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# **GUAM WILDLIFE ACTION PLAN**

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**(GWAP)**

Revised

**JANUARY 10, 2019  
GUAM DIVISION OF AQUATIC AND WILDLIFE RESOURCES  
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## Acronyms and Abbreviations

AAFB – Andersen Air Force Base  
ACOE – Army Corps of Engineers  
AZA – American Zoo and Aquarium Association  
BSP – Bureau of Statistics and Plans, Government of Guam  
CITES – Convention on International Trade of Endangered Species  
CNMI – Commonwealth of the Northern Marianas  
COMNAVMAR – Commander US Naval Forces Marianas  
CSU - Colorado State University  
CZM – Coastal Zone Management  
DOA – Department of Agriculture, Government of Guam  
DPR – Department of Parks and Recreation, Government of Guam  
EEC – Environmental Education Committee  
EO-LAS – Education Outreach Local Action Strategy  
ERA – Ecological Reserve Area  
ESA – Endangered Species Act  
FIA – Forest Inventory and Analysis  
FSRD – Forestry and Soil Resources Division, Government of Guam  
GCA – Guam Code Annotated  
GCMP – Guam Coastal Management Program  
GCRICC – Guam Coral Reef Initiative Coordination Committee  
GCWCS – Guam Comprehensive Wildlife Conservation Strategy  
GDAWR – Guam Division of Aquatic and Wildlife Resources, Government of Guam  
GEPA – Guam Environmental Protection Agency  
GNA – Guam Nature Alliance  
GNWR – Guam National Wildlife Refuge  
GVB – Guam Visitors Bureau  
GWAP – Guam Wildlife Action Plan  
HERA - Haputo Ecological Reserve Area  
NCTS - Naval Computer and Telecommunications Station  
NGO – Non-Government Organization  
NRCS – Natural Resources Conservation Service, USDA  
OIA – Office of Insular Affairs, Department of the Interior  
PL – Public Law, Government of Guam  
SOGCN – Species of Greatest Conservation Need  
SSP – Species Survival Program  
SWARS - State-Wide Assessment and Resource Strategy  
SWGP – State Wildlife Grant Program  
UOG – University of Guam  
USAF – United States Air Force  
USDA – United States Department of Agriculture  
USDA-WS – USDA Wildlife Services  
USFWS – United States Fish and Wildlife Service  
USGS – United States Geological Survey  
USGS BRD – US Geological Survey Biological Research Division  
USN – United States Navy

## **Executive Summary**

In order to receive funds through the State Wildlife Grant Program (SWGP), Congress mandated that each state and territory develop its own “comprehensive wildlife conservation strategy”. The strategy is to assess the health of each state’s, or territory’s wildlife and habitats. Each strategy is required to have eight elements including a description of the status of species determined to be a Species of Greatest Conservation Need (SOGCN), condition of important habitats, conservation actions, monitoring of species, and gauging conservation success. Important in the development of the strategy is a “good faith effort” to include the public and encourage participation in the process.

Guam, a U.S. territory, is the southernmost island in the Mariana Archipelago and the largest island in Micronesia, with a landmass of 560 km<sup>2</sup>, and a population of 159,358 (2010 U.S. Census). The northern portion of the island is a limestone plateau, rising nearly 200 meters above sea level in some places. The southern half of the island is old weathered volcanic material with a cap of limestone most prominent on the Mt. Lamlam-Alifan ridge. The highest point of the island is Mt. Lamlam, in the south, an elevation of 406 meters. Guam’s tropical climate averages daily temperatures ranging from 24-30°C (75-86°F) and average annual rainfall is about 218 cm (86 in). The island has a wet and a dry season. The wet season runs from June to November and the dry season from January to April, with December and May being transitional months.

Like other Pacific Islands, Guam is affected by climate change. Key indicators include rising carbon dioxide in the atmosphere, increasing air and sea temperatures, rising sea levels and upper-ocean heat content, changing ocean chemistry, increasing ocean acidity, changing rainfall patterns, decreasing base flow in streams, changing wind and wave patterns, changing extremes, and changing habitats and species distributions (Keener et al., 2012). The most vulnerable areas include coastal areas and coral reefs, although high elevation areas are also vulnerable. The climate changes are affecting every aspect of life - freshwater supplies, food supplies, animal behavior and habitat are all at risk. Over the coming decades, impacts are expected to become more widespread and more severe.

Prior to revising Guam’s Comprehensive Wildlife Conservation Strategy (CWCS) to draft the 2016 Guam Wildlife Action Plan (GWAP), various agencies, groups, non-profit organizations, and the public in general were solicited for input (Element 7 and 8). Social media was used and a public notice was published in the local newspaper requesting comments to the GWAP to encourage input to the plan. The GWAP was available for review on Compact Disk (CD) and as a hardcopy from the Guam Division of Aquatic and Wildlife Resources (GDAWR) office and as a download from the GDAWR website ([dawr.guam.gov](http://dawr.guam.gov)).

Guam’s WAP identified 76 species including 42 terrestrial (mammals-2, birds-13, lizards-5, snails-3, insects-2 and plants-17), 7 freshwater (fish-4, eel-1, plants-2), and 27 marine organisms (marine mammals-14, fishes-2, clams-4, gastropod-1, spiny lobster-1, sea turtles-2, marine plants-3), as well as an additional 20 family groups as Species of Greatest Conservation Need (SOGCN). A conservation table is devoted to each of them

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summarizing their status, goals, objectives, and action plans (Elements 1, 3, and 4). Besides identifying actions necessary for each species and family, the GWAP includes the development of a memoranda of understanding with other entities for the conservation and management of species and habitat, rehabilitation of habitats, public education, and law enforcement. Further investigations of the families should elucidate the proper designations of the species within each family.

The recovery of native species cannot be achieved without the maintenance and recovery of their habitat. Guam's WAP presents 23 maps showing the location and relative conditions of habitats and conservation areas important to the conservation and recovery of Guam's SOGCN (Element 2). Freshwater habitats, including marshes, rivers and man-made reservoirs, support native freshwater plants and animals, including the Mariana common moorhen (*Gallinula chloropus*). There are five marine preserves that provide refugia for many marine species. Conservation areas under local control, Anao, Cotal, and Balonos conservation areas, as well as conservation areas under federal control can serve as areas for recovering terrestrial species. These areas vary in their condition as suitable habitat for recovery for terrestrial species. Areas in the southern part of Guam tend to have habitat in dire need of programs to replace dominant grasslands (*Miscanthus floridulus*) with suitable native forest habitat. The northern areas have more intact forest but need other management actions such as ungulate control and out planting of certain plant species to enhance the quality of the habitat.

The introduction of invasive species, whether purposeful or accidental, only adds to the difficulty in protecting and recovering Guam's SOGCN. Since the GWAP was written, coconut rhinoceros beetles (CRB, *Oryctes rhinoceros*), little fire ant (LFA, *Wasmannia auropunctata*), and the cycad scale (*Aulacaspis yasumatsui*) have established populations throughout Guam. Guam's native Cycads (*Cycas mariannensis*), a primary component of native habitats, are expected to go extinct within the next decade without major intervention. The CRB population continues to decimate the coconut palm, referred to as the tree of life within the Pacific. The Guam Customs and Quarantine Agency and Department of Agriculture must be vigilant in protecting Guam from non-native species that threaten to destroy resources that Guam's SOGCN depend upon.

The introduction of invasive predators has played a key role in the decline and extirpation of many of Guam's native species. The brown tree snake (BTS, *Boiga irregularis*) has been implicated in the demise of Guam's native avifauna, and the predatory flatworm (*Platydemus manokwari*) has decimated native partula populations. Predator control is an important component in the recovery of Guam's SOGCN. In cases where populations continue to persist in the wild, such as the island grey swiftlet (*Aerodramus bartschi*) and Mariana common moorhen (*Gallinula chloropus*), predator control programs can help protect the resources.

Guam's freshwater ecosystems have also been impacted by the introduction of non-natives. Snakeheads (*Channa striata*), a popular food item in Asia, are established in one river, probably due to an aquaculture escapee. Snakeheads are predatory and control is difficult as they are able to live out of water and crawl to another body of water when

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adverse conditions arise. Walking catfish (*Clarias batrachus*) are another example of a predator of native species that was introduced intentionally in the 1960s. Non-native plants such as hydrilla (*Hydrilla verticillata*) crowd out native vegetation and alternative fish habitat. Guam's native freshwater organisms are at risk within rivers and streams due to the introduction of non-natives, erosion, and man-made dams.

Besides direct predation of native species, invasive species can be a catalyst for the growth of other populations of non-natives. Introduced skinks and geckos outcompete native species while providing a source of food for small BTS. Recent frog introductions of three species of barking frogs (*Fejervarya cancrivora*, *Fejervarya limnocharis* sensu lato, and *Rana guentheri*) and the greenhouse frog (*Eleutherodactylus planirostris*) have provided an additional food source for small and medium sized BTS. The introduction of more size classes of food for the BTS may be enough to push populations to a new level and made control more difficult.

While *in situ* programs are occurring, captive breeding programs must be implemented to build a stock of captive native forest birds, butterflies, lizards, and snails. The program would build populations of organisms for release into conservation areas where limiting factors have been remedied. The GDAWR Captive Breeding Facility in Mangilao has successfully bred Guam rails (*Gallirallus owstoni*), Micronesian Kingfishers (*Todiramphus cinnamominus cinnamominus*) and Mariana crows (*Corvus kubaryi*) for release into the wild. Through funding under the State Wildlife Grant Program, the University of Guam initiated a captive breeding program for the eight-spot butterfly (*Hypolimnas octocula marianensis*) and is planting host plants in an area free of ungulates where hopefully they will be established. This State Wildlife Grant Program funded project is providing valuable information for the possibilities of mitigating the impacts of growth and development on limestone forest species and their habitat.

Monitoring the progress of conservation actions is an important component (Element 5). Guam's WAP suggests utilizing existing survey programs to monitor the status of the SOGCN, such as bird surveys, sampling plots, reef surveys, and aerial surveys. Freshwater and marine habitats are vulnerable to land-based activities. The plan identifies local action strategies that address human activities impacting freshwater and marine ecosystems. Information gathered in these efforts will be used to monitor results of projects and changes in the status of Guam's SOGCN for incorporation into the next five- and ten- year review (Element 6).

Guam's WAP incorporates a holistic approach by including public education and law enforcement as vital components of the plan. It is key to involve the public in the stewardship of the resources and partner with law enforcement. Additionally, enforcement of terrestrial and marine natural resource laws are important.

## Road Map to the Eight Required Elements

This section is provided to assist the Regional Review Team (RRT) in evaluating this document for the purpose of determining if and/or how well Guam’s WAP meets the eight required elements.

Please refer to the following page numbers in order to examine how each of the elements was addressed in the development of Guam’s WAP.

Element 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.

NAAT Guidance	Chapter	Page #	Table Figure	Page #	Appendix	Page #
A. The Strategy indicates sources of information (e.g., literature, data bases, agencies, individuals) on wildlife abundance and distribution consulted during the planning process.	1	20	Table 2	34		
	3	71-101	Table 9 Species Account Table 18	79 102-204 221		
B. The strategy includes information about both abundance and distribution for species in all major groups to the extent that data are available. There are plans for acquiring information about species for which adequate abundance and/or distribution information is unavailable.	3	71-72	Table 2  Species Account  Table 18	34  102-204  221		
C. The Strategy identifies low and declining populations to the extent data are available.	3	71-101	Species Account Table 18	102-204 221		
D. All major groups of wildlife have been considered or an explanation is provided as to why they were not. The State may indicate whether these groups are to be included in a future Strategy revision.	3	71-101				
	6	256				
E. The Strategy describes the process used to select the species in greatest need of conservation. The quantity of information in the Strategy is determined by the State with input from its partners, based on what is available to the State.	3	71-101	Fig 20	257		
	6	256				
	7	261				
	8	263				



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Element 2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1).

NAAT Guidance	Chapter	Page #	Table Figure	Page #	Appendix	Page #
A. The Strategy provides a reasonable explanation for the level of detail provided; if insufficient, the Strategy identifies the types of future action that will be taken to obtain the information.	2	29-52	Table 2 Table 6 Table 7	34 41 44		
B. Key habitats and their relative conditions are described in enough detail such that the State can determine where (i.e., in which regions, watersheds, or landscapes within the State) and what conservation actions need to take place.	2	29-52	Table 2 Table 6 Table 7 Fig. 18 Fig. 19 Fig. 20	34 41 44 208 254 257	App. 3  App. 4	291  293

Element 3. Descriptions of the problems that may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors that may assist in restoration and improve conservation of these species and habitats.

NAAT Guidance	Chapter	Page #	Table Figure	Page #	Appendix	Page #
A. The Strategy indicates sources of information used to determine the problems or threats.	3	79-101	Species Account	102-204	App. 4	293
B. The threats/problems are described in sufficient detail to develop focused conservation actions.	3	79-101	Table 8 Species Account	73 102-204	App. 4	293
C. The Strategy considers threats/problems, regardless of their origins (local, State, national and international), where relevant to the State’s species and habitats.	3	79-101	Table 2 Table 6 Table 7	34 41 44	App. 4	293
D. If available information is insufficient to describe threats/problems, research and survey efforts are identified to obtain needed information.	4	206-220				
E. The priority research and survey needs, and resulting products, are described sufficiently to allow for the development of research and survey projects after the Strategy is approved.	4 5	206-220 240-254	Table 18 Species Account	221 102-204		

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Element 4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions.

NAAT Guidance	Chapter	Page #	Table Figure	Page #	Appendix	Page #
A. The Strategy identifies how conservation actions address identified threats to species of greatest conservation need and their habitats.	4	206-220	Fig. 19	254		
	5	252				
B. The Strategy describes conservation actions sufficiently to guide implementation of those actions through the development and execution of specific projects and programs	4	206-220	Fig. 18	208		
	5	240-254	Fig. 19 Fig. 20	254 257		
C. The Strategy links conservation actions to objectives and indicators that will facilitate monitoring and performance measurement of those conservation actions (outlined in Element 5).	4	206-220	Fig. 18	208		
	5	240-252	Table 18 Species Account	221 102-204		
D. The Strategy describes conservation actions that could be addressed by Federal agencies or regional, national or international partners and shared with other States.	4	205				
	5	239				
	6	255				
	7	260				
E. If available information is insufficient to describe needed conservation actions, the Strategy identifies research or survey needs for obtaining information to develop specific conservation actions.	4	206-220	Species Account	102-204		
F. The Strategy identifies the relative priority of conservation actions.	4	206-220	Table 18 Species Account	221 102-204		

Element 5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions.

