabitants of tropical beaches and make deep burrows above the high water line and rarely leave their burrow during the day. Being nocturnal, these quick runners scavenge along the beach and are known to forage up to a kilometer away from the sea (Poore 2004).

*Uca*, or fiddler crabs, are a diverse group of crabs whose taxonomy is still at the alpha level. This group of inter-tidal crabs are known for the male having one claw greatly enlarged that is used for signaling other males and potential mates.

**Distribution of the ghost crab in the CNMI**

Paulay's, et al. (2003) overview of the distribution of ghost crabs within the Marianas Islands includes *Ocypode ceratophthalma* and *O. cordimana;* both of which occur on Guam. The joint CHIBA-DFW biological cruise to the Northern Islands (Takeda, et al.1994) found the two same species of ghost crabs. *Ocypode ceratophthalma* was found on Pagan while *O. cordimana* was collected on Agrihan. Cloud (1959) reports observing *Ocypoda* spp. along the beaches of Saipan Lagoon.

Though no *Uca* species were listed for the CNMI, Paulay, et al. (2003) identified two fiddler crabs as occurring on Guam; *Uca crassipes* and *U. vocans*. The joint CHIBA-DFW biological cruise to the Northern Islands (Takeda, et al.1994) listed no fiddler crabs.

Based on the habitat requirement of sandy beaches, it is expected that ghost crab distribution will be more in the southern islands as the northern islands have very little beach areas.

**Abundance of the ghost crab in the CNMI**

Abundance estimates of the ghost crab have not been conducted in the CNMI.

**Location and relative condition of key habitats for the ghost crab in the CNMI**

Takeda, et al.(1994) found *Ocypode* specimens in the upper shore of sandy beaches on Pagan and Agihan during the CHIBA-DFW biological cruise to the Northern Islands. Cloud (1959) reports *Ocypoda* along the beaches of Saipan Lagoon and that the "*mainly nocturnal ghost crabs….. burrow in great numbers where the sands are deep and clean*." The above habitats agree with Poore 's (2004) general habitat description for the genus O*cypode*; supratidal and intertidal on open beaches.

Uca crabs are found in mudflats and very shallow subtidal areas (Colin and Arneson 1995), though they are also found on the sandy beaches of Saipan Lagoon (J. Gourley pers.comm.).

The largest expanse of sandy beach habitat in the CNMI is along the Saipan Lagoon which stretches virtually the entire leeward side of Saipan. This is also the area where the greatest population of Saipan is located. With a tourism based economy, a substantial amount of the shoreline beach area is now fronting hotels, water associated recreational sports businesses and public swimming beaches. Direct impacts from these activities to the ghost crab population are unknown, however it should be noted that the ghost crab uses the beach during night while human use is primarily limited to the daylight hours. Though unsubstantiated, it is likely that certain lengths of the Saipan Lagoon beach have been detrimentally impacted to a point where ghost crab populations may have been effected.

Anthropogenic associated water quality problems appear to be localized in Saipan Lagoon (Starmer 2005). There is no information on whether the problem is directly affecting these intertidal crab species. Presumed ghost and fiddler crab habitat for Rota and Tinian is likely to be in good to excellent condition as human population levels are substantially lower than Saipan. The near shore waters and habitats surrounding the remaining islands of the CNMI are considered, with some exceptions, very good to excellent condition as they are either uninhabited or have less than 20 people inhabiting the island. This, of course, does not include Anatahan Island whose recent 2003 volcanic eruption severely impacted the near shore reef habitats with ash fallout (Starmer 2005).

**Problems which adversely affect the ghost crab and its habitats**

Though not presently recognized as a management problem, the absence of any good quality information on fishing effort by species, population levels and distribution of these species makes this situation potentially damaging from a management perspective.

Very little is known about the biology and fishery of ghost and fiddler crabs in the CNMI, therefore specific threats to this species have not yet been identified. However, potential threats are likely to include anthropogenic impacts to sandy beach areas and possible localized water quality problems for those populations located in Saipan Lagoon.

**Priority research and survey efforts**

The following research actions should be conducted simultaneously:

- The first step is for DFW biologists and creel census takers to learn to differentiate the various species of ghost and fiddler crabs that are found in the CNMI. After the taxonomy is understood, oral interviews should be conducted with fishers of different ethnic groups to determine if certain species are targeted for consumption (or other use) or if all ghost and fiddler crabs are considered edible.

- Ensure the inshore creel census is being conducted according to sampling protocol and that the appropriate fishery data is being collected. Investigate whether there is any effort directed at this species and what cultural or economic basis this fishery may have with those fishers, if any.

- Initial research efforts should focus on habitat preference and species distribution along the shores of Saipan Lagoon. This information would be used in conjunction with the descriptive fishery data collected by the inshore creel surveys to develop management measures, if any are required.

## Conservation actions

Harvest of ghost and fiddler crabs are prohibited unless as permitted by the DFW Director as outlined in Part 5, Section 80.1 of the CNMI Division of Fish and Wildlife Non-Commercial Fishing and Hunting Regulations that were promulgated on 20 April 2000 {CR Vol.22(04)}.

Effective enforcement of illegal harvest is considered an essential key to the success of protecting both ghost and fiddler crab populations.

## Monitoring

There are no specific monitoring programs presently targeting ghost or fiddler crabs. Active monitoring programs in the CNMI include the Interagency Marine Monitoring Team and the DFW Marine Sanctuaries Program. Though both programs collect data on invertebrates, their monitoring stations do not adequately survey sandy intertidal habitat where this species occurs. Additionally, since the ghost crab is nocturnal, daytime surveys will likely prove to be inadequate.

## Literature Cited for the ghost crab


Cloud, P.E., Jr. 1959. Geology of Saipan Mariana Islands Part 4. Submarine Topography and Shoal-Water Ecology. U.S. Geological Survey, Professional paper 280-K. United States Government Printing Office, Washington. P. 361-441.

Paulay, G., R. Kropp, P.K.L. Ng, and L.G. Eldredge. 2003. The crustaceans and pycnogonids of the Mariana Islands. Micronesica Vols.35-36:456-513.

Poore, G.C.B. 2004. Marine Decapod Crustacea of Southern Australia: A Guide to Identification. CSIRO Publishing, Victoria Australia. 574 p.

Takeda, M., Y. Fukui, K. Wada and A. Asakura. 1994. . Brachyura (Crustacea: Decapoda) from the northern Mariana Islands, Micronesia. *in* Biological Expedition to the Northern Mariana Islands, Micronesia. Natural History Research, Special issue No. 1, Natural History Museum and Institute, Asakura and Furuki, eds., Chiba, Japan. 344 pp.

# ROCK CRAB

**Common Name**
rock crab, grapsid crab


Figure 75. Shed of grapsid rock crab, Rota East Harbor, 11 Sept 2005
Photo Credit: J. Gourley, Micronesian Environmental Services

**Scientific Name**
Class Decapoda
Order Brachyura
Family Grapsidae

(Taxonomy follows Paulay, et al. 2003)

**Chamorro Name**
Agaaf

**Carolinian Name**
unknown

**Listing Status**
None

**Reasons for selecting the rock crab as a species of special conservation need**
This inter-tidal crab species is presently being harvested at some unknown level by the indigenous population of the CNMI for consumption purposes. There is no data on the magnitude of fishing effort that is directed toward rock crabs. Possibly more disturbing, from a management perspective, is that no information is known about which of the many species are being targeted.

There is no fishery related information on this species in the CNMI. Additionally, there is very limited biological information, including habitat requirements, known on which to base management decisions, should the species require managing.

**Unique characteristics**
Grapsid crabs are dorso-ventrally flattened crabs that are highly visible scurrying among the rock boulders lining shorelines. They appear to adapt quickly to man made wharves and retaining walls along shorelines. Some species of grapsid crabs can remain out of water for long periods of time. They are well suited for the often times harsh environment of the inter- and supra- tidal zones found along rocky coast areas.

The carapace is square-shaped, the front of the crab is broad with short eye-stalks. Male grapsid crabs generally have larger claws than the female. Most of the grapsid crab species in the CNMI are likely opportunistic omnivores.

**Distribution of the rock crab in the CNMI**
Rock crabs occur throughout the Mariana Islands. The joint CHIBA-DFW biological cruise to the Northern Islands (Takeda, et al.1994) found six genera (*Grapsus, Geograpsus, Pachygrapsus, Cyclograpsus, Plagusia, and Percnon)* comprising a total of

10 species. Rock crabs were found on Maug, Guguan, Anatahan, Uracas, Agrihan, Alamagan, Sarigan, and Pagan.

Paulay's, et al. (2003) overview of the distribution of Grapsid crabs within the Marianas Islands includes four genera (*Grapsus, Geograpsus, Pachygrapsus, and Metopograpsus*) comprising 13 species. Rock crabs were documented from the CNMI as occurring on Maug, Guguan, Anatahan, Uracas, Agrihan, Alamagan, Saipan, and Pagan. An earlier source, Cloud, et al. (1959), found rock crabs (i.e., *Grapsus* cf. *tenuicrustatus*) "*conspicuous and abundant*" along the rocky surfaces on the east coast of Saipan.

Species composition of rock crab communities on each of the islands, as well as habitat requirements are still in need of clarification.

**Abundance of the rock crab in the CNMI**

Abundance estimates of the rock crab have not been conducted in the CNMI.

**Location and relative condition of key habitats for the rock crab in the CNMI**

Coastal rocky habitat is not limited for any of the Mariana islands. Even those southern islands where beaches and fringing reefs are more developed, the windward coasts offer vast expanses of limestone rock outcroppings that act as habitat for the various species of rock crabs.

Rock crab habitat is typically not impacted on a grand scale by development pressures. Condition of this habitat type is likely to be considered very good to excellent throughout all the islands with little impact to habitat.

**Problems which adversely affect the rock crab and its habitats**

Though not presently recognized as a management problem, the absence of any good quality information on fishing effort, population levels and specific habitat requirements for these species makes this situation potentially damaging from a management perspective.

Very little is known about the biology and fishery of the rock crab in the CNMI, therefore specific threats to this species have not yet been identified.

**Priority research and survey efforts**

The following research actions should be conducted simultaneously:

- The first step is for DFW biologists and creel census takers to learn to differentiate the various species of rock crabs that are found in the CNMI. After the taxonomy is understood, oral interviews should be conducted with fishers to determine if certain species are targeted for consumption (or other use) or if all rock crabs are considered edible.

- Ensure the inshore creel census is being conducted according to sampling protocol and that the appropriate fishery data is being collected. Investigate whether there is any effort directed at this species and what cultural or economic basis this fishery may have with those fishers, if any.

- Initial research efforts should focus on habitat preference, species distribution and food items of the various species of rock crabs. This information would be used in conjunction with the descriptive fishery data collected by the inshore creel surveys to develop management measures, if any are required.

**Conservation actions**

Harvest of rock crabs are prohibited unless as permitted by the DFW Director as outlined in Part 5, Section 80.1 of the CNMI Division of Fish and Wildlife Non-Commercial Fishing and Hunting Regulations that were promulgated on 20 April 2000 {CR Vol.22(04)}.

Effective enforcement of illegal harvest is considered an essential key to the success of protecting the rock crab populations.

A number of regulatory actions by the DFW indirectly act to conserve these crab species. The DFW has established no-take marine protected areas around Saipan (Mañagaha Marine Conservation Area, Bird Island Marine Sanctuary and Forbidden Island Marine Sanctuary) that includes the adjacent shoreline. These refuges likely serve to protect this species.

**Monitoring**

There are no specific monitoring programs presently targeting rock crabs. Active monitoring programs in the CNMI include the Interagency Marine Monitoring Team and the DFW Marine Sanctuaries Program. Though both programs collect data on invertebrates, their monitoring stations do not adequately survey rocky intertidal habitat where this species occurs.

**Literature Cited for the rock crab**


Cloud, P.E., Jr. 1959. Geology of Saipan Mariana Islands Part 4. Submarine Topography and Shoal-Water Ecology. U.S. Geological Survey, Professional paper 280-K. United States Government Printing Office, Washington. P. 361-441.

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Takeda, M., Y. Fukui, K. Wada and A. Asakura. 1994. . Brachyura (Crustacea: Decapoda) from the northern Mariana Islands, Micronesia. *in* Biological Expedition to the Northern Mariana Islands, Micronesia. Natural History Research, Special issue No. 1, Natural History Museum and Institute, Asakura and Furuki, eds., Chiba, Japan. 344 pp.

# SPINY LOBSTER

**Common Name**
spiny lobster

**Scientific Name**
Class Decapoda
Order Palinura
Family Palinuridae
*Panulirus penicillatus* (Oliver, 1791)
*P. versicolor* (Latreille, 1804)
*P. longipes* Borradaile, 1899

(Taxonomy follows Paulay, et al. 2003)

Figure 76. Spiny Lobster, *Panulirus pencillatus*, fresh market specimen, roadside vendor, Susupe, Saipan, CNMI (22 Sept. 2005) Photo Credit: J. Gourley, Micronesian Environmental Services

**Chamorro Name**
Mahonggang for small to medium sized individuals; Gupo'alao for large sized individuals

**Carolinian Name**
yuurr

**Listing Status**
None.

**Reasons for selecting the spiny lobster as a species of special conservation need**
The spiny lobster is a high value commodity in the CNMI with an established local commercial market that supports both island residents and the restaurant industry. Commercial catches, recorded as total pounds per fishing event, are monitored through the Commercial Purchase data base system. Limitations with the existing data collection effort include such unknowns as species composition, individual lobster weights, and fishing effort associated with subsistence use. Though the biology of the species requires only a simple management strategy, it is important to ensure that the integrity of the existing spiny lobster fishery is not impacted by the sudden arrival of undersized lobsters or a hiatus in lobster catches.

**Unique characteristics**
Panulirid lobsters are generally regarded as opportunistic and omnivorous scavengers with food items being consumed including molluscs (primarily gastropods), crustaceans, echinoderms, seagrass and algae. Lobsters are nocturnal foragers with *Panulirus penicillatus* moving through the spur and groove channels to the reef crest and reef flat. As expected, there are ontogenetic and site differences in prey (Wright and Hill 1993) among the different species of lobsters.

Size at maturity is difficult to determine for both males and females. Once mature, females are believed to produce several broods each year. Male lobsters mate with mature intermolt females by depositing spermatophores onto the fourth and fifth sternal plates of the female. Within a few days after mating, the female extrudes several hundred thousand eggs into a chamber formed by curving the abdomen over the sternum with the eggs being fertilized by the spermatophore as they are extruded.. The eggs are carried by the female for approximately one month before larvae are release into the currents.

Planktonic larvae can remain at this stage from 4 to 12 months or more and reach a size of 50mm before molting into the puerulus stage when they make the transition to a benthic environment where they settle into (or near) habitat utilized by adults. Little is known on the feeding ecology during this larval planktonic stage.

Because of the long duration and extensive dispersal of the planktonic larval stages, it is conceivable that local over exploitation of the lobster stock would likely have little impact on the breeding potential of the regional stock. In other words, there appears to be little risk of recruitment overfishing of lobster fisheries in most Pacific islands. However, the CMNI should be aware that the source or donor population of CNMI lobsters could possibly be over exploited, thus indirectly causing a temporary (?) depressed juvenile recruitment rate onto CNMI reef areas. This would in turn, indirectly affect the lobster recruitment rate in those geographical areas replenished by CNMI lobsters. Despite this broad based claim, the CNMI should move cautiously in making any premature assumptions based on this information.

**Distribution of the spiny lobster in the CNMI**

Nineteen species of *Panulirus* lobsters occur in the tropical and subtropical seas of the world (Poore 2004). *Panulirus penicillatus* is the most common lobster in the Indo-Pacific and has commercial significance (Gosliner et al. 1996, Wright and Hill 1993). *Panulirus longipes* is found in the Indian Ocean, north-east Australia to southern Queensland, while *Panulirus versicolor* occurs throughout the Indo-west Pacific, including northern Australia. (Poore 2004).

*Panulirus penicillatus* is the most common spiny lobster in the CNMI and likely comprises most of the commercial catch (Wright and Hill 1993). Spiny lobsters are commonly caught and sold on all three of the southern populated islands. Hayashi, et al. (1994) found this species on Maug Island during the CHIBA expedition to the Northern Islands. Paulay, et al. (2003) also lists this species from Maug Island. In addition to *P. penicillatus,* Paulay, et al. (2003) identified an additional four *Panulirus* lobsters in Guam (i.e., *P. femoristriga, P. longipes, P. ornatus, and P. versicolor*). Status of the other lobster species are unknown in the CNMI.

**Abundance of the spiny lobster in the CNMI**

Abundance estimates of the various species of spiny lobster have not been conducted in the CNMI. However, there is landing data for lobsters (species combined) that enter the commercial fish market on Saipan. The Commercial Purchase data base, managed by the DFW, collects fishery data information from data invoices maintained by first time fish product purchasers on Saipan. Despite the best effort at data collection, spiny lobster landings are not differentiated at the species level. Additionally, the Commercial Purchase data base does not collect landing information on spiny lobster caught for subsistence use or those lobsters landed elsewhere in the CNMI.

**Location and relative condition of key habitats for the spiny lobster in the CNMI**

All three spiny lobster species inhabit coral reefs, however they are spatially segregated by species in various parts of the reef area. *Panulirus penicillatus* shows the greatest habitat specificity. It is restricted primarily to the well oxygenated windward surf zones of oceanic reefs that have clean and clear water with minimal terrestrial influence. *Panulirus longipes* is found primarily on the windward reef slope in slightly deeper water than *P. penicillatus*. Preferred habitat includes those more sheltered areas where wave action is moderate and coral growth tends to be more prolific. *Panulirus versicolor* is most commonly found in areas with high coral coverage. However, they also occur on exposed reef slopes and sheltered lagoonal or coastal areas with relatively more turbid waters.