NAAT Guidance	Chapter	Page #	Table Figure	Page #	Appendix	Page #
A. The Strategy describes plans for monitoring species identified in (1) and their habitats.	5	240-254				
B. The Strategy describes how the outcomes of the conservation actions will be monitored.	5	253	Fig. 18 Fig. 19	208 254		
C. If monitoring is not identified for a species or species group, the Strategy explains why it is not appropriate, necessary or possible.	3	70				
	4	205				
	5	239				

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<b>NAAT Guidance</b>	<b>Chapter</b>	<b>Page #</b>	<b>Table Figure</b>	<b>Page #</b>	<b>Appendix</b>	<b>Page #</b>
D. Monitoring is to be accomplished at one of several levels including individual species, guilds, or natural communities.	5	240-254			App. 4	293
E. The monitoring utilizes or builds on existing monitoring and survey systems or explains how information will be obtained to determine the effectiveness of conservation actions.	5	252-253			App. 4	293
F. The monitoring considers the appropriate geographic scale to evaluate the status of species or species groups and the effectiveness of conservation efforts.	5 7	253 261	Fig. 19 Fig. 20	254 257	App. 5	312
G. The Strategy is adaptive in that it allows for evaluating conservation actions and implementing new actions accordingly.	5 7 8	253 261 267	Fig. 19 Fig. 20	254 257	App. 5	312

Element 6. Descriptions of procedures to review the Guam Wildlife Action Plan (GWAP) at intervals not to exceed 10 years.

<b>NAAT Guidance</b>	<b>Chapter</b>	<b>Page #</b>	<b>Table Figure</b>	<b>Page #</b>	<b>Appendix</b>	<b>Page #</b>
A. The State describes the process that will be used to review the Strategy within the next ten years.	6 7 8	256 261 263	Fig. 20	257		

Element 7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Comprehensive Strategy 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.

<b>NAAT Guidance</b>	<b>Chapter</b>	<b>Page #</b>	<b>Table Figure</b>	<b>Page #</b>	<b>Appendix</b>	<b>Page #</b>
A. The State describes the extent of its coordination with and efforts to involve Federal, State and local agencies, Indian tribes in the development of its Strategy.	6 7	256 261	Fig. 20	257		
B. The State describes its continued coordination with these agencies and tribes in the implementation, review and revision of its Strategy.	6 7 8	256 261 266-268	Fig. 20	257		

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Element 8. Provisions to ensure public participation in the development, revisions, and implementation of projects and programs. Congress has affirmed that broad public participation is an essential element of this process.

NAAT Guidance	Chapter	Page #	Table Figure	Page #	Appendix	Page #
A. The State describes the extent of its efforts to involve the public in the development of its Strategy.	3	71	Fig. 20	257	App. 1	285
	4	215				
	6	259				
	7	261				
	8	263				
B. The States describes its continued public involvement in the implementation and revision of its Strategy.	4	215	Fig. 20	257		
	8	262				

# **CHAPTER 1: Introduction**

## Guam WAP 2018

Guam, a US territory located at 13°28' N, 144°45' E, is the southernmost island in the Mariana Archipelago and the largest island in Micronesia, with a landmass of 560 km<sup>2</sup>. The northern portion of the island is a limestone plateau, rising nearly 200 meters above sea level in some places, which overlies rock of volcanic origin (Lander 1997). The southern half of the island is old weathered volcanic material with a cap of limestone most prominent on the Mt. Lamlam-Alifan ridge (Fosberg 1960). The highest point of the island is Mt. Lamlam, in the south, with an elevation of 406 meters. The grasslands and ravine forests characterize the vegetation in the south (Fosberg 1960). Wetlands are also an important habitat type occurring in the south.

Guam has a tropical climate, with average daily temperatures ranging from 24-30°C (75-86°F). The average annual rainfall is 218 cm (86 in) (National Weather Service, <http://www.prh.noaa.gov/guam/normal.html>, Accessed 1/24/05). The island has a wet and a dry season. The wet season runs from June to November and the dry season from January to April, with December and May being transitional months. During the wet season, humidity is high and weak southerly or southeasterly winds occur. In contrast, during the dry season, humidity is relatively low and the island experiences northeasterly trade winds (Engbring and Ramsey 1984). Humidity ranges from 65-90%. Typhoons can occur anytime of the year but are more common during the wet season (NOAA 1982).

The El Nino Southern Oscillation (ENSO) is the predominate driver of climate. ENSO events in the Pacific cause dramatic variations in rainfall, trade wind patterns, air and sea surface temperature, sea levels, and cyclone activity, with impacts differing significantly across the Central and Western Pacific Islands (Fletcher et al., 2012; Keener et al., 2012; Romine et al. 2013; Crausbay et al., 2014; Frazier et al., 2017; Brainard et al., 2018; Herring et al., 2018).

These departures from the normal wet and dry season climate regimes pose threats to physical, natural, social, cultural, and economic environments including coral reefs, marine and terrestrial wildlife and their habitats, along with the ecosystem services those habitats provide. It is critical that the Department of Agriculture is provided information generated from sound, actionable scientific research to understand the potential impacts of natural climate variability and a changing climate to address, develop, and implement effective and affordable adaptation policies for management of valued assets, including land; water; fish and wildlife; nearshore, coastal, and the ecosystem services upon which human communities depend.

Superimposed on natural climate variability, Guam must also deal with the impacts of anthropogenic climate change. Across the Pacific basin, air and sea surface temperatures and sea levels are rising, drought is more frequent and prolonged, water lenses are threatened by seawater inundation, and habitat and species distributions as well as ocean chemistry are changing (Keener et al. 2012). These documented observations are demonstrative of a range of concerns for small Pacific Islands natural ecosystems including increased coastal flooding and erosion, migration and loss of forest ecosystems (e.g., Crausbay et al., 2014); increased risk of extinctions (e.g., Urban, 2015); increased coral bleaching (Brainard et al., 2018); and increasing impacts to the marine ecosystems

(e.g., Herring et al., 2018, Serpiti et al., 2017). The areas of most concern for Guam include nearshore and coastal areas, and coral reefs.

Through the Pacific Islands Climate Adaptation Science Center (PICASC), the University of Hawaii – Manoa produced fine-resolution future climate changes over Guam and American Samoa by the late 21<sup>st</sup> century (2080-2099), using a high green house emissions scenario, Representative Concentration Pathway (RCP) 8.5 and a medium emission scenario (RCP4.5) (Wang 2016). According to Wang (2016) surface air temperature (SAT) over Guam is likely to increase by 1.5 – 2.0 °C for RCP4.5; and approximately 3.0 – 3.5 °C for RCP8.5. The projected annual mean future rainfall changes for Guam are not statistically significant in any location in either the RCP4.5 or RCP8.5 scenarios (Wang 2016). The frequency of weak tropical cyclones (TCs) will significantly decrease within 500 km around Guam, while that of strong TCs will increase (Wang 2016).

No different to other Pacific Islands, Guam is experiencing climate change. Key indicators include rising carbon dioxide in the atmosphere, increase air and sea temperatures, rising sea levels and upper-ocean heat content, ocean chemistry changes and increase ocean acidity, changing rainfall patterns, decreasing base flow in streams, changing wind and wave patterns, changing extremes, and changing habitats and species distributions (Keener et al., 2012). The most vulnerable areas include nearshore and coastal areas, and coral reefs. High elevation areas are also vulnerable. The climate changes are affecting every aspect of life. Freshwater supplies, food supplies, animal behaviors and habitats are at risk. Over the coming decades, impacts are expected to become more widespread and severe.

Under natural conditions, Guam hosted a rich diversity of terrestrial and aquatic species. Over 100 species of birds have been documented on the island including migrant, wetland, seabird, grassland, and forest birds (Reichel and Glass 1991, Engbring and Fritts 1988). Three native mammals were also known to Guam, including the Marianas fruit bat (*Pteropus mariannus mariannus*), little Marianas fruit bat (*Pteropus tokudae*) and the Pacific sheath-tailed bat (*Emballonura semicaudata rotensis*), although the Marianas fruit bat is the only extant species. There are six native reptiles, five skink species, and one gecko species that are still found in the wild. Several native tree snail species still exist in low numbers on Guam. Four species of snails, *Samoana fragilis* and *Partula radiolata*, *Partula langfordi*, and *Partula gibba* have been listed as endangered under the Endangered Species Act (ESA; 1973). Guam has more than 320 native plant species of which seventeen are currently eligible for funding under the ESA. In addition, Guam's marine environment includes more than 5000 known species (Paulay 2003a).

Over the last 50 years Guam has experienced tremendous domestic growth and suffered significant environmental degradation island-wide. Guam's native flora and fauna have been impacted by numerous insidious threats, such as the introduction of invasive species, poor land management practices, and overexploitation. These anthropogenic threats are exacerbated by the frequency with which the island is impacted by typhoons, and more recently, the effects of climate change. In the last two decades, Guam has been

hit directly by four storms with sustained winds greater than 150 miles per hour and suffered high wave and winds from large systems passing near Guam (Guard et al. 2003). Many of the terrestrial and aquatic species that may be of abundance now face environmental and man-made threats that could easily reduce or decimate populations. The cognizance of the many threats assailing Guam's native flora and fauna makes all species listed in the Species of Greatest Conservation Need (SOGCN) legitimately a high priority for conservation actions. The various resource agencies of the Government of Guam and their partners continue to address these issues, knowing that economic prosperity and preservation of the Chamorro culture are dependent on the successful recovery and sustainable use of the island's natural resources.

The island possesses a variety of terrestrial habitats, including limestone and ravine forests, savanna complex, and strand vegetation. One hundred named rivers are found in the southern part of the island, along with 2 man-made reservoirs (Best and Davidson 1981). Marine habitats include fringing, patch, submerged and barrier reefs, offshore banks, seagrass beds, and mangroves. The combined area of coral reef and lagoon is approximately 69 km<sup>2</sup> in nearshore waters between 0-3 nm, and an additional 110 km<sup>2</sup> in waters greater than 3 nm offshore (Hunter 1995). Sea surface temperatures range from about 27-30°C, with higher temperatures measured on the reef flats and in portions of the lagoons (Paulay 2003a).

Given its small size, the entire island of Guam has been designated, both locally and federally, as coastal zone. This gives resource managers the authority to incorporate all aspects of the watershed in terms of planning, funding, and implementing management actions. Guam is divided into 19 watersheds in the southern half of the island. These areas are defined by hydrologic unit boundaries based on a 14-digit sub-watershed level (typically 10,000 to 40,000 acres, with a minimum of 3,000 acres) developed by Natural Resources Conservation Service (NRCS) in coordination with the United States Geological Survey (USGS) system developed for larger drainage areas (Guam Water Planning Committee, 1998). The Northern Guam sub-watershed was defined in the Guam Clean Water Action Plan (1998) as an area that has no clearly defined drainage ways, composed of a shallow soil layer over permeable limestone, with little or no runoff. This sub-watershed has been further delineated into sub-basins as more complete data on the flow of water through the northern aquifer become available.

In southern Guam, a mountain ridge running along the western coast creates small, steep watersheds to the west and broader floodplains draining into longer, larger rivers to the east. Of Guam's 100 named rivers and streams, most are located in the southern half of the island (Best and Davidson 1981), forty-six drain into the ocean. The largest of these, the Talofofo River, drains an area of approximately 72.84 km<sup>2</sup> (~18,000 acres) (Best and Davidson 1981).

There are several man-made reservoirs almost all built after World War II. No naturally occurring lakes can be found on Guam. Many of these reservoirs are no longer used for their original purpose. Fena Lake is the largest and most valuable reservoir for its supply of fresh water and the surrounding habitats.



### **Goal**

The goal of Guam’s 2016 Strategic Wildlife Action Plan is to promote the recovery and sustainable use of Guam’s native aquatic and terrestrial species, especially those of greatest conservation need.

### **Authority**

The Department of Agriculture, to be called the Department from here on, is responsible for the control and regulation of fish and game in and about Guam and the administration of laws pertaining to them (5 Guam Code Annotated (GCA), Chapter 63, §63102, see Table 1). GCA defined fish and game as “any aquatic animal life” and “all native or introduced species of wild birds or wild animals.” The Department is also given regulatory power over endangered species (Title 5 GCA, Chapter 63, §63205). It has the authority to promulgate a list of endangered species to be adapted through the Administration Adjudication Act and approved by the Guam Legislature. Title 5 GCA, §63205 also authorizes the Department to enter into agreements with federal, or public agencies, or any person for the purpose of administration, research or management of these resources. The Department, in cooperation with the Department of Parks and Recreation (DPR) and other agencies of the Government of Guam, also has the authority to control and manage conservation reserves on Guam (Title 5 GCA, Chapter 63, §63401).

Pursuant to Section 6 of the Endangered Species Act, a cooperative agreement exists between the Department and the USFWS. This agreement obligates the Department to protect US listed species (see Appendix 2). It also provides for funding and implementation of programs for endangered species research and recovery activities. The Department is also required to enforce other Federal laws such as the Migratory Bird Treaty Act of 1918, Marine Mammal Protection Act of 1972, and Lacey Act of 1981 (as amended).

Other Government of Guam resource agencies have mandates related to management of natural resources and their agency decisions affect the species of greatest conservation need. Public Law (PL) 11-191 established the Guam Environmental Protection Agency (GEPA) on March 3, 1973. GEPA’s mission is “to provide a united, integrated, and comprehensive island-wide program of environmental protection and to provide a framework to fulfill that task” (Title 10 GCA, Chapter 45, §45102). The Government of Guam’s Bureau of Statistics and Plans (BSP) administer the Guam Coastal Management Plan (GCMP) through the Coastal Zone Management Act of 1972 (PL 92-583, as amended; PL 94-370). The GCMP guides the use, protection, and development of land and ocean resources within Guam’s coastal zone. The “coastal zone” defined as all non-federal property within the Territory, including offshore islands and all submerged lands and waters out to three nautical miles.

Table 1. Authorities related to Natural Resource Management on Guam.

<b>No.</b>	<b>Authority or Law</b>	<b>Summary</b>
1.	Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884)	Affords protection of Federally listed species.
2.	Migratory Bird Treated Act of 1918 (16 U.S.C.)	Affords protection of specifically listed migrant species.
3.	Sikes Act of 1960 (16 U.S.C. 670a–670o as amended through P.L. 106-580, Dec. 29, 2000)	Promotes effectual planning, development, maintenance, and coordination of wildlife, fish, and game conservation and rehabilitation in military reservations.
4.	USFWS Cooperative Agreement	An agreement that allows Guam to implement endangered species recovery programs.
5.	Guam Endangered Species Act, 5 GCA 63208, PL – 15-36	Law allows for the adjudication of an endangered species list for Guam.
6.	Game, Forestry and Conservation, 5 GCA, Chapter 63, PL 6-85	Law describing the authority of the Department of Agriculture
7.	Protection of Wild Animals, 5 GCA 63121	Lists species that are considered protected.
8.	Fish, Game, Forestry and Conservation, 5 GCA, 63101-63117	Laws protecting Guam’s fish resources.
9.	Concurrent Jurisdiction	Organic Act of Guam
10.	Lacey Act (P.L. 97-79, 95 Stat. 1073, 16 U.S.C. 3371-3378, approved November 16, 1981, and as amended by P.L. 100-653, 102 Stat. 3825, approved November 14, 1988, and P.L. 98-327, 98 Stat. 271, approved June 25, 1984)	Under this law, it is unlawful to import, export, sell, acquire, or purchase fish, wildlife, or plants taken, possessed, transported, or sold: 1) in violation of Indian law, or US or 2) in interstate or foreign commerce involving any fish, wildlife, or plants taken possessed or sold in violation of State or foreign law.
11.	Marine Mammal Protection Act of 1972 as amended through P.L. 107-136, Jan. 24, 2002	Law established to protect marine mammals in US waters and by US citizens on the high seas and the importation of marine mammals and marine mammal products into the US
12.	Convention of International Trade of Endangered Species (CITES) (entered in force 1975)	Convention on International Trade in Endangered Species. This is an international agreement between Governments that ensures international trade in specimens of wild animals and plants does not threaten their survival.