Within the CNMI, the amount of coral reef habitat in the southern islands is greater and harbors a higher species diversity compared with the northern volcanic islands. Coral reef habitat in the CNMI for the most part is in good condition. Though anthropogenic associated water quality problems appear to be localized in Saipan Lagoon (Starmer 2005), there is no information on whether the problem is directly affecting the species. Presumed octopus habitat for Rota and Tinian is likely to be in good to excellent condition as human population levels are substantially lower than Saipan. The near shore waters and habitats surrounding the remaining islands of the CNMI are considered, with some exceptions, very good to excellent condition as they are either uninhabited or have less than 20 people inhabiting the island. This, of course, does not include Anatahan Island whose recent 2003 volcanic eruption severely impacted the near shore reef habitats with ash fallout (Starmer 2005). Volcanic ash, to a lesser degree, has also impacted the leeward side of Sarigan (M. Trianni Pers. comm.).

**Problems which adversely affect the spiny lobster and its habitats**

Other than gross landings of combined spiny lobster species for Saipan, there is no data on species specific harvest. Though not presently recognized as a management problem, the present situation is in need of improvement from a management perspective.

The most serious threat to interrupting the present sustainable spiny lobster fishery is the short-term over-exploitation of the resource.

A longer term threat to the spiny lobster is associated with serious impacts to the coral reef habitat which this species requires. In the CNMI, the coral reefs are general considered to be in good to excellent condition, however the barrier reef lagoonal system on Saipan is being chronically impacted through non-point source pollution, as well as other anthropogenic uses. Though the impact areas are localized, there is no information whether this is actually affecting the coral reef habitat to a point whereby it is affecting the spiny lobster population.

**Priority research and survey efforts**

● Ensure the inshore creel census is being conducted according to sampling protocol and that the appropriate fishery data is being collected for spiny lobster. Attempt to get species composition, sex and individual weights for captured octopus.

● Modify the existing Commercial Purchase data collection program to list the various species of spiny lobsters found in the CNMI. This would necessitate reprinting of receipt books and forms, as well as educating the fishers and fish retailers about the importance of knowing the weight and species of those individuals that are bought, sold or captured.

**Conservation actions**

It is prohibited to take or be in possession of any spiny lobster that (a) measures less than 3 inches in length measured in a straight line along the carapace from the ridge between the two largest spines above the eyes, back to the rear edge of the carapace; or (b) is carrying eggs, or (c) has been stripped of its eggs, or (d) harvested by spear or any method other than hand. This regulation is found at Part 5, Section 70.1 of the CNMI Division of Fish and Wildlife Non-Commercial Fishing and Hunting Regulations that were promulgated on 20 April 2000 (CR Vol.22(04).

Effective enforcement of illegal harvest is considered an essential key to the success of maintaining a viable sustaining fishery.

A number of regulatory actions by the DFW indirectly act to conserve the spiny lobster. The DFW has banned the use of poisons (including cyanide) and dynamite. In addition, the established no-take marine protected areas around Saipan (Mañagaha Marine Conservation Area, Bird Island Marine Sanctuary and Forbidden Island Marine Sanctuary) and Rota (Sasanhaya Bay Fish Reserve) likely serve to protect this species.

**Monitoring**

There are no specific monitoring programs presently targeting the spiny lobster. Active monitoring programs in the CNMI include the Interagency Marine Monitoring Team (MMT), and the DFW Marine Sanctuaries Program. Though the MMT collects data on invertebrates, their monitoring stations are typically established at depths 25 feet and greater and unfortunately, does not cover all optimal habitat types utilized by this species. The DFW Marine Sanctuaries Program takes note of invertebrate species, but the primary focus of the DFW Program is finfish resource assessment. Both surveys are limited to daytime sampling when the spiny lobster is secretive and difficult to notice.

**Literature Cited for the spiny lobster**

Gosliner, T.M., D.W. Behrens, and G.C. Williams. 1996. Coral Reef Animals of the Indo-Pacific: animal life from Africa to Hawaii exclusive of the vertebrates. Sea Challengers, Monterey, CA. 314 pp.

Hayashi, K-I., T. Komai and A. Asakura. 1994. Macrura (Crustacea: Decapoda: Stenopodidea, Caridea and Palinulidea) Collected from the Northern Mariana

Islands, Micronesia. *in* Biological Expedition to the Northern Mariana Islands, Micronesia. Natural History Research, Special issue No. 1, Natural History Museum and Institute, Asakura and Furuki, eds., Chiba, Japan. 344 pp.

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Poore, G.C.B. 2004. Marine Decapod Crustacea of Southern Australia: A Guide to Identification. CSIRO Publishing, Victoria Australia. 574 p.

Wright, A. and L. Hill, (eds). 1993. Nearshore Marine Resources of the South Pacific. Honiara (Solomon Islands), Suva (Fiji): Forum Fisheries Agency Institute of Pacific Studies. 710 p.

# LAND HERMIT CRAB

**Common Name**
land hermit crab

**Scientific Name**
Class Decapoda
Order Anomura
Family Coenobitidae
*Coenobita* spp.

(Taxonomy follows Paulay, et al. 2003)

**Chamorro Name**
Umang

**Carolinian Name**
Umwel, Umowm

**Listing Status**
None

Figure 77. Land hermit crab, *Coenobita* sp.
Photo Credit: Unknown

**Reasons for selecting the land hermit crab as a species of special conservation need**
Land hermit crabs are believed to be harvested at some unknown level by island residents in the CNMI for consumption purposes (J. Gourley pers. com.) and possibly for fishing bait (D. Wooster pers. comm.). Though considered an export item for the pet industry trade elsewhere in the Pacific, this is not believed to be happening in the CNMI. There is no data on the magnitude of fishing effort that is directed toward these crabs. Possibly more disturbing, from a management perspective, is that no information is known about which species are being targeted.

There is no fishery related information on these species in the CNMI. Additionally, there is very limited biological and population information known on which to base management decisions, should the species require managing.

**Unique characteristics**
Hermit crabs are walking decapods that can spend a substantial amount of time out of water along the coastline. Because the large abdomen is soft and requires protection, refuge is sought in abandoned snail shells (Goslinger, et al. 1996).

During the DFW - CHIBA expedition to the Northern Islands, Hayashi, et al. (1994) found land hermit crabs utilizing the empty shells of the following gastropods: *Turbo, Littoraria, Phasianella, Nerita, Cerithium, Rhinoclavis, Vanikoro, Cymatium, Bursa, Morula*, *Drupa, Nassa, Purpura, Pollia, Alectrion, Peristernia, Latirus*, and *Supplanaxis*. On the southern islands, hermit crabs often utilize the empty shells of the African snail and have been known to use a baby food jars and other manmade objects (D. Wooster pers. comm.).

Land hermit crabs are scavengers eating carrion and vegetable matter. In certain areas they are considered pests as they eat the dog food in the pets bowl (D. Wooster pers. comm.).

Females release eggs in water and the planktonic larvae can travel some distance to settle out in other islands.

**Distribution of the land hermit crab in the CNMI**

With the exception of *C. purpureus*, all other hermit crab species under discussion are widely distributed in the Indo-Pacific region. The exception was considered an endemic of Japan prior to the discovery of a single specimen on Maug (Hayashi, et al. (1994).

In general, distribution of hermit crab species are fairly well known among the islands of the CNMI, however, further investigations are needed to have a full understanding. During the DFW - CHIBA expedition to the Northern Islands, Hayashi, et al. (1994) found five species of *Coenobita.* The distribution of land hermit crabs in the Northern Islands follow:

- *C. brevimanus:* Anatahan and Guguan
- *C. cavipes:* Anatahan and Agrihan
- *C. perlatus:* Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, and Maug
- *C. purpureus:* Maug
- *C. rugosus:* Anatahan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, and Maug

Pauley's, et al. (2003) distributional data for the land hermit crab in the southern islands are as follows:

- *C. brevimanus:* Guam and Saipan
- *C. cavipes:* Guam
- *C. perlatus:* Guam and Saipan
- *C. rugosus:* Guam and Saipan

**Abundance of the land hermit crab in the CNMI**

Abundance estimates of the land hermit crab have not been conducted in the CNMI.

**Location and relative condition of key habitats for the land hermit crab in the CNMI**

Land hermit crabs live high on the shoreline (Gosliner, et al. 1996) and utilize the beach strand forest and limestone forest that lies adjacent to the beach (D. Wooster pers. comm.)

Land hermit crab habitat is more affected on the islands with greater human population levels, such as Saipan, Tinian and Rota. With a relatively large tourism based economy, a substantial amount of the Saipan shoreline beach area is now fronting hotels, water associated recreational sports businesses and public swimming beaches. It is likely that direct and indirect impacts have occurred from these activities as certain lengths of the Saipan Lagoon beach have been drastically altered. Presumed land hermit crab habitat for Rota and Tinian is likely to be in good to excellent condition as human population levels are substantially lower than Saipan. The near shore waters and habitats surrounding the remaining islands of the CNMI are considered, with some exceptions, very good to excellent condition as they are either uninhabited or have less than 20 people inhabiting the island. This, of course, does not include Anatahan Island whose recent 2003 volcanic eruption severely impacted the near shore reef habitats with ash fallout (Starmer 2005).

**Problems which adversely affect the land hermit crab and its habitats**

Though not presently recognized as a management problem, the absence of any good quality information on fishing effort by species and population levels of these species makes this situation potentially damaging from a management perspective.

The most serious threat to land hermit crab populations in the CNMI is over-exploitation of the resources, especially since this species is so easy to collect. No special collection equipment is required, all one has to do is simply pick them up during the night when they are more active. Other potential threats may include:

- coastline development that impacts large tracts of land hermit crab habitat. This includes roadways that the crab must cross in order to gain access to ocean waters. Many crabs can be killed crossing the road by vehicular traffic (J. Gourley pers. comm..);
- the unknown affect non-point source pollution issues associated with the Saipan Lagoon may have on land hermit crabs.
- the unknown predatory affect that wild pigs and coconut crabs have on the population (D. Wooster pers. comm.).

**Priority research and survey efforts**

The following research actions should be conducted simultaneously:

- The first step is for DFW biologists and creel census takers to learn to differentiate the various species of land hermit crabs that are found in the CNMI. After the taxonomy is understood, oral interviews should be conducted with fishers of different ethnic groups to determine if certain species are targeted for consumption (or other use) or if all land hermit crabs are considered edible.

- Ensure the inshore creel census is being conducted according to sampling protocol and that the appropriate fishery data is being collected. Investigate whether there is any effort directed at this species and what cultural or economic basis this fishery may have with those fishers, if any.

- Initial research efforts should focus on habitat preference and species distribution along the shores of Saipan Lagoon, as this likely is the most impacted habitat. This information would be used in conjunction with the descriptive fishery data collected by the inshore creel surveys to develop management measures, if any are required.

**Conservation actions**

It is inferred that the harvest of land hermit crabs are prohibited unless as permitted by the DFW Director as outlined in Part 5, Section 80.1 of the CNMI Division of Fish and Wildlife Non-Commercial Fishing and Hunting Regulations that were promulgated on 20 April 2000 {CR Vol.22(04)}. However, the regulations should be re-visited to ensure they are covered under the appropriate section.

Effective enforcement of illegal harvest is considered an essential key to the success of protecting land hermit crab populations.

A number of regulatory actions by the DFW indirectly act to conserve these crab species. The DFW has established no-take marine protected areas around Saipan (Mañagaha Marine Conservation Area, Bird Island Marine Sanctuary and Forbidden Island Marine Sanctuary) that includes the adjacent shoreline. These refuges likely serve to protect this species.

**Monitoring**

There are no specific monitoring programs presently targeting land hermit crabs. Active monitoring programs in the CNMI include the Interagency Marine Monitoring Team and the DFW Marine Sanctuaries Program. As these two programs collect data on sub-tidal invertebrates, their monitoring stations do not survey intertidal and shoreline (terrestrial) habitats where this species occurs.

**Literature Cited for the land hermit crab**


Gosliner, T.M., D.W. Behrens, and G.C. Williams. 1996. Coral Reef Animals of the Indo-Pacific: animal life from Africa to Hawaii exclusive of the vertebrates. Sea Challengers, Monterey, CA. 314 pp.

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Paulay, G., R. Kropp, P.K.L. Ng, and L.G. Eldredge. 2003. The crustaceans and pycnogonids of the Mariana Islands. Micronesica Vols.35-36:456-513.

# SURF REDFISH

Figure 78. Surf Redfish (*Actinopyga mauritiana)* Bird Island Marine Sanctuary,
Saipan, CNMI
Photo Credit: M. Trianni, CNMI Division of Fish and Wildlife

**Common Name**
surf redfish

(Common name follows SPC 1994)

**Scientific Name**
Order Holothuroidea
Family Holothuriidae
*Actinopyga mauritiana*
(Quoy and Gaimard, 1833)

(Taxonomy follows Paulay 2003)

**Chamorro Name**
balaté

**Carolinian Name**
Ppáleppál

**Listing Status**
None

**Reasons for selecting the surf redfish as a species of special conservation need**
Though listed as a low to medium value species by the Secretariat of the Pacific Community (SPC 1994), a commercial fishery targeting the surf redfish commenced on the island of Rota in October 1995 (Trianni 2002). The fishery operated without the knowledge of the CNMI Division of Fish and Wildlife (DFW) until December 1995. Following a precipitous decline in catch rates, the fishery relocated to the island of Saipan during May 1996 (Trianni 2003). A post-harvest survey coupled with depletion model analysis indicated that the surf redfish had been significantly over-exploited throughout its harvested range on Saipan (Trianni 2003).

During a post WWII survey of fisheries resources in Micronesia Smith (1947), in reference to sea cucumbers, stated that, "*According to Japanese reports, overfishing had reduced the numbers in many places, as no conservation regulations applied to these animals. Our own observations tended to confirm the Japanese statements, as the larger and more desirable commercial species were not very abundant compared with the unutilised species*." Trianni (2002) stated "*Descriptions of the sea cucumbers observed on the island of Saipan in the Mariana Islands by Smith (1947, 50–52) can be tentatively interpreted as the lolly fish, Holothuria atra, the greenfish, Stichopus chloronotus, the elephant trunkfish, Holothuria fuscopunctata, and probably the black teatfish, Holothuria whitmaei* (formerly *H. nobilis,* Rowe and Gates 1995)." The sea cucumber observations of Smith (1947) were restricted to Saipan, and to a lesser degree, Tinian. Although landings of sea cucumbers from the Japanese Mandate years are scattered at best, Richmond (1996) has stated that the Japanese over-harvested many areas in Micronesia, and in some areas recovery had not occurred.

Though relatively lower total landings of sea cucumbers were harvested than some other marine products during the Japanese Mandate period, total catch of sea cucumbers for the Saipan District (Marianas wide ?) in 1937 was recorded at 28.2 metric tons (raw weight?); with 9.9 metric tons of processed dried sea cucumbers exported (Navy Department 1944). For the year 1941, 2,000 kg of sea cucumbers were landed for Saipan. From a regional perspective (i.e., Saipan, Yap, Palau, Chuuk, and Pohnpei) for that same year, total production was 937 tons (Navy Department 1948). Despite the limitations of the historical data, it appears that sea cucumbers were heavily exploited throughout Micronesia, including the CNMI, during the Japanese Mandate years. This historical data has severe limitations as; species composition is unknown, landing weighs are not always defined (wet vs. dried weights) and the inter-workings of the industry from a regional perspective is not fully explained. Interestingly, commercial exploitation disappeared after the war because the United States Commercial Company was not able to develop oriental markets (Navy Department 1948).

The status and distribution of the surf redfish in the CNMI is still not well understood at this time.

**Unique characteristics**

The surf redfish is the principal sea cucumber inhabiting the surge zone of barrier reefs. It occurs from the barrier reef flats over the reef crest to a depth of about 40 feet, although commercially viable populations extend only down to about 20 feet (Trianni 2003). The surf redfish occurs in highest densities on the barrier reef flats and the reef crest, where mean densities can reach up to 8.7 per 100 $m^2$ (Preston 1993; Dalzell, et al. 1996, Trianni and Bryan 2004).

The body wall of the surf redfish is thick and muscular to resist wave impact. They have a well-developed sole or trivium covered with strong tube feet adapted for attachment in the high energy barrier reef zone. The surf redfish has 5 white-colored triangular teeth visible in the anal opening, that serve to prevent infection by parasitic pearl fish (*Encheliophis* spp.) which enter the anal opening of the sea cucumber, living within the lower digestive tract and feeding upon the sea cucumber's gonads and the respiratory trees.

The surf redfish is a surface deposit feeder that consumes and processes sediments on and around the hard bottom coral reef areas it occupies (Preston 1993). The terminal mouth of the surf redfish is typically extended downward with its feeding tentacles gathering sand and detritus off hard bottomed surfaces. The primary food sources associated with these sediments are bacteria, microalgae and dead organic matter (Massin 1982). The undigested sands are re-deposited through the anus as small rounded clumps of sand.

Experimental results have shown that the presence of sea cucumbers at natural density levels enhances the production of microalgae, which benefit from the enhanced nutrient levels resulting from the sea cucumber excretions (Uthicke and Klumpp 1997, 1998; Uthicke 2001a; Uthicke 2001b). As a result, overall production on coral reefs is probably enhanced. As the primary sea cucumber of the surge zone the feeding activities of the surf redfish are most likely critical to the sustained production of the barrier reef surge zone habitat.

**Distribution of the surf redfish in the CNMI**

The surf redfish is located throughout the CNMI on all islands and banks in depths less than 45 feet, where oceanic surge energy is high (M. Trianni pers. comm.).

**Abundance of the surf redfish in the CNMI**

Abundance estimates of the surf redfish have not been conducted for the entire CNMI, although abundance estimates have been generated for commercially harvested areas on Saipan (Trianni 2003), and commercially viable populations have been estimated on Tinian (Trianni and Bryan 2004).

**Location and relative condition of key habitats for the surf redfish in the CNMI**

The key habitats of the surf redfish in the CNMI are the barrier reef zones of the southern islands including Rota, Tinian and Saipan. In these areas key habitat can be further delineated by the presence of high spatial heterogeneity, as it has been observed that barrier reef zones with low spatial heterogeneity have lower densities of the surf redfish (Trianni and Bryan 2004). All other islands in the CNMI lack barrier reef habitats, and therefore, do not contain dense populations of the surf redfish. Although the species is found at all the islands and banks with habitats less than 45 feet deep where oceanic surge energy is high, densities of the surf redfish in such sub-optimal reef habitats are very low, and their contribution to population recruitment is unknown (M. Trianni pers. comm.).

**Problems which adversely affect the surf redfish and its habitats**

The surf redfish has proven to be very vulnerable to over-harvest in the CNMI (Trianni 2002; Trianni 2003; Trianni and Bryan 2004), as have sea cucumber resources in Micronesia (Richmond 1996) and worldwide (Conand 2000).

The prime habitat of the surf redfish is the surge zone of barrier reefs. This habitat is a very high-energy environment that can be adversely affected by significant storm events such as typhoons. The potential impacts of coral reef bleaching events to the reef structure, and hence surf redfish habitat, are unknown. Terrestrial derived influences are typically minimal. The harvest of surf redfish also results in direct damage to the surf redfish's habitat due to compaction by harvesters walking over corals in the barrier reef zone, in particular the barrier reef flats.

**Priority research and survey efforts**

The surf redfish needs to be re-assessed in areas where it has been over-exploited on Saipan. Trianni (2003) found that significant over-exploitation had occurred in harvested areas along the south and west barrier reefs of Saipan. It is not known how well populations of the surf redfish recover from such heavy exploitation (Richmond 1996). Successful sea cucumber reproduction is positively correlated with population density

(Richmond, et al. 1996), and as such, sea cucumbers are most likely highly prone to 'Allee effects' (Allee 1931). If population densities are low, and site recruitment insufficient to sustain a relatively constant growth rate, then local extinction(s) can occur. The threshold for the minimum population size to ensure effective breeding and subsequent recruitment in the surf redfish is not currently known. Given that immediate post-harvest estimates exist for harvested areas on Saipan, and unexploited population estimates exist from Tinian, then the re-surveying of the exploited areas on Saipan will help to elucidate minimum population size requirements in those harvested areas.

In addition to population re-assessment in harvested areas on Saipan, information on surf redfish abundance throughout the CNMI should be obtained, reviewed, and catalogued in order to gather a better understanding of population distribution.

Figure 79. CNMI DFW staff surveying for the surf redfish on the reef flat zone.
Photo Credit: M. Tenorio, Division of Fish and Wildlife

**Conservation actions**

In response to the documented over-exploitation of the surf redfish, the CNMI Legislature passed Public Law 11-63 on 18 February 1999 which imposed a ten-year moratorium on the harvest of all species of sea cucumbers in the CNMI. In addition, DFW regulatory amendments in 2000 {CR Vol.22(04)} incorporated two sea cucumber no-take zones (Section 60.2) that were instituted through export permit conditions during the sea cucumber fishery. These no-take zones included the Bird Island Bay and Laulau Bay, from the high water marks to the 40-foot depth contour. Subsequently, the Bird Island Sea Cucumber Reserve has been subsumed under the Bird Island Marine Sanctuary.

Despite the present moratorium, the most important conservation action at this juncture is to determine abundance, density and habitat preference of the surf redfish and black teatfish (*Holothuria whitmaei*) in the Saipan barrier reef system over a two year time period.

Effective enforcement of illegal harvest is considered an essential key to the success of protecting sea cucumber populations.

**Monitoring**

There are no specific monitoring programs presently targeting the surf redfish. Active monitoring programs in the CNMI include the Interagency Marine Monitoring Team

(MMT), and the DFW Marine Sanctuaries Program. Although the MMT collects data on invertebrates, the monitoring stations set up by the MMT typically are at depths 25 feet and greater, which is the lower end of the depth range of the surf redfish, and beyond the depth of primary habitat. The DFW Marine Sanctuaries Program takes note of invertebrate species, but the primary focus of data collection is finfish resource assessment.

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# BLACK TEATFISH

Figure 80. Black Teatfish (H*olothuria whitmaei)*
Photo Credit: unknown

**Common Name**
black teatfish

(Common name follows SPC 1994)

**Scientific Name**
Order Holothuroidea
Family Holothuriidae
*Holothuria whitmaei* Bell, 1887

(Taxonomy follows Paulay 2003)

**Chamorro Name**
balaté

**Carolinian Name**
Ppáleppál

**Listing Status**
None

**Reasons for selecting the black teatfish as a species of special conservation need**
The black teatfish is listed as a high value species by the Secretariat of the Pacific Community (SPC 1994). A commercial fishery targeting the surf redfish, *Actinopyga mauritiana*, commenced on the island of Rota in October 1995 (Trianni 2002). Ancillary to the harvest of surf redfish was the incidental harvest of the black teatfish, *Holothuria whitmaei*. This fishery operated without the knowledge of the Commonwealth of the Northern Mariana Islands (CNMI) Division of Fish and Wildlife (DFW) until December 1995. The fishery subsequently relocated to Saipan during May 1996 when catch rates dropped precipitously. Although the fishery did not directly target the black teatfish, considerable concern has since arisen with regard to the status of this sea cucumber in the waters of the CNMI.

During a post WWII survey of fisheries resources in Micronesia Smith (1947), in reference to sea cucumbers, stated that, "*According to Japanese reports, overfishing had reduced the numbers in many places, as no conservation regulations applied to these animals. Our own observations tended to confirm the Japanese statements, as the larger and more desirable commercial species were not very abundant compared with the unutilized species*." Trianni (2002) stated "*Descriptions of the sea cucumbers observed on the island of Saipan in the Mariana Islands by Smith (1947, 50–52) can be tentatively interpreted as the lolly fish, Holothuria atra, the greenfish, Stichopus chloronotus, the elephant trunkfish, Holothuria fuscopunctata, and probably the black teatfish, Holothuria whitmaei* (formerly *H. nobilis,* Rowe and Gates 1995)." The sea cucumber observations of Smith (1947) were restricted to Saipan, and to a lesser degree, Tinian. Although landings of sea cucumbers from the Japanese Mandate years are scattered at best, Richmond (1996) has stated that the Japanese over-harvested many areas in Micronesia, and in some areas recovery had not occurred. A study from the Great Barrier Reef in Australia has indicated that the black teatfish has low natural mortality rates as well as very low growth rates (Uthicke and Benzie, 2002).

Though relatively lower total landings of sea cucumbers were harvested than some other marine products during this time period, total catch of sea cucumbers for the Saipan District (Marianas wide ?) in 1937 was recorded at 28.2 metric tons; with 9.9 metric tons of processed dried sea cucumbers exported (Navy Department 1944). For the year 1941, 2,000 kg of sea cucumbers were landed for Saipan. From a regional perspective (i.e., Saipan, Yap, Palau, Chuuk, and Pohnpei) that same year, total production was 937 tons (Navy Department 1948). Despite the limitations of the historical data, it is obvious that sea cucumbers were exploited throughout Micronesia during the Japanese Mandate years. In the CNMI it is likely that high value sea cucumbers such as the black teatfish, were exploited heavily. This historical data has severe limitations as; species composition is unknown, landing weighs are not always defined (wet vs. dried weights) and the inter-workings of the industry from a regional perspective is not fully explained. Interestingly, commercial exploitation disappeared after the war because the United States Commercial Company was not able to develop oriental markets (Navy Department 1948).

The status and distribution of the black teatfish in the CNMI is still not well understood at this time.

**Unique characteristics**

Sea cucumbers are a traditional medicine in Chinese culture. Chen (2004) lists various perceived advantages of sea cucumber including benefits to the blood, "*vital essence*", kidney and intestines, and its use to treat "*weakness, impotence, debility of the aged, constipation due to intestinal dryness and frequent urination*". Additionally, Liao and Clark (1995) report that fishermen believe the black teatfish is a "*nourishing tonic of particular value to pregnant women.*" The protein content of dried sea cucumber is typically greater than 50% in most species (Chen 2004), making sea cucumber products unique protein sources.

The black teatfish is large sea cucumber species that reaches a total length of from 30 – 40cm with a live weight of 2 to 3kg (SPC 1994). In the CNMI adults are typically uniformly black in color with a fine coating of sand over their body. The black teatfish is characterized by having six to eight "teat-like" protrusions along the lateral sides of the body wall.

The taxonomic status of the black teatfish has received considerable attention in recent years, with Uthicke, et al. (2004) having recently established that the Pacific and Indian Ocean black teatfish are two distinct species; *Holothuria whitmaei* and *H. nobilis*, respectively.

Like the surf redfish, the black teatfish also possesses anal teeth, which serve to prevent infection by parasitic pearl fish (*Encheliophis* spp.) that enter the anal open of the sea cucumber, living within the lower digestive tract and feeding upon the sea cucumbers gonads and the respiratory trees.

The black teatfish is a surface deposit feeder that consumes and processes sediments in coral reef areas it occupies (Preston 1993). The terminal mouth of the black teatfish is typically extended downward with its feeding tentacles gathering sand and detritus off benthic surfaces. The primary food sources associated with these sediments are bacteria, microalgae and dead organic matter (Massin 1982). The undigested sands are re-deposited through the anus.

Experimental results have shown that the presence of sea cucumbers at natural density levels enhances the production of microalgae, which benefit from the enhanced nutrient levels resulting from the sea cucumber excretions (Uthicke and Klumpp 1997, 1998; Uthicke 2001a; Uthicke 2001b). As a result, overall production on coral reefs is probably enhanced. As the primary sea cucumber of the surge zone the feeding activities of the surf redfish are most likely critical to the sustained production of the surge zone.

**Distribution of the black teatfish in the CNMI**

The black teatfish may occur throughout the CNMI on all islands and banks, although the actual species distribution has not been verified due to the extended depth range and low densities that have been observed in the CNMI. The absolute depth at which the black teatfish occurs in the CNMI is not known, although in the CNMI the species regularly occurs from the outer reef flat of barrier reefs and in reef slope and spur and groove habitat down to at least 70 feet (M. Trianni pers. comm.).

**Abundance of the black teatfish in the CNMI**

Abundance estimates of the black teatfish have not been conducted in the CNMI, although ancillary observations and/or harvest rates have been documented secondary to similar data for the surf redfish on Rota, Saipan and Tinian (Trianni 2002; Trianni 2003; Trianni and Bryan 2004). Consequently, there are no confident estimates of black teatfish abundance anywhere in the CNMI.

**Location and relative condition of key habitats for the black teatfish in the CNMI**

The key habitats of the black teatfish in the CNMI are not clearly defined. The species appears to have a wide depth distribution over coral reef habitats from outer reef flats down to spur and groove zones to at least 70 feet deep.

**Problems which adversely affect the black teatfish and its habitats**

Due to the low observed densities of the black teatfish any harvest of the species can be considered a threat to the remaining population(s) in the CNMI.

The outer reef flat habitat is a very high-energy environment that can be adversely affected by significant storm events such as typhoons. The potential impacts of coral reef bleaching events to the shallow and deeper reef areas are unknown. Terrestrial derived influences are typically minimal. The harvest of surf redfish in outer reef zones also results in direct damage to the black teatfish's habitat due to compaction by harvesters walking over corals.

**Priority research and survey efforts**

A literature review of the species should take place in order to determine where priority research should be focused in the future. Assessments of the surf redfish should include the collection of abundance and size frequency data for the black teatfish. In addition, current DFW Fisheries Research Section Marine Sanctuary assessments should incorporate the collection of black teatfish abundance and size frequency data.

Successful sea cucumber reproduction is positively correlated with population density (Richmond et al. 1996), and as such, sea cucumbers are most likely highly prone to 'Allee effects' (Allee 1931). If population densities are low, and site recruitment insufficient to sustain a relatively constant growth rate, then local extinction(s) can occur. The threshold for the minimum population size to ensure effective breeding and subsequent recruitment in the black teatfish is not known.

In addition to population re-assessment in harvested areas on Saipan, information on black teatfish in the CNMI should be obtained, reviewed, and catalogued in order to gather a better understanding of the status of this species.

**Conservation actions**

In response to the over-exploitation of the surf redfish sea cucumber (*Actinopyga mauritiana*), the CNMI Legislature passed Public Law 11-63 on 18 February 1999 which imposed a ten-year moratorium on the harvest of all species of sea cucumbers in the CNMI. In addition, DFW regulatory amendments in 2000 {CR Vol.22(04)} incorporated two sea cucumber no-take zones (Section 60.2) that were instituted through export permit conditions during the sea cucumber fishery. These no-take zones included the Bird Island Bay and Laulau Bay, from the high water marks to the 40-foot depth contour. Subsequently, the Bird Island Sea Cucumber Reserve has been subsumed under the Bird Island Marine Sanctuary.

Despite the present moratorium, the most important conservation action at this juncture is to determine abundance, density and habitat preference of the black teatfish and surf redfish (A*ctinopyga mauritiana*) in the Saipan barrier reef system over a two year time period.

Effective enforcement of illegal harvest is considered an essential key to the success of protecting sea cucumber populations.

**Monitoring**

There are no specific monitoring programs presently targeting the black teatfish. Active monitoring programs in the CNMI include the Interagency Marine Monitoring Team (MMT), and the DFW Marine Sanctuaries Program. The MMT collects data on invertebrates, including all species of sea cucumber. The DFW Marine Sanctuaries

Program takes note of invertebrate species, but the primary focus of data collection is finfish resource assessment.

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# SHORTSPINE SEA URCHIN

**Common Name**
shortspine sea urchin

**Scientific Name**
Class Echinodermata
   Order Echinoidea
      Family Toxopneustidae
*Tripneustis gratilla* (L. 1758)

(Taxonomy follows Paulay 2003)

**Chamorro Name**
Nufu

**Carolinian Name**
Larr

**Listing Status**
None.

**Reasons for selecting the shortspine sea urchin as a species of special conservation need**
This shallow water macro-invertebrate has historical ties with commercial exploitation in other areas of the Indo-Pacific. The roe is considered a delicacy in Asia (DAWR 1994) and anecdotal evidence suggests that it was locally harvested on Saipan after the war. Though presently not abundant, historical comments from the late 1950's (Cloud 1959) indicated it was common at that time.

Though there is no fishery related information on the harvest of this species in the CNMI, anecdotal evidence that certain ethnic groups are harvesting this sea urchin for consumption purposes. Unfortunately, there is very limited biological information known on which to base management decisions, should the species require managing.

**Unique characteristics**
The shortspine sea urchin has a number of different color forms (Colin and Arneson 1995) and is considered by some to be the most common and variable of Indo-Pacific urchins (Gosliner, et al. 1996).

This sea urchin species feeds on algae that is scraped off hard substrates with rasping teeth. The mouth is located in the center on the underside of the test (i.e., the calcareous outer shell structure). Waste products exit through a small hole located at the top of the test. The slow moving sea urchin utilizes soft tubed feet with suction cups to graze along the substrate. The internal organs are surrounded by the test and moveable spines offers protection against predators (DAWR 1994). The sea urchin usually covers itself with debris, such as seagrass or algae material and other detrital matter (Gosliner, et al. 1996, Cloud 1959).

### Distribution of the shortspine sea urchin in the CNMI

World wide distribution includes Indo-West Pacific from East Africa to the Hawaiian Islands, except the Arabian Gulf, Pakistan and western India (Liao and Clark 1995).

Within the CNMI, distribution of the shortspine sea urchin has not been fully explored. Cloud (1959) found the shortspine sea urchin "*commonplace*" in the Saipan Lagoon during the late 1950's. Paulay (2003) has documented its presence on Saipan and Guam. The joint CHIBA-DFW biological cruise to all the northern islands did not record any specimens (Irimura, et al. 1994). Island specific distributional data is severely lacking.

### Abundance of the shortspine sea urchin in the CNMI

Abundance estimates of the shortspine sea urchin have not been conducted in the CNMI.

### Location and relative condition of key habitats for the shortspine sea urchin in the CNMI

Gosliner, et al. (1996) reports it is one of most common sea urchins found in shallow water lagoons and bays. Liao and Clark (1995) typically found this species in waters from 0 to 30m in depth. Cloud (1959) found the shortspine sea urchin most abundant in "*areas of abundant but not densest seaweed growth*" on Saipan.

Based on the broad habitat descriptions above, possibly the greatest population of the shortspine sea urchin would be located in Saipan Lagoon (Saipan), as this is the greatest area of contiguous shallow sandy habitat with seagrass meadows in the CNMI.