### **Funding Sources**

The strength of Guam's WAP will be the Department's ability to secure funding to carry out its plans. Guam receives federal funding through the Sport Fish and Wildlife Restoration Act, US ESA Section 6, Coral Reef Initiative, NOAA Pacific Island Regional Office (PIRO), NOAA Pacific Island Fisheries Science Center (PIFSC), Coastal Zone Management (CZM), Clean Water Act Section 319, and Western Pacific Regional Fisheries Management Council. The Department has also received Office of Insular Affairs (OIA) funding for brown tree snake control. Local funding sources include a general fund appropriation for the Department's Law Enforcement section and the Wildlife Conservation Fund that receives monies from hunting license and permit fees, private/Non-Government Organization (NGO) donations, and penalties for natural resource violations. Other previous funding sources include Department of Defense Legacy Funding, the South Pacific Regional Environmental Programme (SPREP), Government of Guam Local Appropriations, in-kind donations from Walt Disney World, and Land Acquisition Grants (Federal).

Guam has received annual appropriations from the US Congress through State Wildlife Grant Programs (SWGP). Acceptance of the SWGP funding was contingent on the development of the initial GWAP (formerly, GCWCS). Development of the 2016 Revised GWAP document, once accepted, will qualify the Department for continued funding under SWGP.

### **Changes and Additions for the 2015 Guam State Wildlife Action Plan**

The GWAP is a living document that will require iterations every 10 years, or as needed. With the increase in demand for imported goods, we foresee an increase of invasive species entering our island. Whether they become established or seized, at the port of entry, the challenge of an effective bio-security is overwhelming and a major concern. In 2011, Government of Guam established a Biosecurity office named Guam Invasive Species Council (GISC) (5 GCA, Guam Operations Chapter 70, 2011). DAWR continues partnership with GISC by providing technical support in addressing invasive species entering (and leaving) Guam's port of entries.

Loss of habitat due to ungulates (JRM Ungulate Management Plan, 2012) and unpermitted clearing or tree cutting remains a burden to species recovery. Fruit bats, for example, require a wide range of foraging area to thrive. In these areas, recruitment of native trees is non-existent as result of feral pigs and deer impact. Emphasis for ungulate control, native tree planting, and enforcement for clearing permits, is objectives addressed in the revised GWAP to minimize the loss of habitats.

The Department is aware that the GWAP is the foundation to build on as improvements continue in future revisions. Several changes were made in this revision to address SOGCN species or groups and explored effective ways of engaging key partners to fulfill the process of amending the document as needed. Developing a standardized method for determining SOGCN and evaluating threats and conservation actions are designed in this revision and will be implemented immediately for effective measures.

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Climate change is now addressed in the current GWAP. It is foreseeable that climate change will have multiple impacts to Guam's wildlife, lands, and waters. A contingent investigation of climate change impacts to the biological resources is pertinent to obtain information to allow for effective adaptive management and will be collaborated on with partner agencies.

Several objectives, actions, and statuses identified in the SOGCN accounts were modified based on new knowledge obtained. These changes were highlighted in specific species accounts, such as the native tree snails, green sea turtle, fruitbat, and native butterfly (see Species Accounts Ch.3). New information will be inputted in TRACS program under the SWG funded projects.

In this revision, we added several plants that were admitted to the US ESA list in 2014 (Federal Register, 2014). Including the newly listed species was based on the thought of providing more attention to monitor these species; and provide research opportunities for conservation efforts. Other species considered for listing were tabled for the next reiteration period. The candidate species (i.e.: harvested for food) will require significant participation and input from the public. Harvesting rate is presumed higher with certain species due to the human population growth and continued price increases for imported goods. Including these species will address sustainable harvesting and captive breeding opportunities. Changes in taxonomic names were made for a few species such as the Guam rail and Micronesian kingfisher. At this time, no SOGCN species were removed from the 2005 Plan. However, efforts to assess these species will be focused to identify priority species (existing population).

Strategies in engaging and obtaining public's involvement are described in chapter 8. The task at hand may continue to be challenging, however, the Department is optimistic to explore all means to successfully solidify the bond between the GWAP and stakeholders (technical experts, students, federal/state agencies, and public).

## **CHAPTER 2: Key Habitats, Conservation Lands, and Marine Preserves (Element 2)**

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Chapter two outlines key habitat types for both terrestrial and aquatic organisms listed in Guam's Species of Greatest Conservation Need (SOGCN). A map of all vegetation, water, and urban areas for Guam was produced by US Department of Agriculture Forest Service Region 5 (2014) and was used to determine habitat types within conservation areas and other government lands. A summary of Guam's habitat types based on the Forest Service Region 5 map has been consolidated into five vegetation classifications in Figure 1 (e.g. forest include all woody vegetation). This GIS map helped GDAWR fulfill element two that required descriptions and relative conditions and community types are identified. Updates in the vegetation maps will be completed as new GIS information becomes available.

The Forestry and Soil Resource Division of the Department of Agriculture (FSRD), along with the local and federal agency partners has updated the SWARS (2010) and land cover assessments for Guam. FSRD provided guidance and enhanced coastal habitat on Cocos Island and conservation lands, watersheds on Guam. The work done was in collaboration to fulfill actions to help benefit SOGCN species in those lands.

Climate change has been a concern with key habitats on Guam, especially coastal habitats, wetlands and all marine habitats. Monitoring for these areas affected are being monitored by NOAA and other partners (i.e. UOG Marine Lab, GCC eco-warriors, NPS, DoD-ENV.). FSRD with their partners, are assessing changes in forested habitats throughout Guam, of great concern are the limited mangrove habitats found in southern Guam's coasts.

### **Key Habitats**

#### *Terrestrial Habitats*

Prior to their demise, many of Guam's terrestrial native species were found throughout the island and in a variety of habitats (Jenkins 1983). Though much habitat remains available, the introduction of the brown treesnake has resulted in the loss of many of Guam's native species of birds and lizards and is probably preventing the recovery of the Mariana fruit bat (Savidge 1987, Rodda et al. 1997, Wiles 1987a).

There are eight general terrestrial habitat types found on Guam as described by Fosberg (1960), Stone (1970), and Engbring and Ramsey (1984) (see Appendix 3). Donnegan et al. (2002) provided additional habitat descriptions in the Forest Inventory and Analysis (FIA) that was used to "estimate forest area, tree stem volume and biomass, tree damages, and associated understory vegetation." The vegetation maps used in GWAP are derived from the June 2005 release of the Guam Detailed Vegetation Map created by the US Department of Agriculture (USDA) Forest Service Region 5 State and Private Forestry; Forest Health Protection and University of Guam's Water and Environmental Research Institute of the Western Pacific (Maria Kottermair 2015 GIS Analyst). The maps were created using geographic modeling techniques that utilized IKONOS satellite imagery and ancillary data such as demographic and soil layers. The analysis was limited to a 1-acre minimum mapping unit; therefore, parcels of habitat smaller than 1 acre are

not adequately depicted in these maps (Figures 2-7). Detailed maps for other habitat types were not available during the revision of the GWAP.

Limestone forests, scrub (secondary forest), mixed woodland, ravine forests, strand, and beach strand are important for all of Guam's native avian, invertebrate, reptilian, and mammalian species. Grassland, coconut grove, and open field provide habitat to native species, though to a lesser degree. The following describe the key habitat types, location, and current status important to the management and conservation of Guam's species of greatest conservation need (Element 1). A summary of the status of these habitats is provided in Table 2.

*Limestone forest.* Limestone forest is composed principally of a mature growth of native trees and plants, with a moderately dense canopy of 10-30 m high. There are no or only a few openings in the canopy, and understory vegetation varies from open to dense. Species of trees including *Ficus sp.*, *Intsia bijuga*, *Artocarpus micronesica* and *Elaeocarpus joga* are commonly found in this forest type. There are several distinct limestone forest types including *Artocarpus-Ficus*, *Mammea*, *Cordia*, *Merrilliodendron-Ficus*, and *Pandanus* (Donnegan et al. 2002).

Limestone forests are found on the northern limestone plateau and on large limestone outcroppings in southern Guam (Figure 5A). Donnegan et al. (2002) reported limestone and scrub forests comprise 34% of total forested areas on Guam. However, recent vegetation mapping indicated that only 13.06% was actually composed of limestone forests (Brown 2005). The structure of limestone forests is slowly changing due to the presence of Philippine deer (*Cervus mariannus*) and feral pigs (*Sus scrofra*) as they browse on seeds and seedlings retarding any regeneration of forest plants (Wiles et al. 1999). Typhoons, loss of pollinators, loss of habitat due to development, introduction of aggressive invasive plant species and plant diseases exacerbate this condition. The current status for limestone forests is slowly declining. Without intervention and restoration this habitat type will be altered so severely that it will not sustain reintroduction of SOGCN. This habitat is vital for almost all of Guam's native forest birds, snails, insects, lizards, and two fruit bat species.

*Scrub forest or Secondary growth forest.* Scrub forest is a degraded, yet diverse, brush-type forest, generally with an open canopy under 10 m high and a dense understory (Jenkins 1983, Engbring and Ramsey 1984). The distribution of scrub forests on Guam is illustrated in Figure 6A. The plant species are similar to those in more mature limestone forests but are at an earlier stage of development. In northern Guam, this habitat is dominated by *Vitex parviflora*, an introduced species from the Philippines. Other introduced species that may be found include *Leucaena*, *Casuarina*, *Morinda*, and *Triphasia*. However, within this forested area native plants can be found as understory cover including *Pipturus*, *Macaranga*, *Neisosperma*, *Pandanus*, *Cyanometra*, and other species.

Much of the Tarague Plateau and Northwest Field region in northern Guam is scrub forest. Donnegan et al. (2002) lumped scrub forest with limestone forest and reported

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34% of Guam's available habitat. Brown (2005) reported 22.62% of this habitat on Guam. Pure examples of these forest types tend to be rare and mixtures of primary and secondary species. Historically, these areas (Tarague and Northwest Field) were cleared for military purposes and repeated destructions by typhoons have played a major role in creating these forests.

The same factors impacting limestone forests are changing the structure of scrub forest (feral deer and pigs, invasive plant species, and typhoons). In the absence of deer, pigs, and invasive plants, scrub forest would regenerate into primary limestone forest habitat. Intervention is needed to ensure the continued existence of this habitat type.

*Open field or Large mowed area.* Open field composes about 1.36% of the available habitat on Guam and includes agriculture fields (ranches and cattle pasture) and other open areas including runways, communication stations, and parks (Engbring and Ramsey 1984). These habitats contain a variety of grass species including *Paspalum*, *Panicum*, *Chrysopogon*, and *Sorghum*. A typical scrub forest surrounds this habitat type in most places within the central portion of Northern Guam (Fosberg 1960). Open field habitats are the result of human disturbance. Open fields that are mowed and maintained provide important habitat for migratory birds including plovers, sandpipers, and others. Unfortunately, these habitats provide the ideal habitat for invasive weeds to take hold.

*Coconut grove.* Coconut grove consists of stands of abandoned coconut plantations (Engbring and Ramsey 1984). A typical forest consist of trees emerging 15-25 m high with the understory containing a variety of native and non-native shrubs and young coconut palms. Coconut grove (*Cocos nucifera*) is more common along sandy coastal areas such as Tarague, Tanguissan, Ritidian, Uruno and Pajon Basins, as seen in Figure 4A. Small patches of *Cocos* are found throughout the northern plateau, most cover less than 5 ha of area. These groves may be diverse with some native and introduced plant species below the canopy (Engbring and Ramsey 1984). Coconut groves make up about 0.76% of the available habitat on Guam (Brown 2005). Coconut palms are susceptible to termites, coconut rhinoceros beetles, and typhoons. The coconut palm was the second most abundant tree on island (second from the endemic cycad), yet, in recent years, many coconut palm trees and ornamental palms on Guam have been severely damaged and killed by CRB. There is no estimate for the proportion of palms killed but the island's palm being killed at an alarming rate (A. Moore, *pers. comm.*). In these habitats, the understory shows a tremendous amount of uprooting by feral pigs. A few native species of birds previously use this habitat including Guam Micronesian kingfishers, rails, and fantails.

*Broken forest or Mixed woodland.* Mixed woodland is habitat similar to the limestone and ravine forest but dissected by many small, open or scrubby fields (Engbring and Ramsey 1984). Broken forest contains both native and naturalized vegetation having much lower more open canopy unlike mature limestone forest containing *Neisosperma*, *Artocarpus*, *Pandanus*, and *Cocos* (Jenkins 1983). Like open fields, broken forest is a result to human disturbance occurring in northern and central Guam (Jenkins 1983, Enbring and Ramsey 1984). Though Donnegan et al. (2002) lumped broken forest with all forested lands reporting about 34%, an estimated 0.19% of land area is composed of this habitat type on



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Guam (Brown 2005). Currently this habitat is relatively poor due to ungulate damage and disturbance.

*Ravine forest* tends to follow topographic contours such as river valleys and depressions. Guam's ravine forests are highly degraded and contain many non-native species including betel-nut palm (*Areca cathecu*) and palma brava (*Heterospate elata*). Native species that can be found in these forests are *Ficus prolixa*, *Glochidion mariannensis*, *Hibiscus tiliaceus*, *Pandanus tectorius*, and *Premna serratifolia*.

This habitat type is found in southern Guam, which is more volcanic in origin (Figure 5B). Historically, ravine forest was more abundant. However, it has been reduced in quality and quantity by damage from deer, pigs, fire, and introduced plant species. There is little native ravine forest left and efforts to restore these areas are underway.

Efforts by the Department of Agriculture's Forestry and Soil Resources Division (FSRD) to improve much of the degraded habitat of southern Guam began in 1997. FSRD started out-plantings of *Acacia sp.* in the badlands, areas where much of the organic topsoil had washed away. In August 2005, FSRD began out-plantings of several native species to reclaim these areas. With the rehabilitation of the ravine forest habitat and control of invasive predators, management and recovery efforts for SOGCN listed species can proceed.

*Savanna or Grassland.* Savanna is a habitat type primarily found in Southern Guam (Figure 7A). The habitat is on volcanic soil and not usually flat (Fosberg 1960). Grasslands is comprised mostly with *Miscanthus* (swordgrass) and *Dimeria*, and scattered fire-susceptible *Casuarina* and fire-resistant *Pandanus*, which however is stunted and poor (Stone 1970). The savanna is often swept with uncontrolled, often deliberately started, grass fires. As a result, marginal trees are killed and swordgrass, and associated savanna species expand their total area (Stone 1970). This condition is further exacerbated by off-road vehicles that are driven in these areas eroding the bare soil especially when during the rainy season. Currently, savanna covers 21.02% of land area in the southern region encroaching surrounding forested areas. This habitat type is important as a foraging habitat for the Island swiftlet.