Though anthropogenic associated water quality problems appear to be localized in Saipan Lagoon (Starmer 2005), there is no information on whether the problem is directly affecting the species. Presumed shortspine sea urchin habitat for Rota and Tinian is likely to be in good to excellent condition as human population levels are substantially lower than Saipan. The near shore waters and habitats surrounding the remaining islands of the CNMI are considered, with some exceptions, very good to excellent condition as they are either uninhabited or have less than 20 people inhabiting the island. This, of course, does not include Anatahan Island whose recent 2003 volcanic eruption severely impacted the near shore reef habitats with ash fallout (Starmer 2005). Volcanic ash, to a lesser degree, has also impacted the leeward side of Sarigan (M. Trianni Pers. comm.). Volcanic ash, to a lesser degree, has also impacted the leeward side of Sarigan (M. Trianni Pers. comm.).

### Problems which adversely affect the shortspine sea urchin and its habitats

Though not presently recognized as a management problem, the absence of any good quality information on fishing effort and population levels for this species makes this situation potentially damaging from a management perspective.

The most serious threat to shortspine sea urchin populations in the CNMI is over-exploitation of the resources. A potential threat could be the unknown affect non-point source pollution issues associated with the Saipan Lagoon may have on this sea urchin.

## Priority research and survey efforts

The following research actions should be conducted simultaneously:

- Ensure the inshore creel census is being conducted according to sampling protocol and that the appropriate fishery data is being collected. Investigate whether there is any effort directed at this species and what cultural or economic basis this fishery may have with those fishers, if any.

- Determine reproductive cycles, density, seasonal population fluctuations and habitat preference of the shortspine sea urchin within the Saipan barrier reef system. This crucial information would be used in conjunction with the descriptive fishery data collected by the inshore creel surveys to develop management measures, if any are required.

## Conservation actions

Harvest of the shortspine sea urchin is prohibited unless as permitted by the DFW Director as outlined in Part 5, Section 80.1 of the CNMI Division of Fish and Wildlife Non-Commercial Fishing and Hunting Regulations that were promulgated on 20 April 2000 {CR Vol.22(04)}.

Effective enforcement of illegal harvest is considered an essential key to the success of protecting shortspine sea urchin populations.

A number of regulatory actions by the DFW indirectly act to conserve macro-invertebrates. The DFW has banned the use of poisons (including cyanide) and dynamite. In addition, the established no-take marine protected areas around Saipan (Mañagaha Marine Conservation Area, Bird Island Marine Sanctuary and Forbidden Island Marine Sanctuary) and Rota (Sasanhaya Bay Fish Reserve) likely serve to protect this species.

## Monitoring

There are no specific monitoring programs presently targeting sea urchins. Active monitoring programs in the CNMI include the Interagency Marine Monitoring Team (MMT), and the DFW Marine Sanctuaries Program. Though the MMT collects data on invertebrates, their monitoring stations are typically established at depths 25 feet and greater and unfortunately, does not cover all optimal habitat types utilized by this species. The DFW Marine Sanctuaries Program takes note of invertebrate species, but the primary focus of the DFW Program is finfish resource assessment.

**Literature Cited for the shortspine sea urchin**


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# GIANT CLAMS

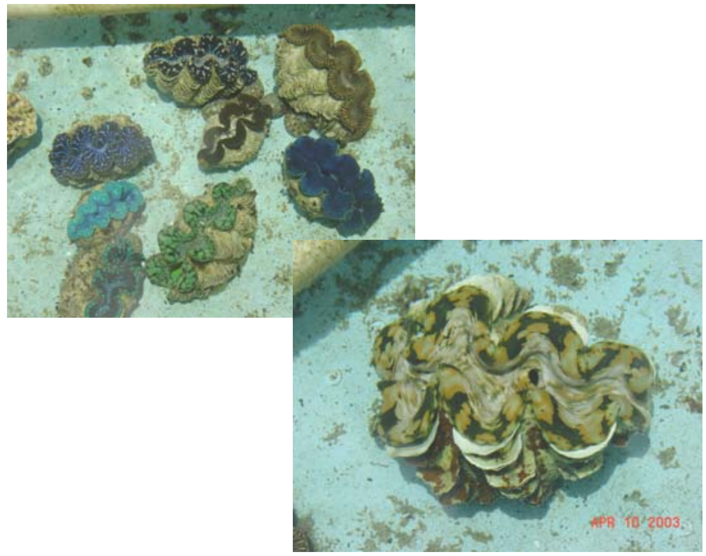


Figure 81. Cultured *Tridacna maxima* (top) and *T. squamosa* (bottom)
Palau Mariculture Demonstration Center, Republic of Palau
Photo Credit: J. Gourley, Micronesian Environmental Services

## Common Name
fluted giant clam
elongate giant clam

(Common names follow Abbott & Dance 2000)

## Scientific Name
Class Bivalvia
Order Veneroida
Family Tridacnidae
*Tridacna squamosa* Lamark, 1819
*Tridacna maxima* (Roding, 1798)

(Taxonomy follows Abbott and Dance 2000)

## Chamorro Name
Hima

## Carolinian Name
Shiim for large specimens;
Tto for smallspecimes

## Listing Status
The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), of which the United States is a party (i.e., member), listed all species of giant clams in the family Tridacnidae on Appendix II in January 2005. International commercial trade of Appendix II wildlife and/or plant species is monitored through a documentation system required for every shipment involving an Appendix II species, as long as one signatory country is involved in the transaction. Within Micronesia, the Territory of Guam (US), the Commonwealth of the Northern Mariana Islands (US) and the Republic of Palau are parties to CITES, while the Republic of Marshall Islands and the Federated States of Micronesia have refrained from joining at this time.

The 2004 IUCN Red List of Threatened Species identifies *Tridacna maxima* and *Tridacna squamosa* as a Threatened species (category LR/cd ); Lower Risk, Conservation Dependent.

## Reasons for selecting giant clams as a species of special conservation need
Giant clams have been consumed and their shells used as tools historically throughout the Indo-Pacific by the indigenous island residents (Wright and Hill 1993, Roth 1980). Two local species of giant clams are consumed. *Tridacna squamosa* is easily “caught” by simply cutting the byssal threads holding the clam to the substrate. Obtaining *T. maxima*, is more difficult as it burrows into coral rock. The local technique of collecting these clams is to use a large screwdriver and pry the clam out of the coral rock.

In addition to consumptive purposes, the shell of *T. squamosa* is also sought by curio and shell collectors. Giant clam shells can be found on display at various island businesses, dive shops, or for sale in tourist gift shops on Saipan (J. Gourley pers. comm.); however one should not assume those specimens were locally obtained.

There is no fishery related information on this species in the CNMI. The extent of local consumption is unknown. In addition, the shell of *T. squamosa* is likely collected by divers, tourists and others for personal shell collections. There is very limited biological information known on which to base management decisions, should the species require managing

**Unique characteristics**

The giant clam family Tridacnidae is comprised of two genera; *Tridacna* and *Hippopus*. The genus *Tridacna* is represented by seven extant species, while *Hippopus* has two. There are two species of giant clams that have been well documented from CNMI waters; *T. maxima* and *T. squamosa.*

*Tridacna squamosa* reaches a maximum shell length of approximately 40cm. The shell sculpture is distinct and attractive, with large protruding well–spaced scutes. As such, this species is important in the shell and curio trade (Copland and Lucas 1988). Stabilization is achieved through byssal threads attaching the clam shell to the coral debris substrate (Okutani 2000) in order to maintain mantle orientation uppermost.

*Tridacna maxima* is a slightly smaller sized clam with sizes up to 35cm. The mantles are usually brightly colored (Copland and Lucas 1988) and is marketed in the aquarium trade. Unlike *T. squamosa*, this species borrows into coral rock (Okutani 2000).

A third species, *T. crocea* has been recorded from Saipan, but only by one researcher (Fujioka 1984). Further investigations are needed to confirm this record. In addition to the indigenous giant clams, two other giant clam species have been released in nearshore waters of Saipan, *T. derasa* and *Hippopus hippopus.* However the current status of the "population" is unknown.

Adult giant clams are simultaneous hermaphrodites. Clams first become sexually mature as males (protandrous) and then subsequently become hermaphrodites releasing both sperm and egg, at separate times, during spawning events. Self-fertilization is avoided with the spawning clam initially releasing spermatozoa, followed by gametes later. Eggs are pelagic for approximately 9 days when the juvenile clam settles onto the substrate.

The symbiosis relationship between the giant clams mantle and zooxanthellae occur upon settlement with the benthic clam ingesting (by filter feeding) naturally occurring zooxanthellae. Both species found in the CNMI anchor the shell with byssal threads for the life of the clam. Several of the larger giant clams (e.g., *T. gigas* and *T. derasa*) rely on a heavy shell for stabilization and to maintain the proper mantle orientation. Some species of giant clams can live for several decades or more.

Food intake from filter feeding is supplemented by nutrient molecules gained from the photosynthesis of the symbiotic zooxanthellae located in the mantle (Copland and Lucas 1988). Giant clams are considered facultative planktotrophs and can derive all their maintenance requirements from their symbiotic zooxanthellae and actually grow in filtered water. However, optimal growth this achieved when nutrient intake is supplemented by the normal filter feeding process (Wright and Hill 1993).

**<u>Distribution of giant clams in the CNMI</u>**

Giant clams are distributed over tropical areas of the Indo-Pacific (Kira 1965). The various species have slightly different ranges within this broad region and there is substantial overlap in most of the species, especially with *T. maxima* and *T. squamosa.* Copland and Lucas (1988) notes these two species are generally distributed from the western Indian Ocean to Polynesia; with *T. squamosa* not quite reaching Polynesia. *Tridacna maxima* is the most widely distributed species of all the giant clam species.

*Tridacna maxima* was found on all nine of the CNMI Northern Islands during the NOAA MARMAP 2003 cruise (Starmer 2005). Earlier sources documents this species on Maug (Vermeij, et al. 1983, Kurozumi and Asakura 1994, Pauly 2003), Saipan (Fujioka 1984, Pauly 2003), Pagan (Vermeij, et al. 1983, Kurozumi and Asakura 1994), and the islands of Anatahan and Alamagan (Vermeij, et al. 1983, Kurozumi and Asakura 1994).

*Tridacna squamosa* has been documented from Saipan (Fujioka 1984, Pauly 2003), Tinian (Pauly 2003), Maug (Vermeij, et al. 1983, Kurozumi and Asakura 1994) and Anatahan (Vermeij, et al. 1983).

A third species of giant clam, *Tridacna crocea,* was documented on Saipan by Fujioka (1984). Further investigations are needed to confirm this record.

**<u>Abundance of giant clams in the CNMI</u>**

Abundance estimates of either species of giant clam have not been conducted in the CNMI. It is commonly known among island residents that *T. maxima* is more common than *T. squamosa*, however the difference in abundance could be related to a function of selective exploitation.

Abundance data obtained on giant clams from the 2003 NOAA MARMAP Cruise is still being analyzed. However, Starmer (2005) reports a maximum density of the elongate giant clam as 0.5-1 $m^2$ found along the interior slope of the eastern end of the northern island of Maug.

**<u>Location and relative condition of key habitats for giant clams in the CNMI</u>**

Giant clams are found in shallow clear waters of coral reefs to a depth of 20m. In turbid water conditions, maximum depths are less due to the limited sunlight penetration (Copland and Lucas 1988). *Tridacna squamosa* appears more often in fairly sheltered lagoon environments adjacent to high islands, while *T. maxima* prefers the closed atoll lagoons in Polynesia (Wright and Hill 1993).

Within the CNMI, the amount of coral reef habitat in the southern islands is greater and has higher species diversity when compared with the northern volcanic islands. Coral reef habitat in the CNMI for the most part is in good condition. Though anthropogenic associated water quality problems appear to be localized in Saipan Lagoon (Starmer 2005), there is no information on whether the problem is directly affecting the species. Presumed giant clam habitat for Rota and Tinian is likely to be in good to excellent condition as human population levels are substantially lower than Saipan. The near shore waters and habitats surrounding the remaining islands of the CNMI are considered, with some exceptions, very good to excellent condition as they are either uninhabited or have less than 20 people inhabiting the island. This, of course, does not include Anatahan Island whose recent 2003 volcanic eruption severely impacted the near shore reef habitats with ash fallout (Starmer 2005). Volcanic ash, to a lesser degree, has also impacted the leeward side of Sarigan (M. Trianni Pers. comm.).

**Problems which adversely affect giant clams and its habitats**

Though not presently recognized as a management problem, the absence of any good quality information on fishing effort and population levels for giant clams makes this situation potentially damaging from a management perspective.

The most serious threat to giant clam populations in the CNMI is over-exploitation of the resources. A potential threat could be the unknown affect non-point source pollution issues associated with the Saipan Lagoon may have on giant clams.

**Priority research and survey efforts**

The following research actions should be conducted simultaneously:

- Ensure the inshore creel census is being conducted according to sampling protocol and that the appropriate fishery data is being collected. Investigate whether there is any effort directed at this species and what cultural or economic basis this fishery may have with those fishers, if any.

- Determine population sizes and densities, habitat preference and distribution of the various species of giant clams within the Saipan barrier reef system. This crucial information would be used in conjunction with the descriptive fishery data collected by the inshore creel surveys to develop management measures, if any are required.

- The culture of giant clams is well understood and has been ongoing in the Micronesian region for almost 20 years. Spawning giant clams under controlled conditions and subsequent raising of the planktonic larvae to settlement stage, offers the opportunity to release veliger/juveniles/young giant clams into the wild for local stock enhancement purposes. In addition, local culturist may be interested in growing out juvenile clams for the food industry or aquarium trade, depending upon the species being spawned. Given that the Northern Marianas College and CREES Extension Service are in the process of building a mariculture center on Saipan, high priority could be given to local culture and rearing of giant clams for subsequent release onto local reefs.

**Conservation actions**

The harvest of giant clams are prohibited unless as permitted by the DFW Director as outlined in Part 5, Section 80.1 of the CNMI Division of Fish and Wildlife Non-Commercial Fishing and Hunting Regulations that were promulgated on 20 April 2000 {CR Vol.22(04)}.

Effective enforcement of illegal harvest is considered an essential key to the success of protecting giant clam populations.

A number of regulatory actions by the DFW indirectly act to conserve benthic bivalves. The DFW has banned the use of poisons (including cyanide) and dynamite. In addition, the established no-take marine protected areas around Saipan (Mañagaha Marine Conservation Area, Bird Island Marine Sanctuary and Forbidden Island Marine Sanctuary) and Rota (Sasanhaya Bay Fish Reserve) likely serve to protect this species.

**Monitoring**

There are no specific monitoring programs presently targeting giant clams. Active monitoring programs in the CNMI include the Interagency Marine Monitoring Team (MMT), and the DFW Marine Sanctuaries Program. Though the MMT collects data on invertebrates, their monitoring stations are typically established at depths 25 feet and greater and unfortunately, does not cover all optimal habitat types utilized by this species. The DFW Marine Sanctuaries Program takes note of invertebrate species, but the primary focus of the DFW Program is finfish resource assessment.

**Literature Cited for giant clams**


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# PECTINATE VENUS


Figure 82. Pectinate venus (*Gafrarium pectinatum*) collected live by J. Gourley on 10 April 2005, South Garapan beach area, Saipan Lagoon, Saipan, CNMI
Photo Credit: J. Gourley, Micronesian Environmental Services

**Common Name**
pectinate venus

(Common name follows Abbott and Dance 2000)

**Scientific Name**
Class Bivalvia
Order Veneroida
Family Veneridae (Venus clams)
*Gafrarium pectinatum* (L., 1758)

(Taxonomy follows Abbott and Dance 2000)

**Chamorro Name**
Tapon for large specimens;
Amsun for small specimens

**Carolinian Name**
Ai'mett for large specimens;
Ghatil for small specimens

**Listing Status**
None.

**Reasons for selecting the pectinate venus as a species of special conservation need**
This small in-faunal bivalve is presently being harvested at some unknown level by the local indigenous population, Micronesian immigrants and foreign guest workers for consumption purposes. There is no data on the magnitude of fishing effort that is directed toward this species. Nor is there any biological information known on which to base any management decisions, should the species require managing.

**Unique characteristics**
This small in-faunal bivalve has no unique characteristics other than it apparently tastes good and it is easy to obtain as no boat or fishing equipment is required. Several fishers have been observed collecting the pectinate venus at low tide, sitting in the *Enhalus* seagrass meadows and working their hands through the sand substrate (J. Gourley pers. comm.). Cernohorsky (1972) reports the abundance of this species as "*moderately common*" with a shell length up to 50mm.

**Distribution of the pectinate venus in the CNMI**
The pectinate venus has a wide ranging distribution from the Kii Peninsula (Japan) to Indian Ocean (Okutani 2000). Abbott and Dance (2000) and Kira (1965) note its general distribution as Indo-Pacific.

Within the CNMI, distribution of the pectinate venus has not been fully explored. Vermeji, et al. (1983) reports this species from Pagan Island and Paulay (2003) and

Fujioka (1984) have documented its presence on Saipan. The joint CHIBA-DFW biological cruise to all the northern islands did not find any specimens (Kurozumi and Asakura 1994). Elsewhere in the Marianas archipelago, Paulay (2003) lists it as occurring in Guam. Island specific distributional data is severely lacking.

**<u>Abundance of the pectinate venus in the CNMI</u>**
Abundance estimates of the pectinate venus have not been conducted in the CNMI.

**<u>Location and relative condition of key habitats for the pectinate venus in the CNMI</u>**
Abbott and Dance (2000) describe the habitat for this common species as shallow sandy areas to 20m in depth. Kira (1965) describes its abundance as "*very common on shallow sandy bottom*". Okutani (2000) provides a more detailed habitat requirement of coarse sand bottom in middle intertidal zone to 20m. Lamprell and Whitehead (1992) describes its habitat as "*littoral sand*".

Based on the habitat descriptions above, possibly the greatest population of pectinate venus would be located in Saipan Lagoon (Saipan), as this is the greatest contiguous area of shallow water sandy habitat in the CNMI. Though anthropogenic associated water quality problems appear to be localized in Saipan Lagoon (Starmer 2005), there is no information on whether the problem is directly affecting the species. Presumed pectinate venus habitat for Rota and Tinian is likely to be in good to excellent condition as human population levels are substantially lower than Saipan. The near shore waters and habitats surrounding the remaining islands of the CNMI are considered, with some exceptions, very good to excellent condition as they are either uninhabited or have less than 20 people inhabiting the island. This, of course, does not include Anatahan Island whose recent 2003 volcanic eruption severely impacted the near shore reef habitats with ash fallout (Starmer 2005). Volcanic ash, to a lesser degree, has also impacted the leeward side of Sarigan (M. Trianni Pers. comm.).

**<u>Problems which adversely affect the pectinate venus and its habitats</u>**
Though not presently recognized as a management problem, the absence of any good quality information on fishing effort, population levels and habitat requirements for this species makes this situation potentially damaging from a management perspective.

Very little is known about the pectinate venus in the CNMI, therefore specific threats to this species have not yet been identified. However, non-point source pollution issues associated with the Saipan Lagoon should be investigated as a potential threat.

**<u>Priority research and survey efforts</u>**
The following research actions should be conducted simultaneously:

- Ensure the inshore creel census is being conducted according to sampling protocol and that the appropriate fishery data is being collected. Investigate whether there is any effort directed at this species and what cultural or economic basis this fishery may have with those fishers, if any.

● Determine reproductive cycles, density, seasonal population fluctuations and habitat preference of the pectinate venus within the Saipan barrier reef system. This crucial information would be used in conjunction with the descriptive fishery data collected by the inshore creel surveys to develop management measures, if any are required.

**Conservation actions**

The harvest of the pectinate venus is prohibited unless as permitted by the DFW Director as outlined in Part 5, Section 80.1 of the CNMI Division of Fish and Wildlife Non-Commercial Fishing and Hunting Regulations that were promulgated on 20 April 2000 {CR Vol.22(04)}.

Effective enforcement of illegal harvest is considered an essential key to the success of protecting pectinate venus populations.

A number of regulatory actions by the DFW indirectly act to conserve in-faunal bivalves. The DFW has banned the use of poisons (including cyanide) and dynamite. In addition, the established no-take marine protected areas around Saipan (Mañagaha Marine Conservation Area, Bird Island Marine Sanctuary and Forbidden Island Marine Sanctuary) and Rota (Sasanhaya Bay Fish Reserve) likely serve to protect this species.

**Monitoring**

There are no specific monitoring programs presently targeting the pectinate venus. Active monitoring programs in the CNMI include the Interagency Marine Monitoring Team, and the DFW Marine Sanctuaries Program. These monitoring programs do not investigate in-faunal bivalve populations.

**Literature Cited for the pectinate venus**

Abbott, R.T. and S.P. Dance. 2000. Compendium of Seashells. Odyssey Publishing, El Cajon, California, USA. 411 pp.

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Kurozumi, T. and A. Asakura. 1994. Marine molluscs from the Northern Mariana Islands, Micronesia. *in* Biological Expedition to the Northern Mariana Islands, Micronesia. Natural History Research, Special issue No. 1, Natural History Museum and Institute, Asakura and Furuki, eds., Chiba, Japan. 344 pp.

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# COMMON SPIDER CONCH

Figure 83. Common spider conch (*Lambis lambis*), collected DOB by D. Wooster (2004), Micro Beach, Saipan Lagoon, Saipan (same shell) Photo Credit: J. Gourley, Micronesian Environmental Services

## Common Name
common spider conch

(Common names follow Abbott and Dance 2000)

## Scientific Name
Class Gastropoda
Order Caenogastropoda
Family Strombidae (true conchs)
*Lambis lambis* (L., 1758)

(Taxonomy follows Abbott and Dance 2000)

## Chamorro Name
toro

## Carolinian Name
Li'yang

## Listing Status
None.

## Reasons for selecting the common spider conch as a species of special conservation need
The common spider conch is often consumed by people of the Indo-Pacific, especially Tonga (Roth 1980). Evidence of local consumption, (i.e., empty broken shells in small piles or in open fire pits) on Saipan Lagoon beach has been observed on several occasions (pers. comm. J. Gourley). Antidotal evidence in the form of local stories suggests that it was plentiful during the 1970's and was consumed regularly (pers. comm. J. Gourley). The extent of present day local consumption is unknown.

There is no fishery related information on this species in the CNMI. Additionally, there is very limited biological information known on which to base management decisions, should the species require managing.

## Unique characteristics
The common spider conch can reach lengths up to 200mm (Cernohorsky 1972, Wilson 1993). Sexual dimorphism is pronounced: males tend to be smaller with the three lower spines being short and hooked. Females are usually larger and have longer upwardly curved spines and large shoulder knobs (Wilson 1993). Strombids are herbivores; feeding on algae and detrital material (Wilson and Gillett 1972).

Females lay long gelatinous tubes covered with sand grains that are coiled into a knotted tangle. An egg mass may contain as many as 500,000 eggs with the eggs hatching into free swimming larvae (Wilson and Gillett 1972).

**Distribution of the common spider conch in the CNMI**

Okutani (2000) gives the distribution of the common spider conch from the Kii Peninsula (Japan) southward to tropical Indo-Wes Pacific. Wilson (1993) provides a simple range that includes the Indo-West Pacific.

Distribution of the common spider conch is not been fully explored in the CNMI, though this species is locally known in the southern islands. In an island wide survey for molluscs, Fujioka (1984) identified this species on Saipan. The overview of molluscs from the Northern Mariana Islands by Vermeji, et al. (1983) and the joint CHIBA-DFW biological cruise to all the northern islands (Kurozumi and Asakura 1994) did not list this species. Elsewhere in the Marianas archipelago, Smith (2003) has documented its presence on Guam. Island specific distributional data is severely lacking.

**Abundance of the common spider conch in the CNMI**

Abundance estimates of the common spider conch have not been conducted in the CNMI.

**Location and relative condition of key habitats for the common spider conch in the CNMI**

The spider conch has been reported from shallow waters (Cernohorsky 1972), water depths ranging from a few fathoms (Wilson and Gillett 1972), to a range of depths between 10 to 20 fathoms (Kira 1965).

This species is common on coral reefs and is often found on the hard reef or a sand bottom substrate (Cernohorsky 1972). Other sources identify preferred habitats as sand bottom in coral reef (Okutani 2000), coral rubble and algae on intertidal reefs, and "*on sand or mud flats or in sand patches on rocky or coral reefs, and they usually occur in great quantity in areas suitable for them*" (Wilson and Gillett 1972).

Within the CNMI, the amount of coral reef habitat in the southern islands is greater and has a higher species diversity when compared with the northern volcanic islands. Coral reef habitat in the CNMI for the most part is in good condition. Though anthropogenic associated water quality problems appear to be localized in Saipan Lagoon (Starmer 2005), there is no information on whether the problem is directly affecting the species. Presumed common spider conch habitat for Rota and Tinian is likely to be in good to excellent condition as human population levels are substantially lower than Saipan. The near shore waters and habitats surrounding the remaining islands of the CNMI are considered, with some exceptions, very good to excellent condition as they are either uninhabited or have less than 20 people inhabiting the island. This, of course, does not include Anatahan Island whose recent 2003 volcanic eruption severely impacted the near shore reef habitats with ash fallout (Starmer 2005). Volcanic ash, to a lesser degree, has also impacted the leeward side of Sarigan (M. Trianni Pers. comm.).

**Problems which adversely affect the common spider conch and its habitats**

Though not presently recognized as a management problem, the absence of any good quality information on fishing effort, population levels and habitat requirements for this species makes this situation potentially damaging from a management perspective.

Very little is known about the common spider conch in the CNMI, therefore specific threats to this species have not yet been identified. However, non-point source pollution issues associated with the Saipan Lagoon should be investigated as a potential threat.

**Priority research and survey efforts**

The following research actions should be conducted simultaneously:

- Ensure the inshore creel census is being conducted according to sampling protocol and that the appropriate fishery data is being collected. Investigate whether there is any effort directed at this species and what cultural or economic basis this fishery may have with those fishers, if any.

- Determine reproductive cycles, density, seasonal population fluctuations and habitat preference of the common spider conch within the Saipan barrier reef system. This crucial information would be used in conjunction with the descriptive fishery data collected by the inshore creel surveys to develop management measures, if any are required.

**Conservation actions**

The harvest of common spider conch is prohibited unless as permitted by the DFW Director as outlined in Part 5, Section 80.1 of the CNMI Division of Fish and Wildlife Non-Commercial Fishing and Hunting Regulations that were promulgated on 20 April 2000 {CR Vol.22(04)}.

It is prohibited to export any species of the spider and conch family Strombidae from the CNMI as outlined in Part 5, Section 80.3 of the CNMI Division of Fish and Wildlife Non-Commercial Fishing and Hunting Regulations that were promulgated on 20 April 2000 (CR Vol.22(04).

Effective enforcement of illegal harvest is considered an essential key to the success of protecting common spider conch populations.

A number of regulatory actions by the DFW indirectly act to conserve benthic gastropods. The DFW has banned the use of poisons (including cyanide) and dynamite. In addition, the established no-take marine protected areas around Saipan (Mañagaha Marine Conservation Area, Bird Island Marine Sanctuary and Forbidden Island Marine Sanctuary) and Rota (Sasanhaya Bay Fish Reserve) likely serve to protect this species.

**Monitoring**

There are no specific monitoring programs presently targeting the common spider conch. Active monitoring programs in the CNMI include the Interagency Marine Monitoring

Team (MMT), and the DFW Marine Sanctuaries Program. Though the MMT collects data on invertebrates, their monitoring stations are typically established at depths 25 feet and greater and unfortunately, does not cover all optimal habitat types utilized by this species. The DFW Marine Sanctuaries Program takes note of invertebrate species, but the primary focus of the DFW Program is finfish resource assessment.

**Literature Cited for the common spider conch**


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# HORNED HELMET SHELL

Figure 84. Horned helmet shell (*Cassis cornuta*), unknown locale data (two different shells)
Photo Credit: J. Gourley, Micronesian Environmental Services

**Common Name**
horned helmet shell

(Common name follows Abbott and Dance 2000)

**Scientific Name**
Class Gastropoda
Order Caenogastropoda
Family Cassidae (Helmet shells)
*Cassis cornuta* (L., 1758)

(Taxonomy follows Abbott and Dance 2000)

**Chamorro Name**
Kulu Prensa

**Carolinian Name**
Sa'wi Schap

**Listing Status**
None.

**Reasons for selecting the horned helmet shell as a species of special conservation need**
Despite its toughness, the foot muscle of the horned helmet shell is often consumed by people of the Indo-Pacific (Roth 1980). The horned helmet shell is also often sought by curio and shell collectors. This species can be found on display at various island businesses, dive shops, or for sale in tourist gift shops on Saipan (J. Gourley pers. comm.); however one should not assume those specimens were locally captured. Though the geographic location was not mentioned, Smith (1948) noted that historical fisheries used to target this species, among others, that resulted in large numbers being shipped to Italy where they were cut into cameos.

There is no fishery related information on this species in the CNMI. The extent of local consumption, if any, is also unknown and it can only be assumed that this species is indiscriminately collected on an opportunistic basis by tourists, divers, island residents and others for personal collections. There is very limited biological information known on which to base management decisions, should the species require managing.

**Unique characteristics**
The horned helmet shell is the largest living Cassid and one of the largest gastropods (Wilson 1993) with shell lengths reaching 300mm (Kay 1979), 350mm (Cernohorsky 1972, Wilson 1993) and some individuals measuring up to 400mm (Colin and Arneson 1995).

Males and females are sexually dimorphic with the male shell being relatively smaller with fewer and larger dorsal knobs. In contrast, females tend to be larger and have smaller but more numerous dorsal knobs (Cernohorsky 1972, Wilson 1993).

The horned helmet shell is carnivorous and preys on echinoderms, especially sea urchins, sand dollars (Gosliner, et al. 1996, Wilson and Gillett 1972), biscuit urchins (Wilson and Gillett 1972), the crown of thorns (*Acanthaster planci*) (Gosliner, et al. 1996), and other molluscs (Tinker 1965, Smith 1948). When consuming sea urchins, the horned helmet shell immobilizes the spines by applying a paralyzing salivary juice on its prey. This species feeds primarily during the night. (Wilson and Gillett 1972)

Not much is known about breeding habits of Cassids (Wilson and Gillett 1972).

**Distribution of the horned helmet shell in the CNMI**

Okutani (2000) describes a fairly wide ranging distribution of the horned helmet shell from the Kii Peninsula (Japan) and Miyake Island (Japan), southward to tropical Indo-West Pacific. Kira (1965) notes distribution as south of Shikoku (Japan) while Wilson (1993) simply gives its distribution as Indo-West Pacific. This species is moderately common in certain pacific localities (Cernohorsky 1972), while in other areas they are limited in number (Smith 1948).

Distribution of the horned helmet is not been fully explored in the CNMI. Vermeji, et al. (1983) reports this species from Pagan and Maug Islands. The joint CHIBA-DFW biological cruise to all the northern islands did not find any specimens (Kurozumi and Asakura 1994). Elsewhere in the Marianas archipelago, Smith (2003) has documented its presence on Guam. Island specific distributional data is severely lacking.

**Abundance of the horned helmet shell in the CNMI**

Abundance estimates of the horned helmet shell have not been conducted in the CNMI.

**Location and relative condition of key habitats for the horned helmet shell in the CNMI**

Water depths at which this species can be found appears to be variable depending upon the source: 2 to 3 fathoms, but can also be found in the intertidal region (Cernohorsky 1972); 2 to 5 fathoms in depth in sand habitat (Kira 1965); less than 1 to 10 fathoms in depth in sand substrates (Kay 1979); and on "*sandy banks on the inside of barrier and fringing reefs at depths of 10 to 20 meters"* (Gosliner, et al. 1996).

Kay (1979) found the horned helmet shell often in association with beds of pen shells (*Pinna* spp.), while Roth (1976) claims they live in colonies on "*sandy and broken coral rock bottoms.*" Cassids, in general, live primarily in sandy substrates (Smith 1948). Individuals bury in the sand (Kira 1965) and emerge to feed on a raising tide (Hinton 1972).

Based on the habitat descriptions above, possibly the greatest population of horned helmet shells would be located in Saipan Lagoon (Saipan), as this is the greatest area of contiguous shallow sandy habitat in the CNMI.

Though anthropogenic associated water quality problems appear to be localized in Saipan Lagoon (Starmer 2005), there is no information on whether the problem is directly affecting the species. Presumed horned helmet shell habitat for Rota and Tinian is likely to be in good to excellent condition as human population levels are substantially lower than Saipan. The near shore waters and habitats surrounding the remaining islands of the CNMI are considered, with some exceptions, very good to excellent condition as they are either uninhabited or have less than 20 people inhabiting the island. This, of course, does not include Anatahan Island whose recent 2003 volcanic eruption severely impacted the near shore reef habitats with ash fallout (Starmer 2005). Volcanic ash, to a lesser degree, has also impacted the leeward side of Sarigan (M. Trianni Pers. comm.).

**Problems which adversely affect the horned helmet shell and its habitats**

Though not presently recognized as a management problem, the absence of any good quality information on fishing effort, population levels and habitat requirements for this species makes this situation potentially damaging from a management perspective.

Very little is known about the horned helmet shell in the CNMI, therefore specific threats to this species have not yet been identified. However, non-point source pollution issues associated with the Saipan Lagoon should be investigated as a potential threat.

**Priority research and survey efforts**

The following research actions should be conducted simultaneously:

- Ensure the inshore creel census is being conducted according to sampling protocol and that the appropriate fishery data is being collected. Investigate whether there is any effort directed at this species and what cultural or economic basis this fishery may have with those fishers, if any.

- Determine reproductive cycles, density, seasonal population fluctuations and habitat preference of the horned helmet shell within the Saipan barrier reef system. This crucial information would be used in conjunction with the descriptive fishery data collected by the inshore creel surveys to develop management measures, if any are required.

**Conservation actions**

Harvest of the horned helmet shell is prohibited unless as permitted by the DFW Director as outlined in Part 5, Section 80.1 of the CNMI Division of Fish and Wildlife Non-Commercial Fishing and Hunting Regulations that were promulgated on 20 April 2000 {CR Vol.22(04)}.

It is prohibited to export any species of the helmet shell family Cassidae from the CNMI as outlined in Part 5, Section 80.3 of the CNMI Division of Fish and Wildlife Non-

Commercial Fishing and Hunting Regulations that were promulgated on 20 April 2000 (CR Vol.22(04).

Effective enforcement of illegal harvest is considered an essential key to the success of protecting the horned helmet shell populations.

A number of regulatory actions by the DFW indirectly act to conserve benthic gastropods. The DFW has banned the use of poisons (including cyanide) and dynamite. In addition, the established no-take marine protected areas around Saipan (Mañagaha Marine Conservation Area, Bird Island Marine Sanctuary and Forbidden Island Marine Sanctuary) and Rota (Sasanhaya Bay Fish Reserve) likely serve to protect this species.