*Beach strand.* Beach strand is a habitat comprised with open sand beaches, barren coastal outcroppings, and coastal areas of sparse vegetation generally 2-3 meters or shorter in height (Engbring and Ramsey 1984). In most areas, open sand beaches are bordered with a mix of scrub and limestone forest. The dominant plant is *Pemphis*, a salt-tolerant species common on the pitted limestone of the windward coast. *Tournefortia* and *Casuarina* is two other salt-tolerant tree species found along beach strands. Currently this habitat type is relatively stable in most areas such as Cocos Island, Ritidian, Pati, Tarague and Pajon Basins, and Islets around southern Guam. Beach strand is important for nesting seabirds, reptiles (nesting for turtles and lizards), and invertebrate species.

*Strand forest.* Strand forest is part of a beach strand habitat but is considered more inland from the beach strand (Fosberg 1960). Strand forest has a mixture of trees at the top of the beach, and on the sand flats, immediately behind it there may be a forest of *Pisonia*,

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*Hernandia*, *Cordia*, *Barringtonia*, and *Casuarina* in most places (Stone 1970). Strand forest is found along Northern Guam coastline and parts of Southern Guam, where *Leucaena* is dominant. This habitat is relatively poor due to man and feral ungulate disturbance and is susceptible to typhoon damage and infestation. Strand forest covers 3.47% of land area.

*Shoreline*. Shoreline habitat tends to follow the coast surrounding Guam, Cocos Island and other islets. This habitat type is mostly bare sand with limestone outcroppings and coral fragments comprised of *Ipomoea* and two grass species, *Sporobolus* and *Thuarea* (Fosberg 1960). Shoreline covers 0.08% of area on Guam and is important to reef herons, sea turtles as a nesting ground, and migratory birds.

*Limestone Caves*. Limestone caves (Karst caves) are formed from natural solution of limestone rock by water (Taborosi 2004). These caves are found both in the north and in a few areas of the south where limestone rock areas are found (USFWS 1991a). Caves provide important roost sites to Sheath-tailed bats and Island swiftlets. These roost caves are vulnerable to disturbance and invasive species.

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Table 2. Terrestrial habitats on Guam their relative condition, percent cover and current needs.

Habitat	Location	Percent Area of Guam	Relative Condition	Threats	Current Needs	Conservation Actions
Limestone Forest	Mostly Northern some Southern	13.06	Decreasing	Ungulates Typhoons Loss of pollinators Development Invasive plant species Plant diseases	Control feral pig and deer  Remove and prevent invasive species  Native tree reforestation  Public Awareness	Research practicable and effective methods of controlling ungulates    Research practicable and cost-effective methods of eradicating invasive plants.
Scrub forest	Northern-Southern	22.62	Increasing	Ungulates Typhoons Loss of pollinators Development Invasive plant species Plant diseases	Control feral pig and deer  Remove and prevent invasive species  Reforestation  Public Awareness	Examine status of pollinators in these habitats to determine what plant species are being pollinated   Explore effective methods of removing noxious plants and replace with native plant species
Open field	Northern-Central	1.36	Increasing	Invasive plant species	Remove and prevent invasive species  Continue mowing and lot maintenance  Control feral pig and deer	Research practicable and cost-effective methods of eradicating invasive plants and ungulates
Coconut grove	Northern	0.76	Decreasing	Termites Coconut rhinoceros beetle infestation	Implement feral pig control,  Remove and prevent invasive species	Research practicable method to eradicate/control CRB

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Habitat	Location	Percent Area of Guam	Relative Condition	Threats	Current Needs	Conservation Actions
				Typhoons Human disturbance  Feral pigs  Plant diseases	Outplanting of native trees  Public Awareness	Research practicable and effective methods of controlling ungulates  Share studies and findings with public
Broken forest	Northern/Southern Guam	0.19	Stable	Ungulate damage  Human disturbance	Implement ungulate control, Outplanting with native trees Native tree reforestation	Collaborate with Forestry Division and other partners to encourage native reforestation efforts in this habitat type.
Ravine forest	Southern Guam	8.3	Decreasing	Ungulate damage  Fire  Lack of organic topsoil  Erosion	Control/Prevent grassland fires  Implement feral ungulate and invasive species control  Native tree reforestation  Outplanting  Promote soil nutrient enrichment	Investigate feasible methods to remove noxious plants such as bamboo and reforest with native trees  Determine ungulate population in ravine forest to investigate adaptive management actions to restore habitat  Investigate soil nutrient quality
Grassland	Mostly Southern Guam	21.02	Increasing	Lack of marginal trees  Grassland fires  Ungulate damage  Human disturbance	Control/Prevent grassland fires  Prevent off-road vehicle impacts  Improve public awareness	Employ soil erosion tools at highly susceptible grasslands to minimize loss of habitat  Collaborate with FSRD and other

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Habitat	Location	Percent Area of Guam	Relative Condition	Threats	Current Needs	Conservation Actions
				Erosion Invasive plant species	Monitor development and clearing,  Bio-control for invasive plant species  Native tree reforestation	partners and participate with the Don't Burn Guam campaign  Investigate impact of recreational users and design Plan to manage grasslands
Beach strand	Northern/Southern	0.08	Stable	Human disturbance  Ungulate damage  Invasive plant species  Marine debris	Implement erosion control  Implement invasive species control  Implement coastal management plans	Coordinate monthly beach cleanups to remove marine debris and implement and enforce illegal bonfire regulations  Employ soil erosion tools at highly susceptible shorelines to minimize loss of habitat
Strand forest	Northern/Southern	3.47	Unknown	Ungulate damage  Human disturbance  Typhoons  Invasive species infestation	Control feral pig and deer  Remove and prevent invasive species  Prevent further loss	Investigate feasible methods to remove and control <i>Leucaena</i> growth at these habitats  Reduce ungulate populations in these habitats for native tree outplanting to occur
Shoreline	Cocos Island, other islets,	0.08	Stable	Sea level rise Human disturbance Marine debris	Monitor erosion  Implement invasive species control  Implement	Monitor changing sea levels due to climate change.

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Habitat	Location	Percent Area of Guam	Relative Condition	Threats	Current Needs	Conservation Actions
					coastal management plans	
Caves	Northern/Southern Guam	<.05	Stable	Human disturbance Ungulate damage Invasive species infestation Development	Prevent filling of caves Prevent human disturbance Invasive species control Reforest surrounding area with native trees	Explore cave ownership with DLM and DPR via MOA  Investigate status of cave habitats, and probability to restore caves for swiftlet translocation in northern Guam.

Freshwater Habitats

Guam has considerably more wetlands (Figure 7B) and a wider variety of types than any of the other Mariana Islands. All of its rivers and nearly all wetlands occur in the southern and central parts of the island, where clay or argillaceous limestone soils retard water percolation and permit surface waters to accumulate. Many interior wetlands are located along the upper drainages of rivers and smaller tributaries. In contrast, the northern limestone plateau allows rapid water seepage, and consequently only a few marshy areas and ephemeral streams exist in the vicinity of Mt. Santa Rosa. Four basic categories of wetlands are described below, with larger sites often having more than one type and their relative condition summarized in Table 6.

*Freshwater swamps.* Freshwater swamps of woody vegetation are the largest category of wetland and may be found on the edges of marshes, along river courses, and in wet depressions in forests. *H. tiliaceus* is usually the major species involved, although the largest tract of swamp forest on the island, the Talofofu River Valley, is dominated by *Barringtonia racemosa* (Fosberg 1960). Other trees that may be present are *P. tectorius*, *Cynometra ramiflora* and *A. catechu*.

*Freshwater marshes.* Natural freshwater marshes are also common, with individual sites varying in size from the Agana Swamp (approximately 0.96 km<sup>2</sup> or 237 acres of marshland) to many that are smaller than 0.5 ha (1.2 acres). Most are dominated by dense, nearly pure stands of *Phragmites karka* that are 2-5 m tall (Fosberg 1960). Other grasses (e.g. *Panicum muticum*), sedges (e.g. *Eleocharis ochrostachys* and *Cyperus* spp.) and the fern *Acrostichum aureum* are often present but usually less prevalent. Two other natural wetlands are important to the Mariana common moorhen (*Gallinula chloropus guami*) include the Atantano, and Namo wetlands (Takano 2003, Ritter and Savidge 1999).

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*Reservoirs.* Man-made freshwater wetlands were originally constructed as water impoundments for humans, cattle and crop irrigation, and are found widely through southern Guam. Many are no longer used but they continue to collect water and maintain aquatic ecosystems. The largest is Fena Lake (0.81 km<sup>2</sup> or 200 acres), which still functions as an important reservoir for drinking water. Other sites are much smaller and tend to have deeper, more open water than natural marshes. These may include ponds dug for aquaculture purposes. Vegetation is variable, but *Phragmites* and *Hibiscus* are usually minor components. A number of these sites are crucial to the preservation of the Mariana common moorhen (Stinson et al. 1991) and are very important to migratory species.

The Masso Reservoir is a 9105 m<sup>2</sup> (2.25 acre) man-made reservoir located in Piti. GDAWR started work in 2005 to restore the reservoir to a state suitable for public fishing, and also enhance it as habitat for the endangered Mariana common moorhen. The Navy constructed the reservoir just after World War II to act as a source for drinking water. Due to chronic sedimentation problems, the project was abandoned in 1951. The Navy retained ownership of the land containing the reservoir until 2000, when it was returned to the Government of Guam. Ownership of the reservoir was transferred from the Ancestral Lands Commission to the Department of Agriculture through Executive Order (E.O. 2006-14). GDAWR has again received funding to rehabilitate the Masso Reservoir in Piti. Work on the site included dredging the reservoir to its original depth, installation of both a fishing platform and educational signage and out-planting of native and *Acacia* trees.

### Mangrove Areas (Brackish/Estuarine)

Estuarine wetlands occur in areas of tidal intrusion or brackish water and consist primarily of mangroves and the lower channels of rivers. These habitats are facilitated by a daily tidal variation of about 75-90 cm. The largest concentrations of mangroves exist along the eastern shores of Apra Harbor, with smaller zones present in Merizo and Inarajan. Although they only total about 0.02 km<sup>2</sup> (5.56 acres), Guam's mangroves are the most extensive and diverse in the Mariana Islands. Species include *Rhizophora mucronata*, *R. apiculata*, *Bruguiera gymnorrhiza*, *Avicennia marina*, *Lumnitzera littorea*, *N. fruticans*, *Xylocarpus moluccensis*, *Heritiera littoralis*, *H. tiliaceus* and *Acrostichum aureum* (Fosberg 1960, Moore et al. 1977). Nine of the island's 46 rivers that empty into the ocean have true estuarine zones. The lower channels of these rivers, which are typically only 5-20 m wide and 1-4 m deep, have elevated salinity levels that extend 0.5-1.6 km upstream (Wilder 1976). *N. fruticans* is a common indicator plant of river zones with brackish water regimes. Marshes of bulrushes (*Scirpus littoralis*) are a third estuarine community and are found at several locations in Apra Harbor. The largest area is the artificial San Luis Ponds. This habitat type is important for many species of migratory shorebirds, native aquatic and terrestrial invertebrates, and aquatic vertebrates.

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### Rivers

The island has 100 rivers and streams, ranging in length from less than 1 km to more than 5 km, all located in the volcanic southern half of the island (Best and Davidson 1981). In southern Guam, a mountain ridge running along the western coast creates small, steep watersheds to the west and broader floodplains draining into longer, larger rivers to the east. Of Guam's 100 named rivers and streams, forty-six drain into the ocean. The largest of these, the Talofof, drains an area of approximately 72.83 km<sup>2</sup> (Best and Davidson 1981).

Tables 3-5 show data for some of the representative rivers of Guam. Note the greater lengths and watersheds for rivers draining to the east coast.

Table 3. West coast rivers.

River	River length	Area drained *	Max flow *	Min flow*	Average flow *
Aplacho	2.805 kilometers	1.3 km <sup>2</sup>	1690 ft <sup>3</sup> /sec	.12 ft <sup>3</sup> /sec	NA
La Sa Fua	4.633 kilometers	2.75 km <sup>2</sup>	1440 ft <sup>3</sup> /sec	.12 ft <sup>3</sup> /sec	4.39 ft <sup>3</sup> /sec
Umatac	2.987 kilometers	5.46 km <sup>2</sup>	7460 ft <sup>3</sup> /sec	.10 ft <sup>3</sup> /sec	8.59 ft <sup>3</sup> /sec

Table 4. Central rivers (draining into Fena Lake).

River	River length	Area drained*	Max flow*	Min flow*	Average flow*
Imong	2.088 kilometers	5.05 km <sup>2</sup>	6100 ft <sup>3</sup> /sec	.36 ft <sup>3</sup> /sec	9.52 ft <sup>3</sup> /sec
Almagosa	2.195 kilometers	3.42km <sup>2</sup>	2650 ft <sup>3</sup> /sec	.05 ft <sup>3</sup> /sec	5.98 ft <sup>3</sup> /sec
Maulap	2.438 kilometers	2.98km <sup>2</sup>	2420 ft <sup>3</sup> /sec	.31 ft <sup>3</sup> /sec	5.02 ft <sup>3</sup> /sec

Table 5. East coast rivers.

River	River length	Area drained*	Max flow*	Min flow*	Average flow*
Ugum	11.460 kilometers	14.92km <sup>2</sup>	14,700 ft <sup>3</sup> /sec	2.7 ft <sup>3</sup> /sec	24.2 ft <sup>3</sup> /sec
Ylig	11.994 kilometers	16.78km <sup>2</sup>	4900 ft <sup>3</sup> /sec	.07 ft <sup>3</sup> /sec	27.2 ft <sup>3</sup> /sec
Pago	10.060 kilometers	14.69km <sup>2</sup>	17,300 ft <sup>3</sup> /sec	No flow	26.1 ft <sup>3</sup> /sec

\* USGS Pacific Islands Water Center Web Site



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Forty-six of Guam's rivers drain to the ocean. Nine of these forty-six rivers have true estuarine zones. Fish fauna of this section includes few native freshwater species, but many marine species including snappers, jacks, halfbeaks, and mullets. These reaches are characterized by soft, muddy or silt-laden substrates, slow moving, relatively, deep water. The terrain in this region is flat. The dominant vegetation along this stretch of a river includes mangroves, *Nypa*, and *Hibiscus*.

Upstream of saltwater influence, most marine species drop out, and *Kuhlia* becomes the dominant predator. Most of the native gobies and invertebrates appear in this region. Usually, the substrate in this area of rivers is sandy, or a mixture of sand and cobble, with areas of base-rock or clay. Channel width is generally narrower than the estuarine region. The slope of the terrain is gentle and water velocity is generally slow. Dominant vegetation in this region includes bamboo and *Hibiscus*.