**Monitoring**

There are no specific monitoring programs presently targeting the horned helmet shell. Active monitoring programs in the CNMI include the Interagency Marine Monitoring Team (MMT), and the DFW Marine Sanctuaries Program. Though the MMT collects data on invertebrates, their monitoring stations are typically established at depths 25 feet and greater and unfortunately, does not cover all optimal habitat types utilized by this species. The DFW Marine Sanctuaries Program takes note of invertebrate species, but the primary focus of the DFW Program is finfish resource assessment.

**Literature Cited for the horned helmet shell**


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# TURBAN SHELL

Figure 85. Turban shell, *Turbo* sp.
Photo Credit: Unknown

**Common Name**
Tapestry turban
Rough turban
Silver-mouth turban

(Common names follow Abbott and Dance 2000)

**Scientific Name**
Class Gastropoda
Order Archaeogastropoda
Family Turbinidae (Turban shell)
*Turbo petholatus* L., 1758
*Turbo setosus* Gmelin, 1791
*Turbo argyrostoma* L., 1758

(Taxonomy follows Abbott and Dance 2000

**Chamorro Name**
Aliling Pulan

**Carolinian Name**
Lifott Maram

**Listing Status**
None.

**Reasons for selecting the turban shell as a species of special conservation need**
Turban shells are locally consumed by people of the CNMI and throughout the Indo-Pacific region. In addition, Roth (1980) reports that *T. argyrostoma* is eaten by the peoples of Japan, Korea, China and countries south. Unfortunately, the extent of present day local consumption is unknown.

There is no fishery related information on this species in the CNMI. Additionally, there is very limited biological information known on which to base management decisions, should the species require managing.

**Unique characteristics**
(Smith 2003) identified three common turban shells from the Marianas; *Turbo petholatus, T. setosus*, and *T. argyrostoma.* Abbott and Dance (2000) note their abundance as common, abundant, and common respectively. Cernohorsky (1972) indicates these three species are moderately common throughout their range. Species of this family are herbivores. Females' lay gelatinous egg-masses and the eggs hatch as free swimming larvae (Wilson and Gillett 1972).

The shell size for all three local species of *Turbo* is moderately large, up to 80mm in length (Cernohorsky 1972). The operculum of *Turbo petholatus* is called a "cat's eye" and is used in making shell jewelry (Wilson and Gillett 1972). The shells of *Turbo setosus* and *T. argyrostoma* are used in making buttons (Kira 1965).

**Distribution of the turban shell in the CNMI**

Turban shells, in general, are widely distributed in the tropical Pacific region (Okutani 2000). *Turbo petholatus* can be found south of Ryukyus (Kira 1965) and throughout the western Pacific (Cernohorsky 1972). The range for *T. setosus*, includes the large area south of Bonin Islands and the Ryukyus (Kira 1965) and throughout the tropical Pacific (Cernohorsky 1972). The third local species, *T. argyrostoma,* ranges from south of southernmost Kyushu (Kira 1965) and westward from Polynesia (Cernohorsky 1972).

The distribution of turban shells are fairly well known for the CNMI, however additional work in the Northern Islands is still needed to complete the understanding. Vermeij et al. (1983) listed *Turbo petholatus* as occurring on Anatahan, Sarigan, Pagan, Asuncion and Maug. Kurozumi and Asakura (1994) found this species on Pagan and Maug.

*Turbo setosus* appears to have the greatest known distribution within the CNMI. Vermeij et al. (1983) listed this species as occurring on Anatahan, Guguan, Pagan, Agrihan, Asuncion and Maug. Kurozumi and Asakura (1994) collected *T. setosus* from Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, Maug and Uracas. In an island wide survey for molluscs, Fujioka (1984) found this species on Saipan.

Vermeij et al. (1983) listed *Turbo argyrostoma* as occurring on Anatahan, Sarigan, Pagan, Asuncion and Maug. Kurozumi and Asakura (1994) collected this species on Anatahan, Alamagan, Pagan, Asuncion, and Maug. Fujioka (1984) found this species on Saipan.

Elsewhere in the Marianas archipelago, Smith (2003) has documented all three species on Guam.

**Abundance of the turban shell in the CNMI**

Abundance estimates of the turban shell have not been conducted in the CNMI.

**Location and relative condition of key habitats for the turban shell in the CNMI**

In general turban shells can be found from the intertidal zone to 20-30 meters. Of course the various species inhabit specific niches that may overlap in areas (Okutani 2000). Gosliner, et al. (1996) reports *T. petholatus* occurs in shallow (intertidal to 10 meters) rubble areas where it feeds on microscopic algae, while Okutani (2000) notes its habitat as the intertidal zone to 30m deep on coral bed. Kira (1965) finds this species in depths to 10 fathoms. *Turbo argyrostoma* is found from the intertidal zone to 30m deep on rocks (Okutani 2000). Kira (1965) found this species in 5 to 10 fathoms of water. *Turbo setosus* is found from the lower intertidal to sub-tidal zone on rocks (Okutani 2000).

Based on the broad habitat descriptions above, these species can occur in most of the near shore waters surrounding any of the CNMI islands. Though anthropogenic associated water quality problems appear to be localized in Saipan Lagoon (Starmer 2005), there is no information on whether the problem is directly affecting the species. Presumed turban shell habitat for Rota and Tinian is likely to be in good to excellent condition as human population levels are substantially lower than Saipan. The near shore waters and habitats surrounding the remaining islands of the CNMI are considered, with some exceptions, very good to excellent condition as they are either uninhabited or have less than 20 people inhabiting the island. This, of course, does not include Anatahan Island whose recent 2003 volcanic eruption severely impacted the near shore reef habitats with ash fallout (Starmer 2005). Volcanic ash, to a lesser degree, has also impacted the leeward side of Sarigan (M. Trianni pers. comm.).

**Problems which adversely affect the turban shell and its habitats**

Though not presently recognized as a management problem, the absence of any good quality information on fishing effort, population levels and specific habitat requirements for this species makes this situation potentially damaging from a management perspective.

The most serious threat to the turban shell populations in the CNMI is over-exploitation of the resources. A potential threat could be the unknown affect non-point source pollution issues associated with the Saipan Lagoon may have on turban shells, either directly to the species or indirectly to its habitat.

**Priority research and survey efforts**

The following research actions should be conducted simultaneously:

- Ensure the inshore creel census is being conducted according to sampling protocol and that the appropriate fishery data is being collected. Investigate the amount of effort that is directed at this species and what cultural or economic basis this fishery may have with those fishers, if any.

- Determine reproductive cycles, density, seasonal population fluctuations and specific habitat requirements for turban shells within the Saipan barrier reef system. This crucial information would be used in conjunction with the descriptive fishery data collected by the inshore creel surveys to develop management measures, if any are required.

**Conservation actions**

The harvest of the turban shell is prohibited unless as permitted by the DFW Director as outlined in Part 5, Section 80.1 of the CNMI Division of Fish and Wildlife Non-Commercial Fishing and Hunting Regulations that were promulgated on 20 April 2000 {CR Vol.22(04)}.

Effective enforcement of illegal harvest is considered an essential key to the success of protecting turban shell populations.

A number of regulatory actions by the DFW indirectly act to conserve benthic gastropods. The DFW has banned the use of poisons (including cyanide) and dynamite. In addition, the established no-take marine protected areas around Saipan (Mañagaha Marine Conservation Area, Bird Island Marine Sanctuary and Forbidden Island Marine Sanctuary) and Rota (Sasanhaya Bay Fish Reserve) likely serve to protect this species.

## Monitoring

There are no specific monitoring programs presently targeting turban shells. Active monitoring programs in the CNMI include the Interagency Marine Monitoring Team (MMT), and the DFW Marine Sanctuaries Program. Though the MMT collects data on invertebrates, their monitoring stations are typically established at depths 25 feet and greater and unfortunately, does not cover all optimal habitat types utilized by this species. The DFW Marine Sanctuaries Program takes note of invertebrate species, but the primary focus of the DFW Program is finfish resource assessment.

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# TRUMPET TRITON

**Common Name**
trumpet triton

(Common name follows Abbott & Dance 2000)


Figure 86. Trumpet triton (*Charonia tritonis*) , unknown locale data (two different shells)
Photo Credit: J. Gourley, Micronesian Environmental Services

**Scientific Name**
Class Gastropoda
Order Caenogastropoda
Family Ranellidae
*Charonia tritonis* (L., 1758)

(Taxonomy follows Abbott and Dance 2000)

**Chamorro Name**
Kulu

**Carolinian Name**
Sa'wi

**Listing Status**
None.

**Reasons for selecting the trumpet triton as a species of special conservation need**
The trumpet triton is often consumed by people of certain Asian countries and the Indo-Pacific in general (Roth 1980). The shell has been utilized "*since ancient time*s" as a type of horn used by the military and for ceremonial purposes (Kira 1965). In addition, the shell is also sought by curio and shell collectors. The trumpet triton can be found on display at various island businesses, dive shops, or for sale in tourist gift shops on Saipan (J. Gourley pers. comm.); however one should not assume those specimens were locally obtained.

There is no fishery related information on this species in the CNMI. The extent of local consumption, if any, is also unknown and it can only be assumed that this species is indiscriminately collected on an opportunistic basis by tourists, divers, island residents and others for personal collections. There is very limited biological information known on which to base management decisions, should the species require managing.

**Unique characteristics**
The trumpet triton, the second largest gastropod found in the Indo-West Pacific (Kay 1979), can reach lengths up to 450mm (Wilson 1993) with some individuals possibly exceeding 500mm (Gosliner, et al. 1996; Kay 1979).

The trumpet triton is carnivorous and preys on echinoderms, especially sea urchins (*Heterocentrotus mamillatus*), the cushion star (*Culcita novaeguinae*) and the crown-of-thorns (*Acanthaster planci*) (Gosliner, et al. 1996, Kay 1979, Wilson 1993). When consuming sea urchins, the trumpet triton paralyze their prey with an acid fluid extruded from large salivary glands (Kay 1979).

Species specific reproduction information is lacking, however Ranellids typically lay egg capsules in cup-shaped clusters in crevices or on the underside of stones (Wilson and Gillett 1972).

**Distribution of the trumpet triton in the CNMI**

Okutani (2000) describes a fairly wide ranging distribution of the trumpet triton from the Kii Peninsula (Japan) and Hachijo Island (Japan), southward to tropical Indo-West Pacific in coral reefs. Kira (1965) reports its distribution as south of Kyushu in 5 to 10 fathoms of water. Interestingly, this species also occurs in the tropical western Atlantic (Wilson and Gillett 1972).

Distribution of the trumpet triton is not been fully explored in the CNMI. The overview of molluscs from the Northern Mariana Islands by Vermeji, et al. (1983) does not list this species. The joint CHIBA-DFW biological cruise to all the northern islands found this species on Maug Island(s) (Kurozumi and Asakura 1994). Elsewhere in the Marianas archipelago, Smith (2003) has documented its presence on Guam. One specimen was collected from Sarigan during the 2005 NOAA MARMAP cruise (M. Trianni pers. comm.) Island specific distributional data is severely lacking.

**Abundance of the trumpet triton in the CNMI**

Abundance estimates of the trumpet triton have not been conducted in the CNMI.

**Location and relative condition of key habitats for the trumpet triton in the CNMI**

The trumpet triton is considered a shallow water coral reef species (Wilson 1993, Okutani 2000) that is found at moderate depths from 3 to 25+ meters. Kay (1979) reports this species occasionally frequent near reef edges.

Within the CNMI, the amount of coral reef habitat in the southern islands is greater and has a higher species diversity when compared with the northern volcanic islands. Coral reef habitat in the CNMI for the most part is in good condition. Though anthropogenic associated water quality problems appear to be localized in Saipan Lagoon (Starmer 2005), there is no information on whether the problem is directly affecting the species. Presumed trumpet triton habitat for Rota and Tinian is likely to be in good to excellent condition as human population levels are substantially lower than Saipan. The near shore waters and habitats surrounding the remaining islands of the CNMI are considered, with some exceptions, very good to excellent condition as they are either uninhabited or have less than 20 people inhabiting the island. This, of course, does not include Anatahan Island whose recent 2003 volcanic eruption severely impacted the near shore reef habitats with ash fallout (Starmer 2005). Volcanic ash, to a lesser degree, has also impacted the leeward side of Sarigan (M. Trianni Pers. comm.).

**Problems which adversely affect the trumpet triton and its habitats**

Though not presently recognized as a management problem, the absence of any good quality information on fishing effort, population levels and habitat requirements for this species makes this situation potentially damaging from a management perspective.

Very little is known about the trumpet triton in the CNMI, therefore specific threats to this species have not yet been identified. However, non-point source pollution issues associated with the Saipan Lagoon should be investigated as a potential threat.

**Priority research and survey efforts**

The following research actions should be conducted simultaneously:

- Ensure the inshore creel census is being conducted according to sampling protocol and that the appropriate fishery data is being collected. Investigate whether there is any effort directed at this species and what cultural or economic basis this fishery may have with those fishers, if any.

- Determine reproductive cycles, density, seasonal population fluctuations and habitat preference of the trumpet triton within the Saipan barrier reef system. This crucial information would be used in conjunction with the descriptive fishery data collected by the inshore creel surveys to develop management measures, if any are required.

**Conservation actions**

Harvest of the trumpet triton is prohibited unless as permitted by the DFW Director as outlined in Part 5, Section 80.1 of the CNMI Division of Fish and Wildlife Non-Commercial Fishing and Hunting Regulations that were promulgated on 20 April 2000 {CR Vol.22(04)}.

It is prohibited to export any species of the triton shell family Cymatidae (= Ranellidae) from the CNMI as outlined in Part 5, Section 80.3 of the CNMI Division of Fish and Wildlife Non-Commercial Fishing and Hunting Regulations that were promulgated on 20 April 2000 (CR Vol.22(04).

Effective enforcement of illegal harvest is considered an essential key to the success of protecting the trumpet triton populations.

A number of regulatory actions by the DFW indirectly act to conserve benthic gastropods. The DFW has banned the use of poisons (including cyanide) and dynamite. In addition, the established no-take marine protected areas around Saipan (Mañagaha Marine Conservation Area, Bird Island Marine Sanctuary and Forbidden Island Marine Sanctuary) and Rota (Sasanhaya Bay Fish Reserve) likely serve to protect this species.

**Monitoring**

There are no specific monitoring programs presently targeting the trumpet triton. Active monitoring programs in the CNMI include the Interagency Marine Monitoring Team (MMT), and the DFW Marine Sanctuaries Program. Though the MMT collects data on invertebrates, their monitoring stations are typically established at depths 25 feet and greater and unfortunately, does not cover all optimal habitat types utilized by this species. The DFW Marine Sanctuaries Program takes note of invertebrate species, but the primary focus of the DFW Program is finfish resource assessment.

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# OCTOPUS

**Common Name**
octopus

**Scientific Name**
Class Cephalopoda
Order Octopoda
Family Octopodidae
*Octopus* spp.

(Taxonomy follows Ward 2003)

**Chamorro Name**
Gamson

**Carolinian Name**
Ghuus


Figure 1. Octopus, *Octopus* sp., fresh market specimen, roadside vendor, Susupe, Saipan, CNMI (17 September 2005)
Photo Credit: J. Gourley, Micronesian Environmental Services

**Listing Status**
None.

**Reasons for selecting octopus as a species of special conservation need**
The octopus is presently being harvested by the local indigenous population, Micronesian immigrants and foreign guest workers for consumption purposes. It is fished commercially and for subsistence use on Saipan, Tinian and Rota.

Commercial octopus landings data for Saipan is being collected by the DFW-managed Commercial Purchase data system, however certain critical variables are lacking, most notably, individual weights, subsistence fishing effort and species composition. Unfortunately, octopus taxonomy is at the alpha level and additional work is required in order to know which species are being taken in commercial and subsistence fisheries.

Demand for octopus is not expected to decrease on Saipan due to the large indigenous population, an Asian-based tourist industry, and a faltering economy. Future fishing effort in the near shore waters of the populated islands may actually increase under this situation. Therefore, this is a time sensitive issue that needs to be addressed.

**Unique characteristics**
The octopus is a carnivorous shell-less mollusk that has eight arms lined with suckers and no tentacles. (Norman and Reid 2000)

Ward (2003) tentatively identified 19 octopus species from Guam and the CNMI (i.e., Pagan Island), including three species of pygmy octopus that do not enter the commercial market. Of this provisional species list, only three are identified to species (*Octopus abaculus, O. ornatus,* and *O. cyanea*) with the remaining either unknown or undescribed. Additional species are expected to be discovered (Ward 2003).

Of the three recognized species previously listed for the Marianas, some basic information exists for *O. cyanea* and *O. ornatus*. The day octopus (*O. cyanea*) is active mainly during the day on coral reefs (Norman and Reid 2000, Kay 1979, Gosliner, et al. 1996) foraging on large Portunid and Xanthid crabs and fish, including moray eels to depths of approximately 20m (Gosliner, et al. 1996). Other apparent incidental prey items include isopods and stomatopods (Boletzky and Hanlon 1983). After catching prey items, the octopus kills them by a toxin secreted from the salivary gland (Kay 1979). The body of this species grows to at least 16cm with the arms to at least 80cm (Norman 2000).

Females lay eggs on a hard substrate with hatching occurring about 3 to 5 weeks later at night. Newly hatched octopi are pelagic for approximately 30 days. The life span is about 14 months after settlement. (Kay 1979)

In contrast, the white-striped octopus (*O. ornatus*) is nocturnal on coral reefs preferring to eat other octopus species (Norman and Reid 2000). Body size reaches approximately 13cm while the long arms stretch to more than a meter (Norman 2000).