Above the first waterfall on a river, the most common habitat found is riffles and plunge pools. This is an area characterized by small runs separated by small waterfalls and pools. In the dry season, water flow may stop in this region, and the pools become separated from each other. The substrate in these habitats is usually pavement or larger rocks. *Kuhlia* and *Stenogobius* are unable to get past a waterfall and are not found upstream of the first major falls (>3 meters). Gobies and *Macrobrachium* shrimp are more common here, and *Anguilla* eels become the dominant predator. Water in this region is shallow (< 1 foot or 30.54 cm), except in the pools. This area generally has fast-flowing water, and a relatively steep elevation drop. Dominant vegetation in this region might include ferns, *Hibiscus*, and *Pandanus*.

Table 6. Freshwater habitats on Guam.

Habitat Type	Location	Percent of area	Relative Condition	Needs	Conservation Actions
Freshwater swamps	Edges of marshes, along river courses, wet depressions in forests	0.06%	Unknown	Implement current management plans/laws Control invasive species vegetation and animals	Revisit localized regulations that provide protection of these habitats to strengthen laws and enforcement Investigate noxious plants and animals in the habitat to develop and implement adaptive management actions
Freshwater marshes	Found in Central to southern Guam	0.29%	Stable	Implement current management plans/laws Control invasive species vegetation Control brown treesnake (BTS)	Investigate feasible methods to minimize ungulate damage. Employ BTS and feral cat control mechanisms to protect nesting moorhens
Reservoirs	Widely through southern Guam	0.01%	Unknown Stable	Implement current management plans/laws Control invasive species	Inventory invasive species found in reservoirs and employ feasible methods to remove invasive species
Mangrove	Southern Guam	0.14%	Stable, expected to decrease due to climate change	Implement current management plans/laws Control invasive species vegetation Prevent further loss	Obtain baseline database for mangrove habitat for adaptive management. Investigate feasible methods to remove invasive species in mangrove areas.
Rivers	Southern Guam	0.13%	Unknown	Implement current management plans/laws Reduce sedimentation Control invasive species	Assess current condition of rivers Obtain baseline database needed for adaptive management

Marine Habitats

Guam’s marine habitats are extremely complex and can be described in a number of ways. They can be classified by the type of cover (e.g. coral, seagrass, unconsolidated sediment, macroalgae) or by zone (e.g. reef flat, fore reef slope). The combination of these two classifications leads to a large number of specialized habitats, so this document will primarily refer to reef zones, and describe some of the more important types of cover found in each of these zones (see Table 7).

On Guam, reef flats are relatively flat platforms extending from a few meters to over a kilometer from the shoreline to the wave-washed reef margin. The seaward portion

usually slightly elevated and often exposed at low tide, is known as the outer reef flat. The inner reef flat is adjacent to the shore, usually retains water during low tide, and is often referred to as the “moat”. Intertidal fringing reef flats have no significant moat development and are generally fully exposed during low tides. These reef flats are common along the southern coasts. In addition, some reef flats, such as the Achang reef flat, have middle reef flat moat development. In these areas, the inner and outer reef flats are exposed during low tide, but the middle reef flat retains water. The reef flat zone may have a range of cover types including pavement, seagrass beds, staghorn coral (*Acropora*) thickets, *Porites* microatolls, sand/rubble fields, and macroalgae. Although all of these habitats are utilized by reef fish species, the seagrass beds and staghorn coral thickets are perhaps the most important reef flat habitats for juvenile reef fish considered species of concern.

Sea grass beds cover approximately 3.7 km<sup>2</sup> (917 acres) of reef flats in numerous coastal bays around Guam (NOAA 2005). Guam’s sea grass beds are composed of three species: *Halodule uninervis*, *Enhalus acoroides*, and *Halophila minor* (Lobban and Tsuda 2003). These sea grass beds range in size from small beds a few meters in diameter to continuous beds nearly one km<sup>2</sup> in size. The largest of these sea grass beds are found along the reef flats in the southern part of the island including Cocos Lagoon and within the Achang Reef Flat Preserve. These sea grass beds are used as foraging grounds by green sea turtles (*Chelonia mydas*). Other substantial sea grass resources are located in East Agana Bay, Pago Bay, Piti Bomb Holes Marine Preserve, and Agat areas. These sea grass beds are important nursery areas for a number of reef fish species including emperors (*Lethrinidae*), wrasses (*Labridae*), and goatfish (*Mullidae*). Sea grass resources in Guam are threatened by land-based sources of pollution and recreational misuse and overuse including personal watercraft and trampling by divers.

Lagoon zones are areas enclosed by the low tide line of the inner edge of barrier reef flat. Guam has two areas that can be considered true lagoon zones: Apra Harbor and Cocos Lagoon in Merizo. The depth in these areas ranges from less than one meter to over 30 m. Apra Harbor has sandy and muddy bottom in between scattered patch reefs and shoals. These patch reefs and shoals boast some of the highest coral cover in Guam with many areas exceeding 100% coral cover. They also support diverse macroalgae and sponge communities. Cocos Lagoon is generally shallower than Apra Harbor and has a predominantly sand bottom with numerous small patch reefs scattered. This sheltered area has delicate staghorn coral communities that provide safe refuge for Convention of International Trade of Endangered Species (CITES) listed juvenile humphead wrasse (*Cheilinus undulatus*) and other reef fish species of concern. The lagoon is also home to soft coral stands that provide unique habitat found in few locations in Guam’s waters. These lagoons are utilized by a wide variety of reef fish species as well as both green (*C. mydas*) and hawksbill (*Eretmochelys imbricata*) sea turtles.

Channels connect lagoons or reef flats to the outer reef slope. Some examples of this type of reef zone are the Manell and Mamaon Channels in Merizo leading into Cocos Lagoon. Many smaller channels are found leading from reef flat areas to the outer reef slope. These are strongly influenced by tidal currents and host a wide variety of plankton-

feeding animals. Depending on the strength of the currents, channels may have a barren floor of shifting rubble or may be thickly covered in hard and soft corals. Based on data from the region, these areas are likely key spawning aggregation sites for a number of reef fish species. Manell Channel in Merizo is an important congregating site for green sea turtles (*C. mydas*) and channels in Tumon and East Hagatña are known congregating sites for manta rays (*Manta birostris*) and other filter feeders.

The area extending from the seaward edge of reef flat to the submarine terrace is known as the reef front or fore reef slope. The coral communities and the structure of the substrate in this zone are directly related to the level of wave action and frequency of wave assault. Reef front zones that are protected from strong wave action are often characterized by a gentle slope covered with large stands of branching or tabular corals. As wave energy and exposure increase, the corals in these areas tend to become smaller and more compact. Areas with severe wave action tend to be dominated by lower, stout branched corals. Channels in these areas may be strewn with boulders. Some of these areas have spur and groove formations characterized by alternating ridges and vertical sided channels.

Seaward of the reef front is the submarine terrace where the reef front flattens out. The channels become shallower with sand rather than rubble floor. In areas with constant surge, the corals are low profile encrusting, stocky, or massive coral species. In sheltered areas, large branching and tabular corals are common. These terraces are frequented by schools of surgeonfish and parrotfish.

The outer reef slope slopes down from the submarine terrace and into deep water. They are usually steep (greater than 30°) with moderate to high coral cover. Coral cover and species composition are strongly influenced by the slope's exposure to storm swells and presence of tidal currents. In general, coral cover and diversity remain high to depths of 40-60 m, with plate forms dominating the slope down to as deep as 112 m. Below this level gorgonians and soft corals dominate the slope.

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Table 7. Summary of the status of marine habitats on Guam.

Marine Habitats	Location	Total Area	Relative Condition	Needs	Conservation Actions
Reef Flats	All around Guam, most extensive on the western and southern shores  Largest beds are along the southwest and southern coasts	5260 acres	Stable to threatened	Continue Guam Coral Reef LAS Continue management of Marine Preserves Reduce land-based sources of pollution, Improve fisheries management, Address recreational misuse and climate change	Gather and combine database from research partners to make a comprehensive database on reef flats studies and monitoring. Establish a monthly beach clean-up volunteer program to remove plastics and other harmful substances found near reefs Implement and enforce laws protecting reef flats and sea grass beds addressing recreational impacts
Sea Grass	Largest beds are along the southwest and southern coasts 5260 acres	917 acres			
Reef Front	All around Guam, most extensive on the western and southern coasts	15,125 acres	Stable	Continue Guam Coral Reef LAS Continue management of Marine Preserves Reduce land-based sources of pollution, Improve fisheries management Address recreational misuse and climate change Maintain Marine Preserves	Investigate status of Marine Preserves Establish a monthly beach clean-up volunteer program to remove plastics and other harmful substances found near reefs Implement and enforce laws protecting reef flats and sea grass beds addressing recreational impacts
Lagoon	Primarily Apra Harbor / Cocos Lagoon	1,721 acres	Stable	Continue Guam Coral Reef LAS Continue Marine Preserves Reduce land-based sources of pollution Improve fisheries management, address recreational misuse and climate change Maintain Marine Preserves	Establish a monthly beach clean-up volunteer program to remove plastics and other harmful substances found near reefs Implement and enforce laws protecting reef flats and sea grass beds addressing recreational impacts

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<b>Marine Habitats</b>	<b>Location</b>	<b>Total Area</b>	<b>Relative Condition</b>	<b>Needs</b>	<b>Conservation Actions</b>
Channel	All coastal areas.	280 acres	Stable	Continue Guam Coral Reef LAS Continue management of Marine Preserves Reduce land-based sources of pollution Improve fisheries management Address recreational misuse and Climate change Maintain Marine Preserves	Investigate impacts of vessels on channels  Reduce or remove marine debris in channels  Effectively monitor impacts of human misuse
Submarine Terrace	Surrounding island	Unknown	Unknown	Assess current status  Reduce land-based sources of pollution,  Improve fisheries management  Address recreational misuse and climate change	Investigate impacts of vessels  Reduce or remove marine debris  Effectively monitor impacts of human misuse
Outer reef Slope	Surrounding island	Unknown	Unknown	Assess current status Reduce land-based sources of pollution Improve fisheries management, Address recreational misuse and climate change	Investigate impacts of vessels  Reduce or remove marine debris  Effectively monitor impacts of human misuse  Investigate incidence of coral bleaching and COTS outbreaks

### Terrestrial Conservation Areas

The Government of Guam has recognized the need to protect and preserve the natural resources of the island. In 1956, the Department, in cooperation with other government agencies, was given the authority to control and manage land and water areas set aside as conservation areas (PL 3-103). In 1982, PL 16-62 reestablished the authority of the Department over Conservation Reserves having joint jurisdiction with the Department of Parks and Recreation. The development of a Master Plan for Park and Conservation Land (DOA and DPR 1999) was completed and followed the criteria that these lands had no claims, ownership, or interest attached to it.

Approximately 20% of Guam has been designated as local or federal conservation lands (Figure 8). The Government of Guam has identified four areas for conservation: Anao, Bolanos, Masso, and Cotal Conservation areas. An additional 20 areas, totaling approximately 4.40 km<sup>2</sup> or 1087 acres (Draft Master Plan for Park and Conservation Land 1999), were proposed to be included as conservation lands. Though this plan was never formally adopted, the proposed areas contain habitat that are vital to restoration efforts proposed in the GWAP. Ratification of this plan would be beneficial to all species listed in Guam's SOGCN.

The Government of Guam owns the Anao, Bolanos, and Cotal Conservation Areas. The land area covered by the three areas is 16.5 km<sup>2</sup> (4077 acres). Masso River Reservoir Area was also deeded to the Government of Guam in 2006 under an agreement with the Department of the Navy and Department of the Interior for conservation, protection, development, and management of fish and wildlife recreation resources. These areas vary in habitat types and provide unique opportunities for restoration of SOGCN. Historic documents at Department of Land Management identified a fifth Government of Guam Conservation land in Yigo Guam known as the Y-Piga Conservation area. However, Y-Piga will not be included into the GWAP until legal documents are obtained supporting the area is actually a conservation land.

The Anao Conservation Area encompasses an area of 3.1 km<sup>2</sup> (764 acres) and is located in northeastern Guam. This conservation area contains several habitat types to include limestone forest (78.6%), scrub forest (14.7%), strand vegetation (3.9%), barren (0.4%), urban buildup (0.4%), urban cultivated (0.9%), and unknown (1.1%), (Figure 9).

Limestone forests dominate the upper plateau and windblown vegetation along the coastal cliffs. There is a contiguous band of limestone forest that runs north to Pati Point and west to Ritidian Point (part of the GNWR Overlay). Fruit bats likely use the area to forage due to the abundance of native limestone forest species. Access to the area is via a single dirt road to a footpath that leads down the cliff to the coast. No developed recreational facilities are present, but hikers, hunters, and anglers utilize the area and an "educational trail" was established along the footpath.

Scrub forest is located along the northwestern perimeter of Anao. With ungulate control and out-planting by FSRD, partners and stakeholders, limestone forest can be restored

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making it favorable for reintroducing native species. The Brown tree snake is also necessary and vital to recovery in the area.

Another habitat type located within the Anao Conservation area is strand vegetation. This habitat is located in the areas below the cliffline along the eastern edge bordering the Pacific Ocean. Control of predators and invasive plant species will ensure this area is maintained for listed SOGCN.

The Bolanos Conservation area, 11.6 km<sup>2</sup> (2,854 acres) (Figure 10), is managed by GDAWR for hunting and outdoor recreation. The area is composed of savanna complex (*Miscanthus floridulus* and other grassland species) (47.1%), scrub forest (0.2%), ravine forest (50.2%), badlands (2.5%), barren areas (0.06%), and urban buildup (<0.01%). Historically, the area was predominantly ravine forest with very little savanna complex. However, humans and ungulates have changed the landscape through agricultural burning and browsing. Today, Bolanos is nearly an even mix of savanna complex and ravine forest. The range of ravine forest is reduced in each successive dry season.

Bolanos Conservation Area is difficult to access and is limited to hikers and hunters. The mosaic of fire-dominated vegetation such as *M. floridulus* makes this area and its limited access a challenge for natural resource managers. The restoration of native fauna to Bolanos would require reducing savanna complex and rehabilitation to ravine forest. However, portions of Bolanos that still harbor native vegetation should be receptive to native fauna should sufficient habitat exist to support such reintroductions. All efforts to rehabilitate Bolanos would involve ungulate and brown tree snake control.

The 2.7 km<sup>2</sup> (662 acres) of the Cotal Conservation Area is predominately covered by savanna complex (73.8%) with scrub forest (24.7%) and urban buildup (1.2%) being the next most abundant habitat types (Figure 11). Barren and badland habitats are less than one percent of the total area. Efforts to improve the habitat have been met by repeated arson. A stream is present in the area and provides for indigenous freshwater fauna and reef protection. At present, this area provides little forest values and is not connected to the southern Refuge Overlay. This area is accessible by the public. Reforestation efforts combined with public education activities may be implemented in this area in order to restore SOGCN. The Department's FSRD has begun efforts to restore native species to this area that would make this area available to release efforts of native species of birds and other animals in the future. However, the prevalence of grassland fires in this area makes reforestation challenging.

Masso River Reservoir Area is located on 29.5 acres of land known as Apra Parcel #2 in the village of Piti, Guam. The reservoir has 9105 m<sup>2</sup> (2.25 acre) of open water surrounded by phragmitis in the shallow edges with reforested uplands. Sixteen acres of land above the Masso Reservoir were planted with approximately 13,000 trees, both to reduce sedimentation and to restore habitat to the watershed above the reservoir from 2008-2014. Initially, 9500 nitrogen fixing Acacia trees were planted during 2008-2011 to enrich the soil and stabilize bare patches of ground. After the Acacias became established, 3500 native trees were planted to continue to control sedimentation and



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improve the habitat for native animals. Some of the native trees planted in the Masso watershed are locally rare, including Ifit (*Intsia bijuga*). The tree plantings were accomplished by hundreds of members of the community including civic groups, school groups, university biology classes, scout troops, and Government of Guam staff. The site is used for kids fishing derbies, nature walks, bird watching, and at least one master's thesis comparing sedimentation in the Masso watershed with a nearby watershed. Additionally, five Eagle Scout projects, involving accessibility improvements to hiking trails and ramps to the fishing platform have been completed within the past two years, with two more projects pending. The upland restoration work in the Masso watershed has reduced sediment deposition into the reservoir and the 336-hectare Piti Bomb holes MPA that is host to uncommon marine organisms and locally listed and federal candidate species. Masso River Reservoir is important habitat for migratory and endangered aquatic birds, such as the Mariana moorhen (*Gallinula chloropus guami*).

In addition to locally managed conservation lands, the federal government has identified conservation areas on Guam (Figure 8). On June 14, 1991, the USFWS published its intent to establish a wildlife refuge overlay (Federal Register Vol. 56, No. 115, pp. 27485-27493). The Guam National Wildlife Refuge (GNWR) Overlay was established in December 1993 creating the 97.1 km<sup>2</sup> (24,000-acre) GNWR Overlay. The Memorandum of Understanding (MOU) between the USFWS, the U. S. Navy (USN), and the U. S. Air Force (USAF) established the overlay units of the GNWR. The goal of this MOU was to develop cooperative agreements for the management of Guam's natural resources on federal and conservation lands. The USAF entered into a Cooperative Agreement with the USFWS with purpose of establishing the overlay units on lands administered by the USAF on Guam, to define the management administrative roles, and responsibilities of the USAF for the GNWR. These federal agencies, among others, are valuable partners in the implementation of Guam's WAP.

Cocos Island (CI) is a 33.6-ha, atoll like island located 2.5 km southwest of Guam (Figure 8). The island is 1.93 km long and 0.15 km wide. The northeastern 24.8-ha of the island (approximately two-thirds) is privately owned and managed by Cocos Island Resort (CIR). The remaining 8.8-ha area is a park managed by Guam Department of Parks and Recreation (DPR). The habitat on the island can be grouped into beach strand, strand forest, and shoreline.

In September 2008, GDAWR, DPR, USFWS, and CIR signed a Safe Harbor Agreement (SHA) under Section 10(a)(1)(A) of the Endangered Species Act that formalized the commitment of the parties to enhance the habitat on CI in support of the establishment of endangered Guam rails (*Gallirallus owstonii*). The SHA is a voluntary agreement for the landowner to maintain, create, restore, or improve habitat for endangered or threatened species. In return, the landowner will not be subject to future land use restrictions or liabilities due to incidental take of endangered species on the property. In this particular case, the GDAWR was responsible for the management actions to establish a breeding population of rails on CI. Cocos Island Resort provided shuttle services for management-related activities and continues to operate the day resort.

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Prior to release of captive-bred Guam rails the rodents were eradicated from CI, and predatory monitor lizards were reduced to give the newly released birds the best chance for survival. A Biosecurity Plan was developed and implemented for the prevention and early detection of incursions of brown tree snakes (BTS) and rodents onto CI. Guam Forest and Soil Resources planted native trees and provided maintenance of invasive vines to enhance the forest on CI for the benefit of native species.

On November 16, 2010, 16 captive-bred Guam rails were released on the government side of the island. The released birds were radioed and monitored daily for six weeks and then at least five times per week for the following months until the transmitters failed. Within 4 months, the first nest was located. In August 2012 another release of ten birds occurred. Subsequent monitoring of both releases and nest reports have resulted in a total of 29 nests, 56 eggs, and 23 chicks observed. Initially, rails had maintained territories near the release site in the government park, however monitoring and sightings of unbanned birds now shows rails spreading to all parts of the island.

Cocos Island (CI) is a demonstration of Guam's conservation issues and how GDAWR can collaborate with landowners to manage natural resources to benefit species of greatest conservation need. Guam rails, Micronesian starlings, native skinks and geckos, and nesting sea birds, all species no longer found on Guam due to the BTS, are breeding successfully on Cocos Island.

Not only is CI an important terrestrial conservation area, it is an important nesting area for Green sea turtles (*Chelonia mydas*). GDAWR has documented sea turtle nesting on the island starting in 1983 up to the present. Green sea turtles continue to come back to the island year after year to nest. Maintaining and monitoring the shoreline and beach strand habitat is important to ensure the development and growth of Guam's Green sea turtle nesting population.

The GNWR Overlay includes a variety of habitat types within its boundaries. The habitats include limestone forest, scrub forest, savanna complex, ravine forest, strand vegetation, and Casuarina thicket. Like the conservation areas that belong to the Government of Guam, the habitat contained within the GNWR is degraded. The overabundance of feral ungulates and other factors continue to degrade these habitats. Guam DAWR will work with GWNR management, AAFB, and COMNAVMAR to improve the habitat for the benefit of Guam's SOGCN.

### **Marine Preserves**

Over 10% of Guam's coastline has been set aside in five marine preserves: Tumon Bay, Piti Bomb Holes, Sasa Bay, Achang Reef Flat, and Pati Point (Figure 8). The preserves were established in 1997 in response to decreasing reef fish stocks but were not fully enforced until 2001. Fishing activity is restricted in the preserves with limited cultural take permitted in three of the five areas.

The largest of the preserves, Pati Point Marine Preserve, contains 20 km<sup>2</sup> or approximately 4900 acres reef environment (Figures 12 and 13). The area was originally

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designated as a marine preserve and managed area by the Air Force in 1973 (Stevens 1973). The preserve includes narrow reef flats edged by steep fore reef slopes that are populated by a wide variety of coral species. The beaches within this preserve are important green sea turtle (*C. mydas*) nesting areas. Limited access to the preserve provides some level of protection; however, enforcement of regulations becomes increasingly difficult. Under the territorial marine preserve designation, only hook and line fishing from shore is allowed for all species of fish.

The Tumon Bay Marine Preserve lies adjacent to the central tourist district on Guam. This 4.5 km<sup>2</sup> (1117 acre) preserve features a broad reef flat (2.7 km<sup>2</sup>, 665 acres) and gently sloping fore reef slope (0.7 km<sup>2</sup>, 166 acres), and broad bank/shelf habitat (1.42 km<sup>2</sup>, 351 acres less than 100 feet deep). This preserve (Figure 14) contains almost one km<sup>2</sup> (253 acres) dominated by coral. On the fore reef slope, the dominant species is plate-and-pillar coral (*Porites (synarea) rus*), complemented by a wide variety of other species. The reef flat contains large stag horn (*Acropora*), lobe (*Porites*), and lettuce (*Pavona*) coral stands. These coral stands provide rich habitat for a variety of fish species including the CITES listed Humphead wrasse (*C. undulatus*) and many other species of reef fish. Extensive sand patches that harbor sea cucumbers and a variety of scavengers complement this coral-dominated area. Limited traditional fishing with hook and line or talaya (cast net) from shore is allowed in this preserve for four types of fish: *kichu* (convict tangs, *Acanthurus triostegus*), *manahac or sesjun* (rabbitfish, *Siganus sp.*), *I'e* (juvenile jacks and trevallies, *Caranx sp.*), and *ti'ao* (juvenile goatfish, *Mullidae species*). Talaya may be used for *kichu and manahac or sesjun*, along the reef margin.

Piti Bomb Hole Preserve (3.6 km<sup>2</sup> or 896 acres) stretches from Asan Point to the outlet channel from the Cabras power plant (Figure 15). The broad reef flat (1.4 km<sup>2</sup>, 349 acres) in Piti Bay extends from 72 m near the mouth of Tepungan Channel to 978m east of Asan Point (Randall and Eldredge 1976). The reef flat includes unique solution features known as the “bomb holes” that provide sheltered areas of deeper water. The deepest of these sinkholes are 30-32 feet at mean lower low water (MLLW) (Tsuda and Donaldson 2004). These sinkholes are densely populated by a variety of hard and soft coral species. They host rich soft coral communities and fish and invertebrate assemblages not often found within the reef margin. In addition, Piti Bay’s fore reef slope has unique rubble-pile habitats utilized by a number of unusual/rare species of echinoderms and mollusks (Paulay 1994). These features are not known from any other area of Guam. The western end of the preserve is transected by Tepungun Channel. Dolphins, large rays, and bumphead parrotfish (*Bolbometopon muricatum*) frequent this preserve. Since 1996, the main sinkhole has been occupied by the Fish Eye Marine Park, an 11 m (36 ft.) diameter underwater observatory. There is a 1.8 m (6 ft.) wide and 290 m (950 ft.) long pier that provides access to the park. This area is frequented by commercial scuba diving tours and is visited by up to 200 divers a day.

Sasa Bay Marine Preserve (3.1 km<sup>2</sup> or 770 acres) includes a significant subset (0.5 km<sup>2</sup>, 126 acres) of the largest mangrove stand in the Mariana Archipelago (Figure 16). This preserve extends from the dry dock island to Polaris point and ends at the public right of way bordering Marine Corps Drive (Route 1). The northern border is route 18 and the

southern is the road to Polaris Point. The diverse mangrove swamp serves as nursery grounds for jacks (*Carangidae*), barracudas (*Sphyraenidae*), snappers (*Lutjanidae*), and groupers (*Serranidae*) (Wiles and Ritter 1993). The bay also serves as a foraging ground for green and hawksbill sea turtles. Coral habitat (0.02 km<sup>2</sup>, 4.5 acres) is limited inside of the preserve due to the heavy sediment load entering the bay from the Sasa and Aguada rivers.

The fifth preserve is the Achang Reef Flat Preserve in Merizo (4.8 km<sup>2</sup>, or 1199 acres), which extends from the Ajayan Channel to Achang Bay (Figure 17). It includes a wide variety of habitats including mangroves, seagrass, sand, coral, and channel. The seagrass, mangrove, and estuarine areas of this preserve are important nursery area for a number of fish species. Manell channel, the largest channel included in the preserve, is an important congregation site for green sea turtles as the surrounding areas include rich foraging habitat including dense sea grass beds. Seasonal traditional fishing [as defined in five GCA Chapter 63 §63101] is permitted in this preserve for lessor' (juvenile forktail rabbitfish, *Siganus argenteus*), achemson (juvenile fusiliers, *Ptercaesio tile*), and atulai (big eye scad, *Selar crumenophthalmus*) under special permit.

### **Freshwater Conservation Areas**

There are few freshwater conservation areas on Guam. Within the Sasa Bay Marine Preserve, a wetland site has been designated as a moorhen foraging site. There is also Fena Lake, the largest reservoir on Guam, which is important for nesting moorhens. Fena Lake is located in southern Guam, on Naval Ordnance Annex, which is part of the GNWR Overlay. Three rivers empty into this reservoir. Due to the relative inaccessibility of Naval Ordnance Annex, these are some of the pristine river habitats on Guam.

### **Federal Marine Conservation Areas**

The Guam National Wildlife Refuge Overlay includes the federally owned War in the Pacific National Historical Park, Guam National Wildlife Refuge, and two Naval Ecological Reserve Areas (ERA), Orote and Haputo (Figure 8). The marine portion of the two ecological reserve areas compliments the marine preserves. These areas were established as mitigation for construction projects in Apra Harbor for the naval base. Managed by the US Navy (1978), these areas are closed to commercial fishing, however there is little management or enforcement.

The Orote Peninsula ERA stretches from Orote Point south to Agat Bay. Diversity and species composition of the Orote Peninsula reefs are strongly influenced by physical factors such as wave exposure, currents, riverine influence, and bottom topography. A number of unique micro and macrohabitats exist in this area with very different assemblages found within each. A recent survey of the area indicated that Blue Hole, the Orote Boulder Fields, and the Orote Point Reef Slope were biologically important due to unique species and high biodiversity. The researchers identified 1252 species of marine animals within the ERA. This included 156 species of scleractinian corals, two of which (*Leptoseria n. sp.* and *Favia rotundata*) were new records for Guam. A total of 339 fish species were recorded, representing approximately 37% of the known species from Guam. Macroinvertebrates accounted for 657 species encountered during the qualitative

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surveys. Diversity appears to be related to habitat, with areas such as the reef flat between Neye Island and the coast, and the patch reefs in North Agat Bay, exhibiting high levels of diversity. In general, diversity declines from Orote Point southeastward and then increases again in the Agat area (Paulay, et. al. 2001)

The Haputo ERA is located along the northwest coast of Guam, from just south of Haputo Beach to just north of Double Reef. The area is bounded by narrow, supratidal benches or unprotected rock faces; however, the area also contains two small, localized reef flats near Haputo Beach and Double Reef. Double Reef, an incipient barrier reef, is a unique feature in this area that creates highly heterogeneous habitat, including a distinct back reef community. Surveys identified, 944 species of marine animal, including 154 species of scleractinian corals. Quantitative studies indicated that coral cover was relatively high at most Haputo survey stations, ranging between 37-64%. This is higher than most surveyed locations in Guam's waters. Two hundred and seven fish species, approximately 22% of the known species from Guam, were identified at this site. Large piscivorous and herbivorous were rare. The study indicated that while corals were thriving, the fish targeted by the local anglers were less diverse and less abundant at the Haputo ERA than expected. The low abundance of target species suggests that overfishing may also be a problem in this area.