Sexes in the octopi are separate, with reproduction occurring through copulation. Fecundity in *O. cyanea* approaches 600,000 eggs that are approximately 1 to 2 mm in length. Newly hatched young are planktonic and can spend “weeks” in the plankton prior to settling into a benthic existence. Norman and Reid (2000) report that large females eat the male after mating. Not as fecund, *Octopus ornatus* lays tens of thousands of eggs, each about 2mm in length (Norman and Reid 2000).

**Distribution of octopus in the CNMI**

The octopus has representatives in all oceans of the world from inter-tidal reefs to depths of more than 7 kilometers. Both *O. ornatus* and *O. cyanea* are found on coral reefs throughout the tropical Indo-Pacific (Norman and Reid 2000).

The octopus is likely to occur throughout the CNMI on all islands, although actual species distribution is unknown, primarily due to the taxonomic difficulty of identifying species. Ward (2003) does list an undescribed octopus species from Pagan Island. Kurozumi and Asakura (1994) report unidentified octopus on both Agrihan and Maug islands during the CHIBA cruises to the northern islands. Other site specific data is lacking.

**Abundance of octopus in the CNMI**

Abundance estimates of the various species of octopus have not been conducted in the CNMI. However, there is landing data for octopus (species combined) that enter the commercial fish market on Saipan. The Commercial Purchase data base, managed by the DFW, collects fishery data information from data invoices maintained by first time fish product purchasers on Saipan. Despite the best effort at data collection, octopus landings are not differentiated at the species level, as it is too difficult. Additionally, the Commercial Purchase data base does not collect landing information on octopus caught for subsistence use or those octopus landed elsewhere in the CNMI.

**Location and relative condition of key habitats for octopus in the CNMI**

Habitat requirements for both *O. cyanea* and *O. ornatus* are coral reefs, reef flats and other rocky substrata to depths of 50 meters (Kay 1970). The octopus (*O. cyanae*) lives in shallow holes 30 to 60cm deep, with an entrance usually marked with scattered piles of rubble and crab shells (Kay 1979).

Within the CNMI, the amount of coral reef habitat in the southern islands is greater and has higher species diversity when compared with the northern volcanic islands. Coral reef habitat in the CNMI for the most part is in good condition. Though anthropogenic associated water quality problems appear to be localized in Saipan Lagoon (Starmer 2005), there is no information on whether the problem is directly affecting the species. Presumed octopus habitat for Rota and Tinian is likely to be in good to excellent condition as human population levels are substantially lower than Saipan. The near shore waters and habitats surrounding the remaining islands of the CNMI are considered, with some exceptions, very good to excellent condition as they are either uninhabited or have less than 20 people inhabiting the island. This, of course, does not include Anatahan Island whose recent 2003 volcanic eruption severely impacted the near shore reef habitats with ash fallout (Starmer 2005). Volcanic ash, to a lesser degree, has also impacted the leeward side of Sarigan (M. Trianni pers. comm.).

**Problems which adversely affect octopus and its habitats**

Despite the esoteric nature of scientific nomenclature, the repercussions of the taxonomic unknowns for the octopus species in the Marianas lead to a breakdown in developing appropriate fishery management measures. Other than gross landings of combined octopus species for Saipan, there is no data on species specific harvest and even worse, a good understanding of what species are being caught. Though not presently recognized as a management problem, the present situation is in need of improvement from a management perspective.

The most serious threat to octopus populations in the CNMI is over-exploitation of the resources.

**Priority research and survey efforts**

The following research actions should be conducted simultaneously:

- Examine, compile and analyze existing historical landings data for the octopus. This summary report would assist the DFW in determining the direction of future research.

- Ensure the inshore creel census is being conducted according to sampling protocol and that the appropriate fishery data is being collected for octopus. Attempt to get species composition, sex and individual weights for captured octopus.

- Modify the existing Commercial Purchase data collection program to list the main species of octopus collected. This would necessitate reprinting of receipt books and forms, as well as educating the fishers and fish retailers about the importance of knowing the species and weight of each individual of this species that is bought, sold or captured.

● Determine reproductive cycles and home ranges of the various octopus species that are commercially fished within the Saipan barrier reef system. This crucial information would be used in conjunction with the descriptive fishery data collected by the inshore creel surveys to develop management measures, if any are required.

**Conservation actions**

The harvest of octopus is prohibited unless as permitted by the DFW Director as outlined in Part 5, Section 80.1 of the CNMI Division of Fish and Wildlife Non-Commercial Fishing and Hunting Regulations that were promulgated on 20 April 2000 {CR Vol.22(04)}.

Effective enforcement of illegal harvest is considered an essential key to the success of protecting octopus populations.

A number of regulatory actions by the DFW indirectly act to conserve octopus. The DFW has banned the use of poisons (including cyanide) and dynamite. In addition, the established no-take marine protected areas around Saipan (Mañagaha Marine Conservation Area, Bird Island Marine Sanctuary and Forbidden Island Marine Sanctuary) and Rota (Sasanhaya Bay Fish Reserve) likely serve to protect this species.

**Monitoring**

There are no specific in-situ monitoring programs presently focusing on octopus. Active monitoring programs in the CNMI include the Interagency Marine Monitoring Team and the DFW Marine Sanctuaries Program. The MMT will collect data on octopus, however the survey methodology may require adaptation for octopus. The DFW Marine Sanctuaries Program takes note of invertebrate species, but the primary focus of data collection is finfish resource assessment. Both surveys are limited to daytime sampling, thus missing data from those octopus species that are nocturnal or crepuscular.

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# Chapter 9:

# PUBLIC and AGENCY PARTICIPATION











# Chapter 9: PUBLIC AND AGENCY PARTICIPATION

## Approach

Greg Schroer of Resources Northwest, Saipan CNMI, was hired under independent contract to garner public and agency participation in the development of the CWCP for the CNMI. The public participation process described in this chapter is intended to meet the requirements of Element 8. Public and agency opinions were sought on the planning process, on the species of greatest conservation need and their habitats, on threats to those species, and on conservation strategies to protect those species.

## Methods

The CWCP purpose and goals, and draft list of Species of Greatest Concern, were communicated to natural resource management agencies and the public between February 24 and May 31, 2005. During this process, the agencies and the public were asked to share their opinions on the following topics:

1. **wildlife and fish species and habitats with the greatest conservation needs (***the draft list of species of greatest concern was provided for public review***);**
2. **threats to wildlife and fish species and their habitats;**
3. **actions needed to conserve wildlife and fish species and habitats; and**
4. **other issues or suggestions regarding CNMI wildlife and fish conservation.**

A variety of methods were used to disseminate the information, including: flyers; fact sheets; newspaper articles; e-mail announcements; newspaper and radio public service announcements; and meetings, as described below.

**CWCP Information Sheets**: CWCP information was distributed via e-mail, large and small group meetings, individual interviews, and posting at key sites on the islands of Rota, Tinian, and Saipan. The cover page summarized the CWCP needs, purpose, and goals; meeting dates, times, and locations; and addresses and phone numbers for obtaining additional information and submitting comments. Additional pages (except for posted flyers) contained DFW's draft list of Species of Greatest Conservation Concern.

**Species Fact Sheets**: Biological information fact sheets for the proposed terrestrial species were distributed at the general public meetings and small group meetings (described in the "Meetings" subsection below). Fact sheets were not available for most proposed marine species, therefore, field guides were provided at meetings for public review.

**Newspaper Articles:** Five newspaper articles were published in the Saipan Tribune from February 24 until March 17, 2005 to help elicit public interest and participation in the planning process. The underlying theme for the articles was "Our Natural Heritage," and each article focused on a proposed species of greatest conservation concern, or a group of proposed species, as summarized below.

| Article Date | Primary Article Topic |
|---|---|
| February 24, 2005 | Mariana fruit bat |
| March 3, 2005 | Birds of the Commonwealth |
| March 10, 2005 | Coconut crab |
| March 17, 2005 | Green sea turtle |
| March 24, 2005 | Marine Invertebrates |

**E-mail Announcements**: During March through May 2005, CWCP information and requests for comments were e-mailed to representatives of CNMI and federal agencies with management responsibilities for wildlife, fish, and other natural resources. Those agencies included the CNMI Department of Lands and Natural Resources, Division of Environmental Quality, and Coastal Resources Management Office, as well as the US Fish and Wildlife Service, US Natural Resources Conservation Service, and the US Navy. Similar notices also were e-mailed to citizens that had previously provided addresses to the agencies.

**Public Service Announcements**: During the first three weeks of April 2005, community service announcements were published in the Saipan Tribune and the Marianas Variety to notify the public about the CWCP project and the date, time and location for public meetings. Public service announcements also were given on two Saipan-based radio stations during that same period.

**Meetings**: During April and May 2005, a variety of meetings were held on all three islands to directly convey the CWCP details and to gather comments, as described below.

General public meetings: General public meetings were held on April 19, 2005 (Saipan), April 28, 2005 (Tinian), and May 17, 2005 (Rota) to introduce the CWCP project, as well as to answer questions and gather comments. Those public meetings were advertised using e-mail, newspapers, radio stations, phone, and posted flyers, as described above.

Multi-agency Meetings: A multi-agency meeting was held on April 15, 2005 for representatives of natural resource management agencies based in the CNMI (Department of Lands and Natural Resources, Division of Environmental Quality, Coastal Resources Management Office, and the Natural Resource Conservation Service).

Small Group Meetings: Small group meetings were held on each of the islands to gain additional comments from specific user groups, such as fishermen and hunters.

Individual Interviews: Individual interviews also were conducted on each island to answer questions and garner comments. Greg Schroer made inquires on all three islands, along with assistance from Estanislao Taisacan and Shelwyn Taisacan of Rota, Mike Tenorio and John Castro of Saipan, and Henry Cabrera of Tinian. These individuals have detailed knowledge of many wildlife and fish species issues, as well as an understanding of the practices and opinions of hunters, fishermen, and other resource users.

## Participants

**Rota**: Most comments obtained on Rota were from the general public, and this shows the important role that natural resources have among many families in this small community. A majority of Rota's population is directly or indirectly (i.e., through family members) associated with natural resources activities such as farming, fishing, hunting, and medicinal plant gathering. Most comments were obtained through individual interviews and small group meetings. Comments were not received by e-mail or mail, which was generally expected since verbal communication is the preferred means of communication in this small island community.

**Tinian**: Tinian's public and agency comments were submitted during individual interviews and small group discussions. Comments were not received via mail or e-mail, which was generally expected since most communication in this small island community is conducted verbally.

**Saipan**: Public comments on Saipan were provided through individual interviews, public meetings, small group discussions, and, to a less extent, through e-mail and mail. Attempts to obtain more comments from fishermen via small group meetings were unsuccessful; however, the DFW will solicit additional comments from fishermen through Fisheries Forums scheduled to continue through 2006.

Agency representatives provided a majority of the comments on Saipan, and those were given via individual interviews, agency meetings, and e-mail communications. The high response from agency personnel was generally expected since most biologists in the CNMI are based on Saipan.

## Results

This public participation process confirmed that the best method for collecting comments in the CNMI is through individual interviews and small group discussions. Large meetings also were relatively successful on Rota and Saipan, and e-mail was an essential tool for communicating with natural resource scientists. Overall, the variety of methods used for public outreach resulted in a broad spectrum of public and agency participation.

Results of this work showed that most public participants were not intimately familiar with many of the species that DFW had initially proposed as Species of Greatest Conservation Concern. This was generally expected since most of the public is not educated in wildlife or fisheries sciences, and they generally do not monitor many of those species. However, most public participants had at least a general understanding and concern for many species that they, or their acquaintances, hunt or gather for consumption. There also were numerous general concerns expressed for overall natural resources conservation. These interests and concerns provided a foundation for expanding public understanding and appreciation for lesser known species and ecosystem management issues during the discussions.

Natural resource agency personnel provided the most technically detailed comments regarding species and habitats. This generally was expected since agency personnel work with many species and habitats as part of their jobs and personal interests. The individuals with advanced education in ecosystem sciences and/or multiple years of survey experience provided the most detailed technical comments. The comments collected during the public participation process are summarized as follows.

<u>All Islands Summary</u>

1. Concerns for low or declining populations of some terrestrial and freshwater species, particularly:

   - Coconut crab (*Birgus latro*)
   - Marianas fruit bat (*Pteropus m. mariannus*)
   - White-throated ground dove (*Gallicolumba xanthonura*)
   - Saipan bridled white-eye (*Zosterops conspicillatus saypani*)
   - Mariana fruit dove (*Ptilinopus roseicapilla*)
   - Freshwater vertebrates and invertebrates of Rota's streams (i.e., Rota blue damselfly (*Ischnura luta* spp.)
   - Philippine turtle dove (*Streptopelia bitorquata*) [non-native species]
   - Deer (*Cervus mariannus*) [non-native species]

2. Concerns for low or declining populations and size of marine species, particularly:

   - Hermit crab (*Coenobita perlatus*)
   - Sea crabs (*Carpilius maculates*?)
   - Rock crab (*Grapsus* spp.)
   - Ghost crab (*Ocypode cerathopthalma*)
   - Green sea turtles (*Chelonia mydas*)
   - Octopus (*Octopus* spp.)
   - Spiny lobsters (*Panulirus* spp.)
   - Spinner dolphins (*Stenella longirostris*)
   - Humphead parrot fish (*Bolbometopon muricatum*) and other parrot fish (Scaridae)
   - Giant coralgrouper (*Plectropomus laevis*) and other groupers (Serranidae)
   - Sea cucumbers (Holothuroidea)
   - Sea urchins (Toxopneustidae)
   - Giant clams (*Tridacna* spp.)
   - Chitins (*Acanthopleura* spp.)
   - Turbo snails (*Turbo* spp.)

3. Native species mentioned in public and agency comments that were not included on the draft list of Species of Greatest Conservation Concern (these species also are listed above):

    - Rock crab (*Grapsus* spp.)
    - Sea crabs (*Carpilius maculates*?)
    - Ghost crab (*Ocypode cerathopthalma*)
    - Chitins (*Acanthopleura* spp.)
    - Freshwater vertebrates and invertebrates of Rota's streams (i.e., Rota blue damselfly (*Ischnura luta* spp.)
    - Various marine snails harvested from lagoons and the barrier reefs
    - Philippine turtle dove (*Streptopelia bitorquata*) [non-native]

4. Concerns for unsustainable harvests (legal and illegal) of marine species by non-residents and commercial harvesting operations;

5. Concerns for inadequate training, personnel, and equipment for wildlife and fish law enforcement;

6. Concerns for captive breeding and rearing facilities for rare species, such as marine snails, clams, and crabs, and terrestrial species such as the coconut crab, Marianas fruit bat, and deer;

7. Concerns for adverse impacts caused by invasive, non-native animals, such as feral cats and dogs, rats, non-native slugs and predatory flatworm; monitor lizards, black drongos; and invasive, non-native plants, such as tangan tangan, and vines, such as the ivy gourd; and

8. Concerns for overall conservation of wildlife and fish species and habitats.

<u>Rota Summary</u>

Some terrestrial species (coconut crab; Mariana fruit bat; Philippine turtle dove; white-throated ground dove; and deer) were identified as species of greatest concern due to the apparent population declines resulting from hunting. Some participants suggested that these species deserve better monitoring and management measures (full protection or modified hunting seasons and take limits) to help conserve the populations.

Many participants raised concerns regarding the declines of numerous marine species populations, including the hermit crab; octopus; spiny lobster; green sea turtles; spinner dolphins; humphead parrot fish; rock crab (haguaf); chitins (tagula); and various other marine snail species.

Many individuals from Rota commented that the Department of Public Works has been increasing their water extraction from Rota's two largest spring/stream systems. Those two water sources historically flowed year-around during many years, yet those fresh water systems are now essentially dry during most of each year. Freshwater shrimp, fish, eels, and invertebrates, such as the Rota blue damselfly (a federal species of concern), are directly impacted by this high level of water extraction.

Many participants pointed out that non-native plant and animal species are having increasingly greater impacts on native species. They specifically mentioned the non-native slugs [possibly also referring to the predatory introduced flatworm], monitor lizard, rat, black drongo, wild pig, and invasive plants as significant concerns.

Numerous Rota residents formally and informally also stated their deep philosophical concern about natural resource conservation and the need for better public education. Some feel that public education could partially offset the limited support given to law enforcement operations, which was another significant concern mentioned by participants.

Many Rotanese requested better law enforcement of fish and wildlife conservation laws, including providing better training, more personnel, and more equipment, such as boats and trucks (currently only one truck is available with questionable operating capacity). Participants stated the Rota wildlife and fish law enforcement personnel are very limited in their ability to enforce laws, and they need a "hotline" phone number to provide effective and efficient communication access for the public.

Rota residents feel that they should have an aquaculture program and facilities that could help conserve species of snails, clams, and crabs. This included the idea of having a sea turtle rearing facility to help produce higher rates of births and recruitment.

Some individuals wanted the CNMI to designate the non-native deer as a domestic livestock species so that it can be raised and harvested on farms. They felt that this action, combined with reductions of the wild population, would help reduce the adverse impacts to native plants in conservation areas and it would help support the agricultural industry. Fruit bat captive breeding and rearing also was requested to help supplement the wild population.