Maps

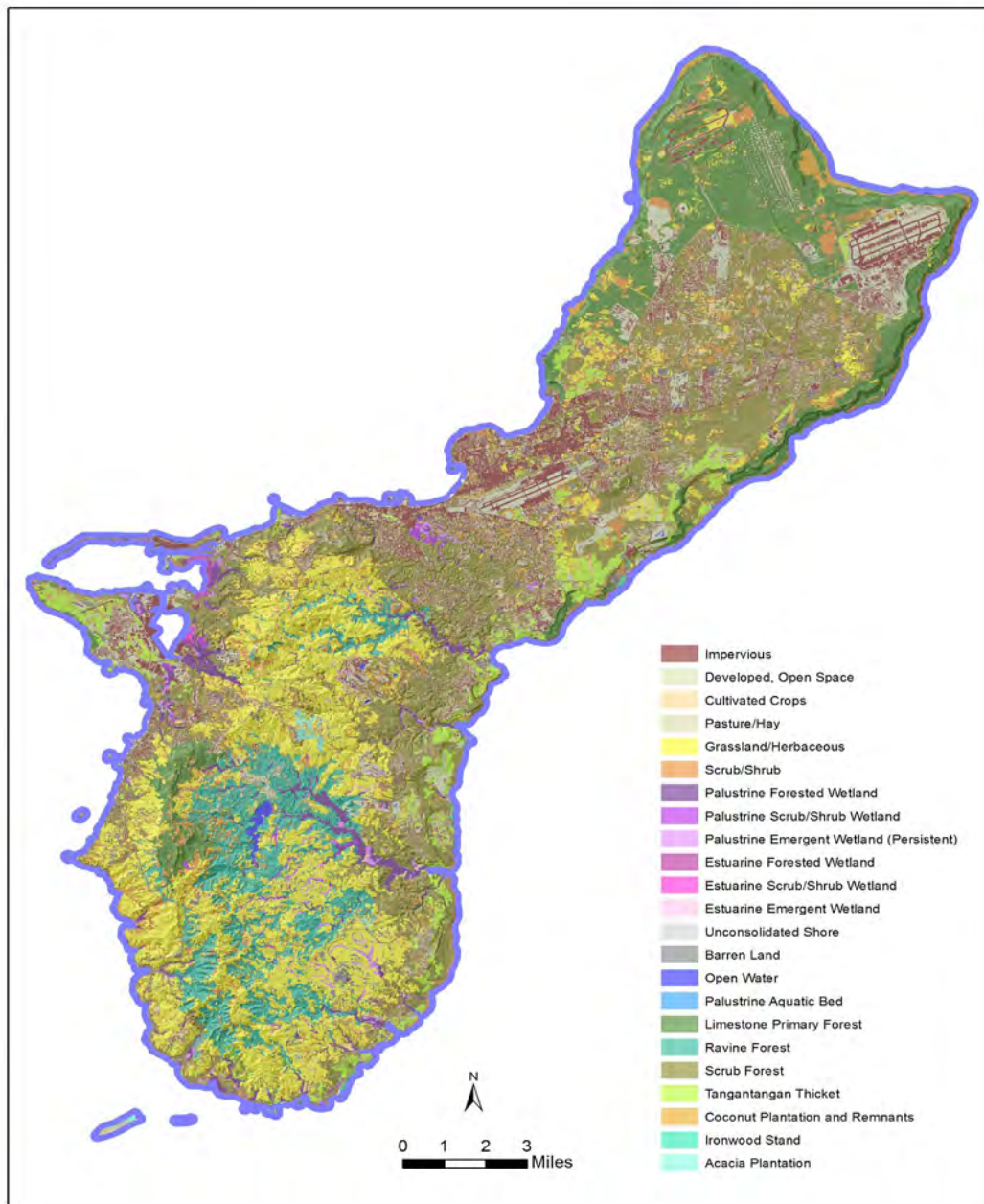
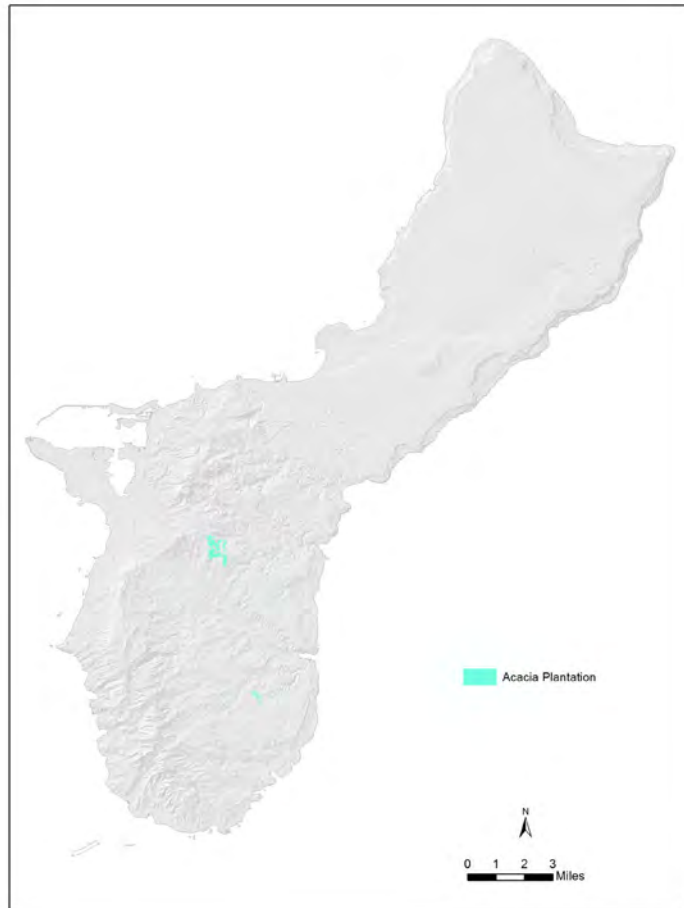
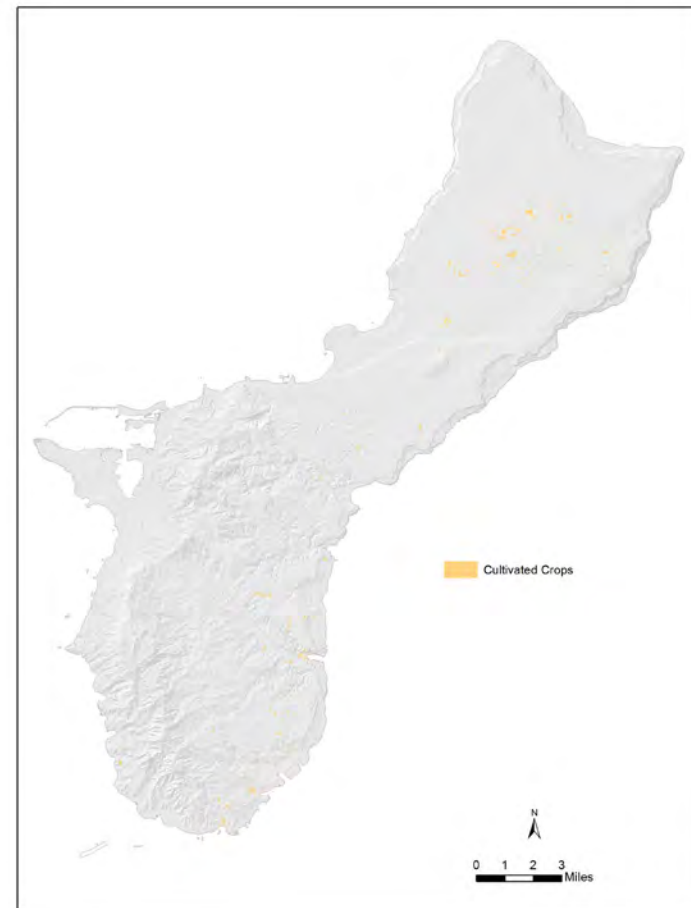


Figure 1. The distribution of various vegetation types around Guam [M. Kottermair 2015].

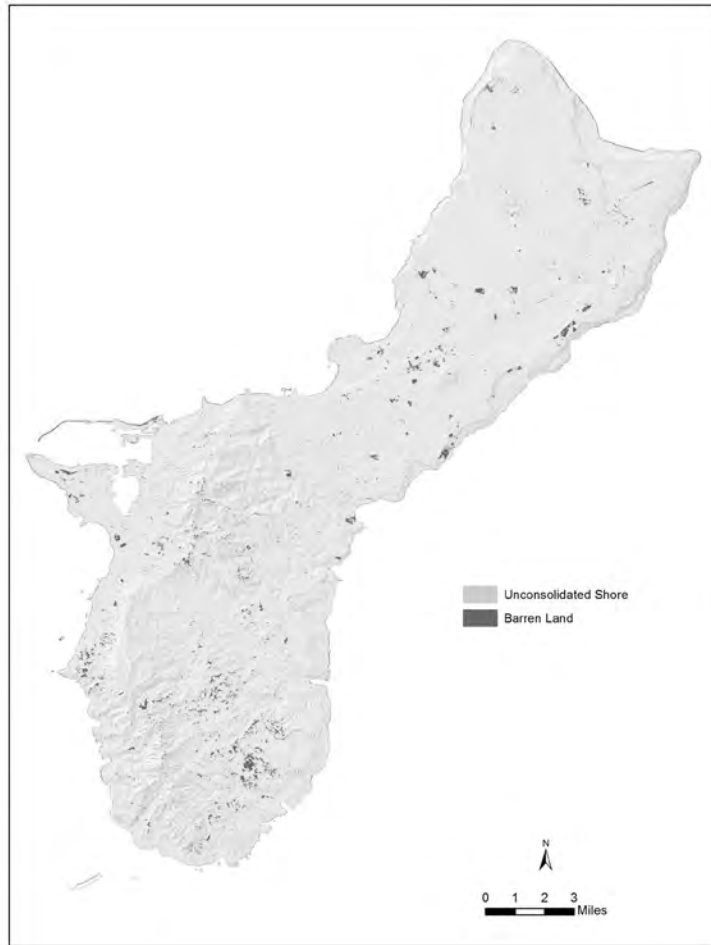


A.

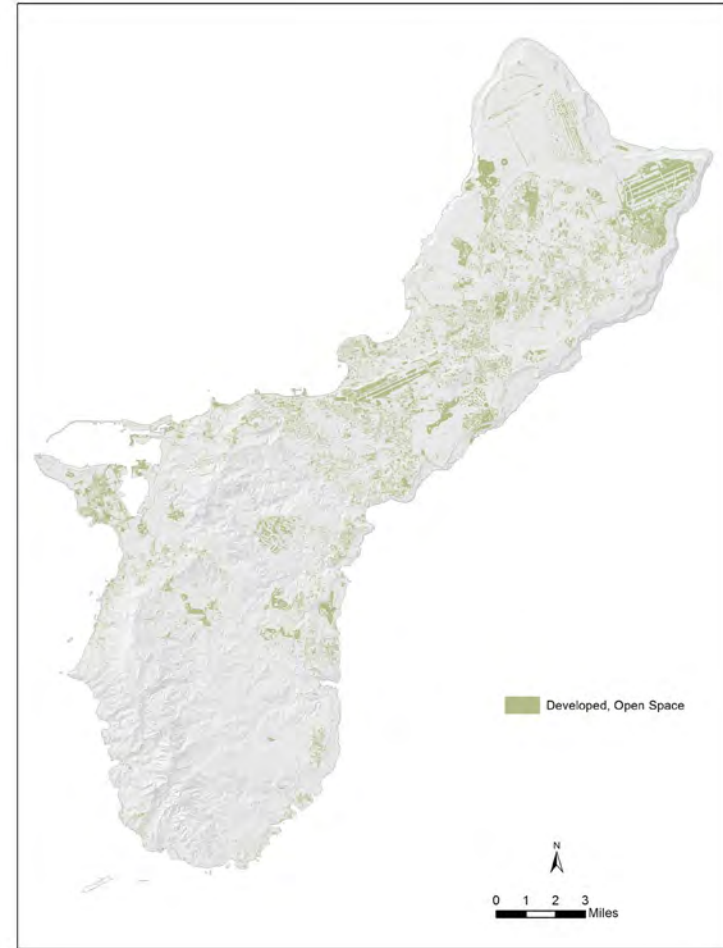


B.

Figure 2. Location of Acacia Plantation (A) and Cultivated Crops (B) habitats [USDA 2015, M. Kottermair 2015].



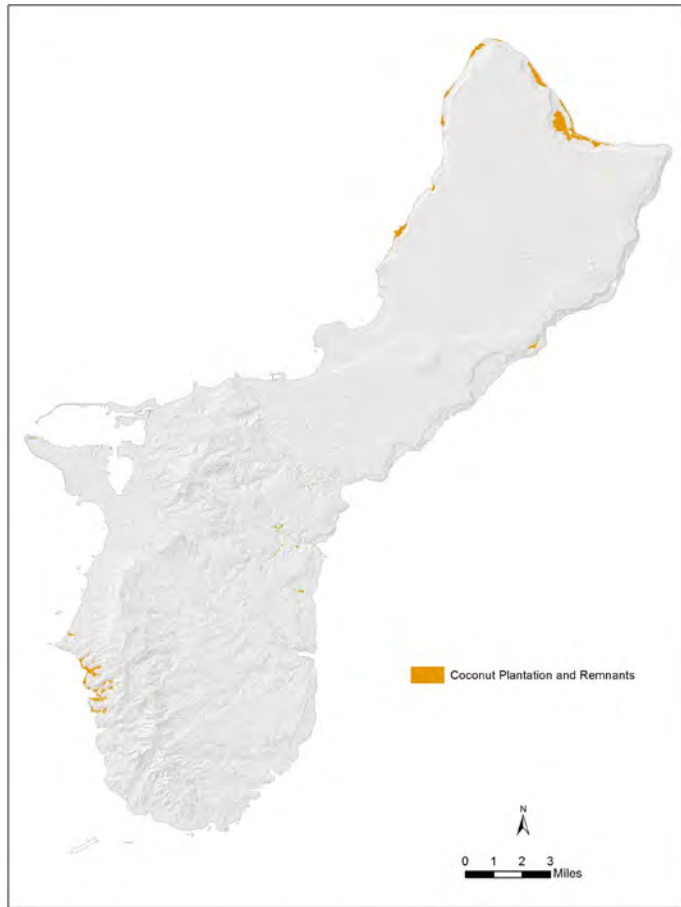
A.



B.

Figure 3. Location of Barren Land and Unconsolidated Shore (A) and Developed Open Space (B) habitats [USDA 2015, M. Kottermair 2015].



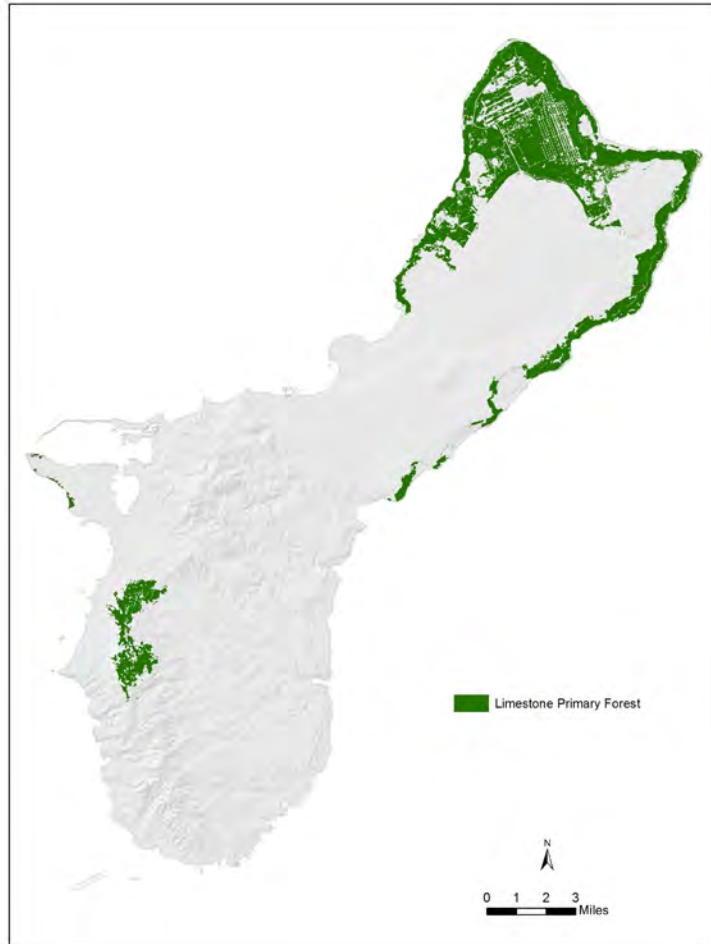


A.