Tinian Summary

Tinian residents voiced many concerns about the general decline of marine species populations, particularly in lagoons and at the barrier reef. Specific species of concern are the parrot fish; groupers; sea crabs; sea cucumbers, sea urchins, spiny lobsters; giant clams; and sea turtles.

Many of the respondents voiced concern about the high levels of harvest conducted by non-residents in lagoon and barrier reef areas, and that those non-residents are beginning to fish deeper waters with greater success. Participants also stated that they have personally seen night-time fishing operations, including SCUBA fishing operations, around Tinian and Aguiguan Island ("Goat Island" - a smaller island approximately 2 miles south of Tinian), and they believe some or all of those operations are commercial ventures from Saipan.

Most comments about terrestrial wildlife species pertained to coconut crabs and fruit bats. Respondents felt that many coconut crabs are killed each year as a result of Tinian's frequent wildfires (Figure 88). The greatest threat to coconut crabs on Aguiguan Island (Goat Island) appears to be from monitor lizard predation. Past efforts at controlling that lizard population were not successful. Some Tinian residents suggested more effective control methods be investigated and implemented to reduce or eliminate the monitor lizards on Aguiguan Island, such as using a bounty program, baiting, or trapping.

Figure 88. Coconut crab killed by wildfire.

Numerous respondents requested a marine conservation area be established in Barcinis Bay (also referred to as Turtle Bay) on Tinian's southwestern shoreline (Figures 89 and 90). Local divers stressed that this area is Tinian's best location for a conservation area due to the variety of fish, turtles and coral/sand habitats. This conservation area has been previously proposed for many years, and agency and public participants stated that it has overwhelming political and public support.

Figure 89. Proposed location of the Turtle Bay Marine Conservation Area.

Figure 90. Proposed locations for the Turtle Bay Marine Sanctuary and the Tinian Forest Conservation Area.

Department of Lands and Natural Resources agency participants also stated there is strong political and agency support for a forest conservation area along Tinian's southeastern coastline and the adjoining steep slopes (Figure 90). That conservation area would help protect some of last remnants of native forests on Tinian (which only occur on 5-10% of the island). Some respondents felt that protecting some native forest, as well as restoring other areas of the island to native forest, would help restore the fruit bat and other native animal and plant populations, help decrease the spread of wildfires and non-native plants, and improve the tourism environment.

Some residents felt that there was not enough enforcement of wildlife and fish conservation laws on Tinian, and they wanted to see improvements in that law enforcement. Some residents also expressed the need for greater public education as well as better training for law enforcement personnel.

As with Rota and Saipan residents, Tinian residents also believe that they should have captive breeding and rearing programs and facilities that could provide a food source or restoration program for Mariana fruit bats, marine snails, clams, crabs, and sea turtles while also reducing the pressure on the native populations of those species.

Saipan Summary

Several terrestrial species (coconut crabs; Saipan bridled white-eye; wedge-tailed shearwater; Mariana fruit dove; and the Marianas fruit bat) were specifically identified as species of concern due to their apparent population declines or habitat limitations. Some participants suggested that there should be increased surveys and monitoring for these species, and some even offered to volunteer their assistance with that work.

Participants are concerned about the declining populations of marine species, including the hermit crab; octopus; spiny lobsters; green sea turtles; humphead parrot fish; rock crab (haguaf); sea crab; ghost crab; sea urchins; chitins (tagula); turbo snails; and various other marine snail species. They also stated their concerns for the potential over harvesting of marine invertebrates within the shallow lagoon and barrier reef areas.

A few participants indicated they feel the fish populations are beginning to increase as a result of regulations that prohibit gill net fishing and SCUBA fishing. One respondent suggested marine protected areas be developed in a manner that helps restock over-fished areas.

Many participants pointed out that non-native plant and animal species are having serious and increasing adverse impacts on native species. They specifically mentioned feral cats, rats, and invasive plants, such as the tangan tangan and invasive vines as significant concerns.

Some participants voiced their concerns over the outdated vegetation maps being used to monitor habitat trends. They feel more funding and effort should be dedicated to update those maps.

One participant strongly recommended a native forest restoration program be implemented, particularly one that establishes more native trees that are preferred by Mariana fruit bats for foraging and roosting.

Some individuals stated the importance of public education to long-term conservation programs, and such education could help offset the limited support given to law enforcement operations.

As with Rota and Tinian residents, some Saipan residents also feel that they should have an aquaculture program and facilities that could supplement declining populations of snails, clams, and crabs. This includes the idea of having a sea turtle rearing facility to help produce higher rates of births and recruitment.

## **Recommendations**

The public participation process showed that the public has a strong interest and concern for fish and wildlife species, although their understanding was typically limited to those species that they either hunt or gather for consumption. This interest and concern provides a foundation from which broader wildlife and fish conservation topics can be introduced and discussed. These discussions often can lead to a deeper understanding and appreciation of lesser known species, as well as habitat management and conservation issues.

This public outreach process provides an excellent means for DFW to get in touch with our public "clients." If continued, this periodic public outreach will create a more informed public, which will provide greater understanding and support for DFW programs and regulations. Feed-back obtained through this process also will allow the DFW to better prepare and implement effective management programs.

The public participation program should be conducted again during the next 1-2 years to build upon the educational foundation developed by this initial work. Over the long-term, this public participation should be conducted at least once every 5 years to maintain that communication, education, understanding, appreciation, and support.

Individual interviews and small group meetings are the most effective methods for communicating with the public. These methods provide immediate feedback that helps clarify and educate, and they also blend well with the verbal communication method preferred in these small island communities. These methods are particularly effective when conducted by numerous CWCP representatives on each island. The best CWCP representatives are those that are respected community members, good communicators, and have a strong interest and understanding of fish and wildlife species, and conservation issues.

E-mail communication, multi-agency meetings, and personal interviews are effective means for communicating with natural resource scientists and managers.

Continuing education should be used to develop and maintain a greater public understanding and appreciation for wildlife and fish species. This will result in greater future public participation and support for planning and management programs. Newspaper articles provide one means for incrementally educating the public through time, and a multitude of other methods also could be used, such as small group forums and workshops, radio and television programs, posters, and information flyers.

# Chapter 10:

# WHERE WE GO FROM HERE

# Chapter 10: WHERE WE GO FROM HERE

**Implementation of conservation actions**

A number of conservation actions have been proposed in this Comprehensive Wildlife Conservation Strategy – for habitats, for terrestrial species, and for marine species. The challenge now facing DFW is to prioritize and implement those actions.

Grants for making conservation actions work

A mechanism is already in place that lends itself to implementation of conservation actions. DFW's work for research, conservation and management of fish and wildlife resources is funded almost entirely by federal grants available through the U.S. Fish and Wildlife Service. These grants are vitally important for the furtherance of conservation in the CNMI. The economy of the islands has been on a downturn for almost a decade. The cash-strapped local government has only been able to support enforcement efforts, and does not fund the necessary research, conservation and management of fish and wildlife that is covered by federal grants. Grants being employed by DFW at the current time for purposes of enhancing conservation include the following.

- The Pittman-Robertson Wildlife Restoration Act of 1937 provides DFW with the "base grant" for research, conservation and management of wildlife species. This grant is funded by hunter license fees and excise taxes. There are limitations on how these funds may be spent. For example, funds cannot be spent on invertebrates, or on enforcement activities.
- The Dingell-Johnson Sportfish Restoration Act of 1950 provides DFW with the "base grant" for research, conservation and management of finfish species. This grant is funded by angler license fees and excise taxes. There are limitations on how these funds may be spent. For example, funds cannot be spent on invertebrates, or on enforcement activities.
- The Endangered Species Act Section 6 provides DFW with funding for research and conservation of endangered species. The current year's Section 6 funding is being dedicated to research and conservation of the Mariana Crow, the Rota Bridled White-eye, and the Mariana Swiftlet.
- The Non-traditional ESA Section 6 provides DFW with funding for innovative conservation measures. For example, DFW is now utilizing Land Recovery Acquisition funding from this grant to purchase private wetlands and forested lands to be held in public ownership for wildlife habitat. DFW is also developing a Habitat Conservation Plan (HCP) for the agricultural homestead development on Rota to conserve the Mariana Crow, and has recently been awarded a grant to develop an island-wide HCP for Rota.
- The State Wildlife Grant has provided DFW with funding to develop this CWCS, to develop a management plan for the Mañagaha Marine Conservation Area, to conduct research of the literature and develop a survey protocol for coconut crabs, among other tasks. Future funding under the State Wildlife Grant will be used primarily to implement conservation actions

proposed in this CWCS. This program has the advantage of allowing research and management on invertebrate species.

- Other federal grants through agencies outside of the USFWS have recently become available to DFW. Examples of these include: the Brown Treesnake Interdiction Program and Awareness grant provided by the Department of the Interior, Office of Insular Affairs; the Coral Reef Initiative grant administered by the National Oceanic and Atmospheric Administration (NOAA); and fisheries research and management support made available through the Western Pacific Regional Fishery Management Council.

During the grant cycle, project proposals are made by DFW professionals to the grantor agencies. If projects are approved and funded by the grantor agency, then projects are initiated by DFW. Most of the priority research needs and conservation actions described in this CWCS could be initiated if they are proposed as projects under the various grant programs in which DFW takes a part. Although the various grants are managed by different professionals in DFW's organization, it is proposed that a State Wildlife Grant Manager be appointed to oversee the prioritization, implementation and reporting of the conservation actions in this CWCS.

Monitoring the effectiveness of conservation actions

The grant cycle also provides a mechanism to annually monitor the effectiveness of conservation actions that are initiated. At the end of each fiscal year, DFW professionals submit annual reports concerning the grants they manage. DFW uses the standard format requested by USFWS Federal Aid. For each project, the following are listed: proposed objectives, a description of how the objectives were met, and differences between the work proposed and work actually carried out (including cost differences). It is at this juncture that the results of taking a conservation action can be judged against the desired outcome, accomplishments noted and problems identified.

Adapting conservation actions to respond appropriately to new information or changing conditions

Annual reporting provides one opportunity to identify how effective conservation actions are at getting the job done, by matching planned objectives to real outcomes. Sometimes, however, the need to change course is obvious to professional fisheries and wildlife biologists before the reporting period comes to an end.

One example of this event that has recently occurred at DFW relates to charcoal farmers. The Saipan Upland Mitigation Bank was established to allow large developments (such as golf courses and other resorts) the opportunity to mitigate the take of the endangered Nightingale Reed-warbler by purchasing credits. But, the mitigation bank was never intended for small operators, such as charcoal farmers. These individuals clear areas of tangantangan for charcoal production and, in the process, must apply for permits from DFW. Each permit request entails a field visit by DFW technicians to determine if there are Nightingale Reed-warblers on the proposed clearing site. DFW's Wildlife Section has been inundated by permit requests, and it has become clear that the permit system is inadequate at addressing the needs of these smaller operators for mitigation. A new avenue for mitigation needs to be developed. Consequently, funding through two different grants has been requested to hire an additional Natural Resources Planner to devise compliance conditions for the permits and to develop standard review procedures.

Adapting to changed conditions requires elasticity, an attribute that is difficult to achieve in the government agency setting. DFW faces many challenges to getting the job done efficiently and timely. Funding is limited. Professional staff turnover is high, and it is difficult to find qualified biologists to fill positions in these far-flung islands. Procurement of goods or services requires a lengthy local government process, even though backed by federal grant funds. These challenges, however, have spawned creative solutions. For example, due to the difficulty in hiring an individual biologist from the Mainland to move to Rota, DFW has entered into an agreement with an institution, the University of Washington, to initiate research and conservation for the Mariana Crow and the Bridled White-eye on Rota.

## Coordination with other agencies

Agency participation in the development of the CWCS

Government agencies on Saipan that were invited to participate in the development of this CWCS are as follows:

- CNMI Department of Lands and Natural Resources
- DLNR Division of Forestry
- DLNR Division of Land Registration and Survey
- CNMI Division of Environmental Quality
- CNMI Coastal Resources Management Office
- Marianas Public Land Authority
- Department of Community and Cultural Affairs
- Historic Preservation Office
- Carolinean Affairs Office
- Office of the Governor
- Saipan Mayor's Office
- Northern Islands Mayor's Office
- NMC-CREES (Northern Marianas College – Community Research Extension Educational Services)

Government agencies on Tinian that were invited to participate in the development of this CWCS are as follows:

- Tinian Department of Lands and Natural Resources
- Tinian Division of Fish and Wildlife
- Tinian Commonwealth Forestry
- Tinian Coastal Resources Management Office
- Tinian Division of Environmental Quality
- Tinian Marianas Public Land Authority
- Tinian Department of Community and Cultural Affairs

- Tinian Historic Preservation Office
- Tinian Mayor's Office
- Tinian Municipal Council
- NMC-CREES on Tinian

Government agencies on Rota that were invited to participate in the development of this CWCS are as follows:

- Rota Department of Lands and Natural Resources
- Rota Division of Fish and Wildlife
- Rota Commonwealth Forestry
- Rota Coastal Resources Management Office
- Rota Division of Environmental Quality
- Rota Marianas Public Land Authority
- Rota Department of Community and Cultural Affairs
- Rota Historic Preservation Office
- Rota Mayor's Office
- Rota Legislative Delegation
- Rota Municipal Council

U.S. government agencies that were contacted during, or were invited to participate in the development of this CWCS are as follows:

- U.S. Fish and Wildlife Service (through Honolulu)
- U.S. Natural Resource Conservation Service (Saipan)
- U.S. National Park Service at American Memorial Park (Saipan)
- U.S. Coast Guard (through Guam)
- U.S. Navy (through Guam)

The results of these agencies' participation in the development of the CWCS are presented in Chapter 9.

<u>Agency participation in the implementation, review and revision of the CWCS</u>
Although the agencies listed above were invited to participate in the development of this CWCS, not all of them elected to do so. Stakeholder lists were compiled and will be used in the future to encourage agency involvement in the implementation, review and revision of the CWCS. Of particular importance is cultivating a good working relationship between DFW and the Marianas Public Land Authority (MPLA). MPLA is the custodian for all public lands in the Commonwealth, to be held in trust for the benefit of persons of Northern Marianas descent. Conservation actions that entail the use of public land – whether through agreement, easement, or direct conveyance – will necessarily require the blessing of MPLA.

## **<u>A procedure to review and revise the CNMI's Comprehensive Wildlife Conservation Strategy</u>**

The CNMI has changed a lot in the last ten years. The economy has taken a fall, with the result that planned resort and golf course developments have not materialized. While the lagging economy bodes poorly for people, it has probably benefited wildlife populations because less forested habitat has been disturbed.

It is not certain where the CNMI will be in the next ten years with respect to conservation of fish and wildlife resources. Circumstances that affect DFW's ability to get the job done most probably will change – funding levels are not certain, and the human impact on the marine and terrestrial environment may change with the uncertain economy. A review and revision of the CWCS should be undertaken within the next ten years to more effectively respond to these changes. The following procedure is proposed for reviewing and revising the CWCS within the next ten years.

<u>Appointment of a SWG Manager</u> -- A State Wildlife Grant Manager (SWG Manager) will be appointed to oversee the initiation, fulfillment and reporting of conservation actions proposed under the CWCS. This SWG Manager will be an employee of DFW whose salary is paid by the State Wildlife Grant.

<u>Amend CWCS for NAAT approval</u> -- The SWG Manager will make any amendments called for by the National Advisory Acceptance Team (NAAT), deemed to be necessary for the CWCS to be finally approved. This task will be performed if and when any amendment requests are received from the NAAT.

<u>Prioritize conservation actions and apply for State Wildlife Grant funding</u> -- Within the first five years after approval of this CWCS by the NAAT, the SWG Manager will consult with DFW biologists and staff, analyze the priority surveys and conservation actions stated in the CWCS, prioritize which of these will be implemented with the available State Wildlife Grant funding, and write the necessary grant applications and/or amendments to obtain funding for their implementation from USFWS Federal Aid.

<u>Initiate implementation of priority research efforts and conservation actions</u> -- Within the first five years after approval of this CWCS by the NAAT, the SWG Manager will initiate and support the implementation of approved priority research efforts and conservation action projects by:

- managing projects approved for funding under the State Wildlife Grant, including procuring necessary goods and contracting for services, and writing progress reports;
- advising and assisting other DFW professionals who manage other grant programs to determine if those other grants can be used to implement CWCS conservation actions; and,
- encouraging the implementation of conservation actions by other agencies through their respective authorities and funding sources.

<u>Monitor the need for change</u> -- At the end of the first five years of implementation of this CWCS, the SWG Manager will undertake an analysis of how effective the operations of DFW and other agencies have been at meeting the objectives of conservation actions, by

comparing desired outcomes with work accomplished. The SWG Manager will consult the following sources of information to monitor the need to change the direction of research or of conservation actions:

- annual progress reports produced under DFW's various grant programs;
- changes in wildlife abundance trends or habitat condition reported by DFW biologists and professionals from other resource agencies, both local and federal;
- progress reports produced by other agencies;
- new biological information regarding species of special conservation need, or species that should be added as species of special conservation need; and
- opinions expressed by the public.

Revise the priority research and conservation actions in the CWCS – Once an analysis of the need for change in the direction being pursued for priority research efforts or conservation actions has been identified, the SWG Manager will revise the CWCS accordingly, and write an amended CWCS document. This is a large task that will take a year or more to complete and will necessarily depend on grant funding being available. The amended CWCS will guide conservation and management of species of special conservation need for the following five years.

Figure 91. Volunteer Marilyn Swift with Wedge-tailed Shearwater chick. Photo by Shelly Kremer.

TAKE ACTION…..TAKE CONSERVATION ACTION!!