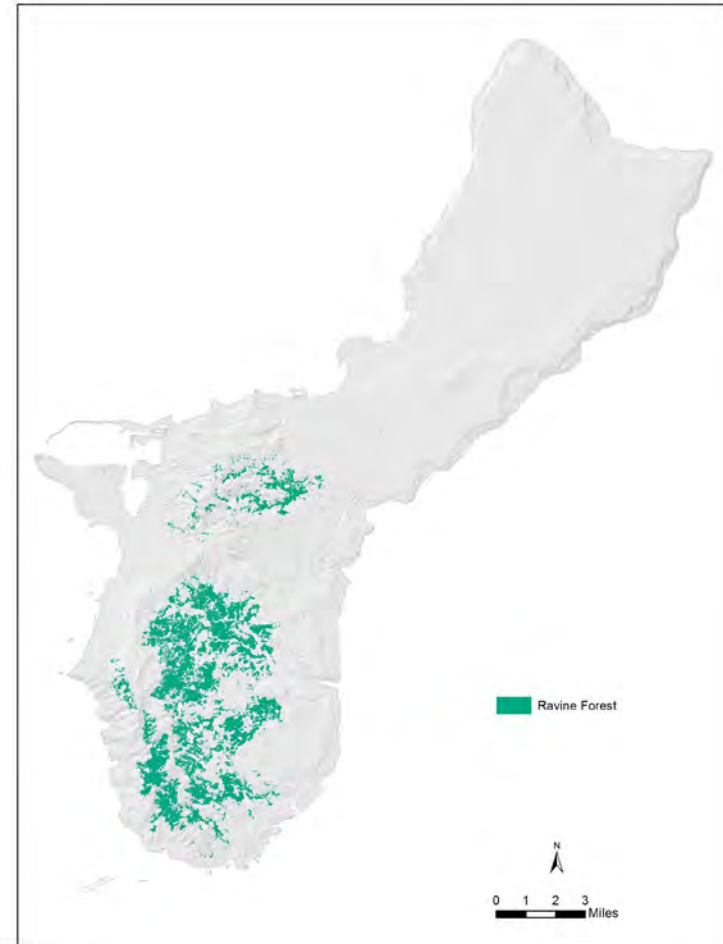


B.

Figure 4. Location of Coconut Plantation and Remnants (A) and Ironwood Stand (B) habitats [USDA 2015, M. Kottermair 2015].

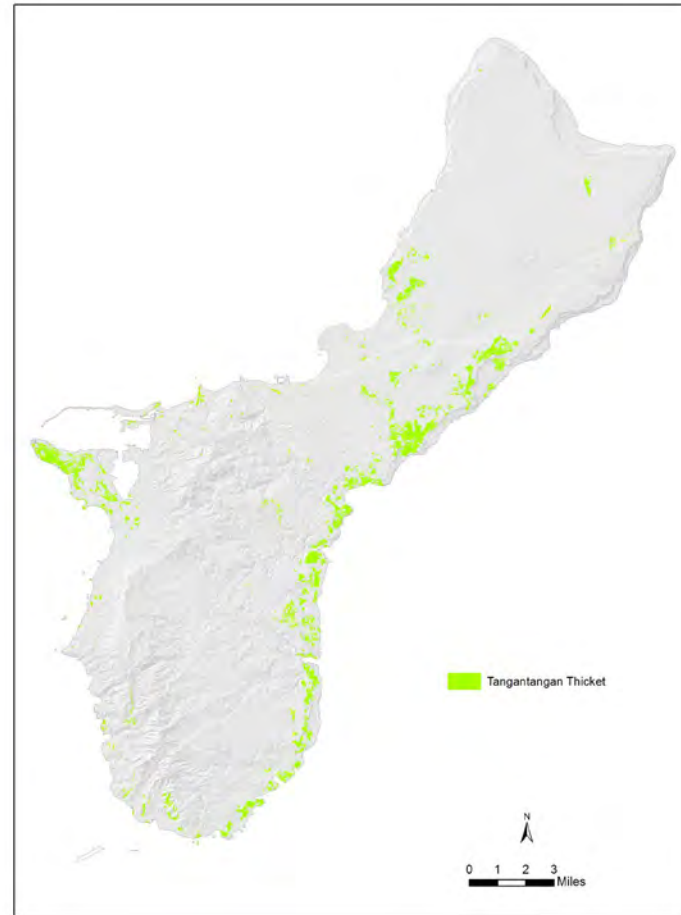
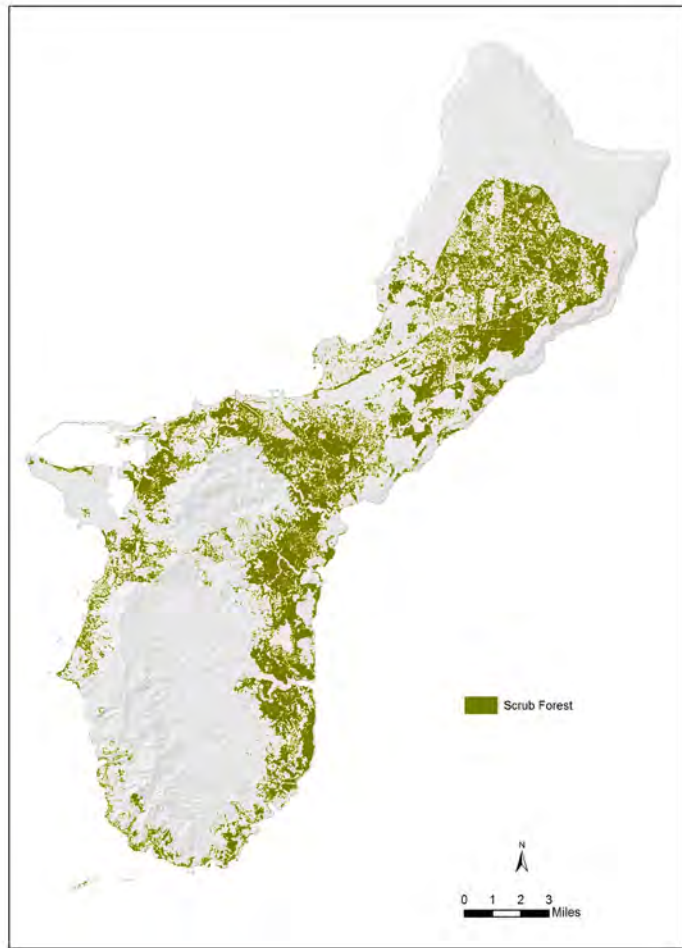


A.



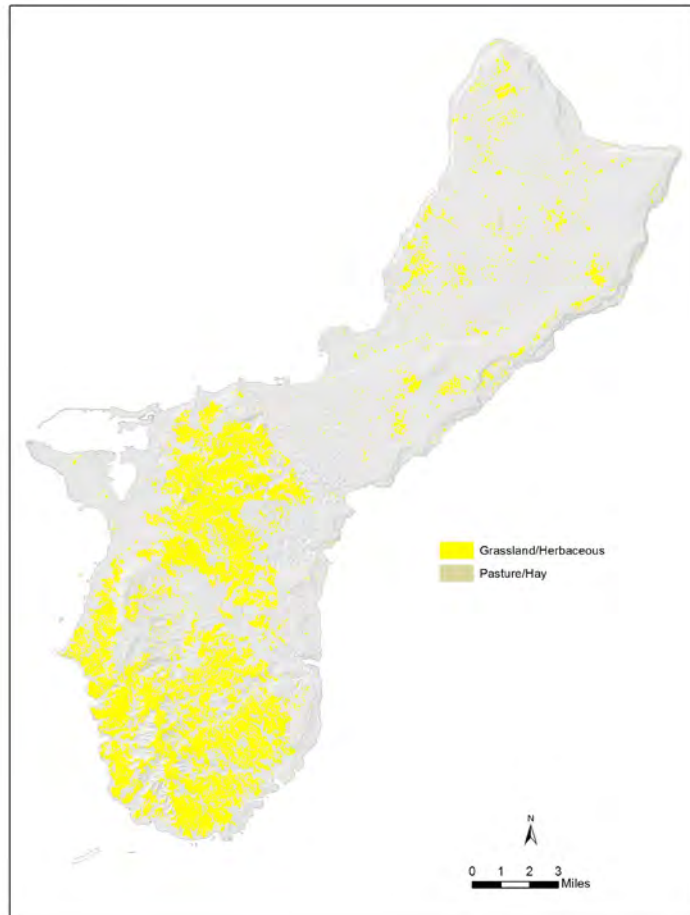
B.

Figure 5. Location of Limestone Primary Forest (A) and Ravine Forest (B) habitats [USDA 2015, M. Kottermair 2015].

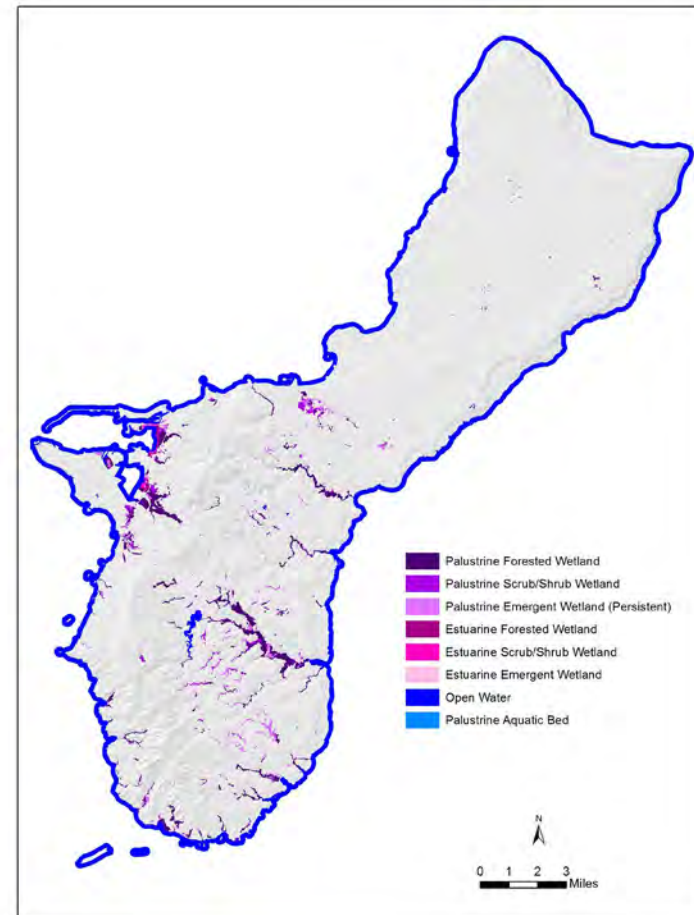


A. B.

Figure 6. Location of Scrub Forest (A) and Tangantangan Thicket (B) habitats [USDA 2015, M. Kottermair 2015]



A.



B.

Figure 7. Location of Grassland/Herbaceous (A) and Wetland (B) habitat [USDA 2015, M. Kottermair 2015].

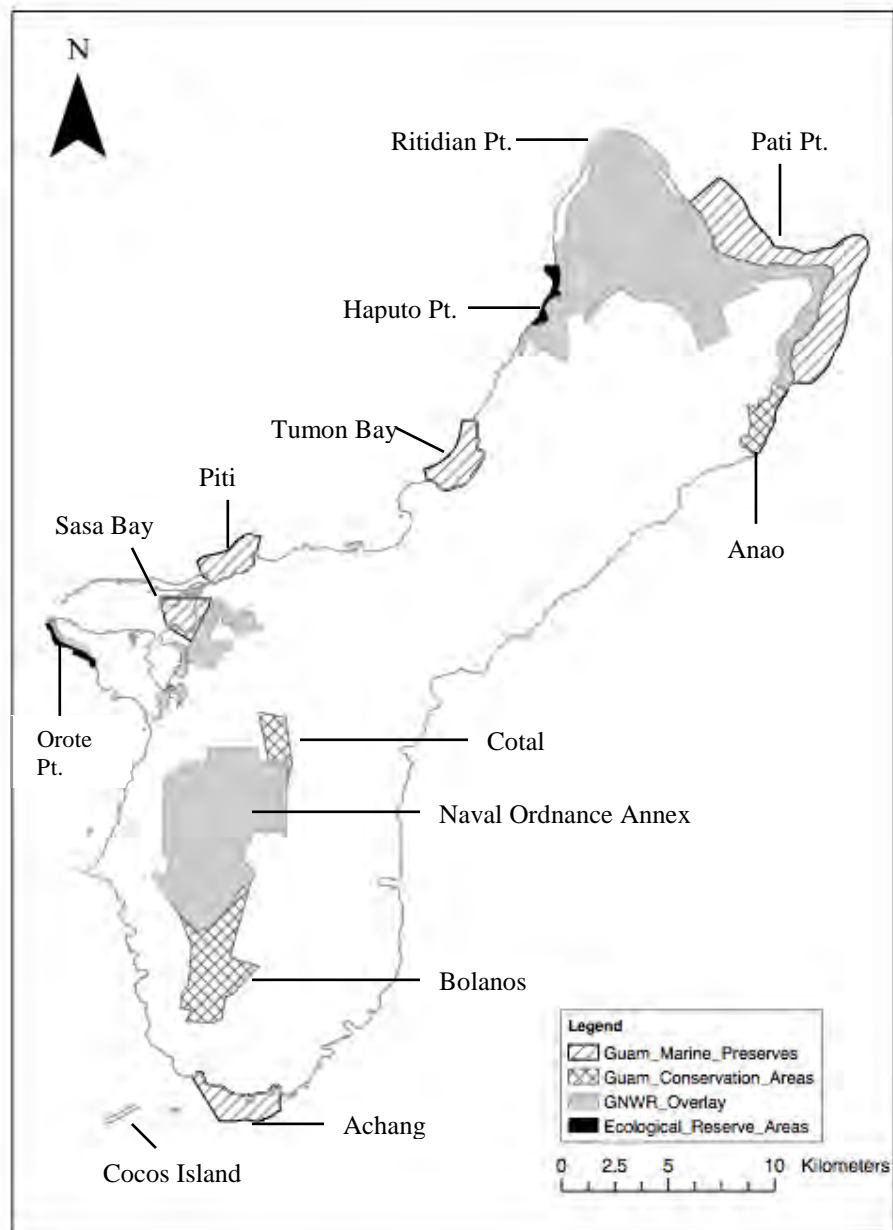


Figure 8. The location of conservation lands and marine preserves found on Guam [USFWS 2005, Brown 2005].

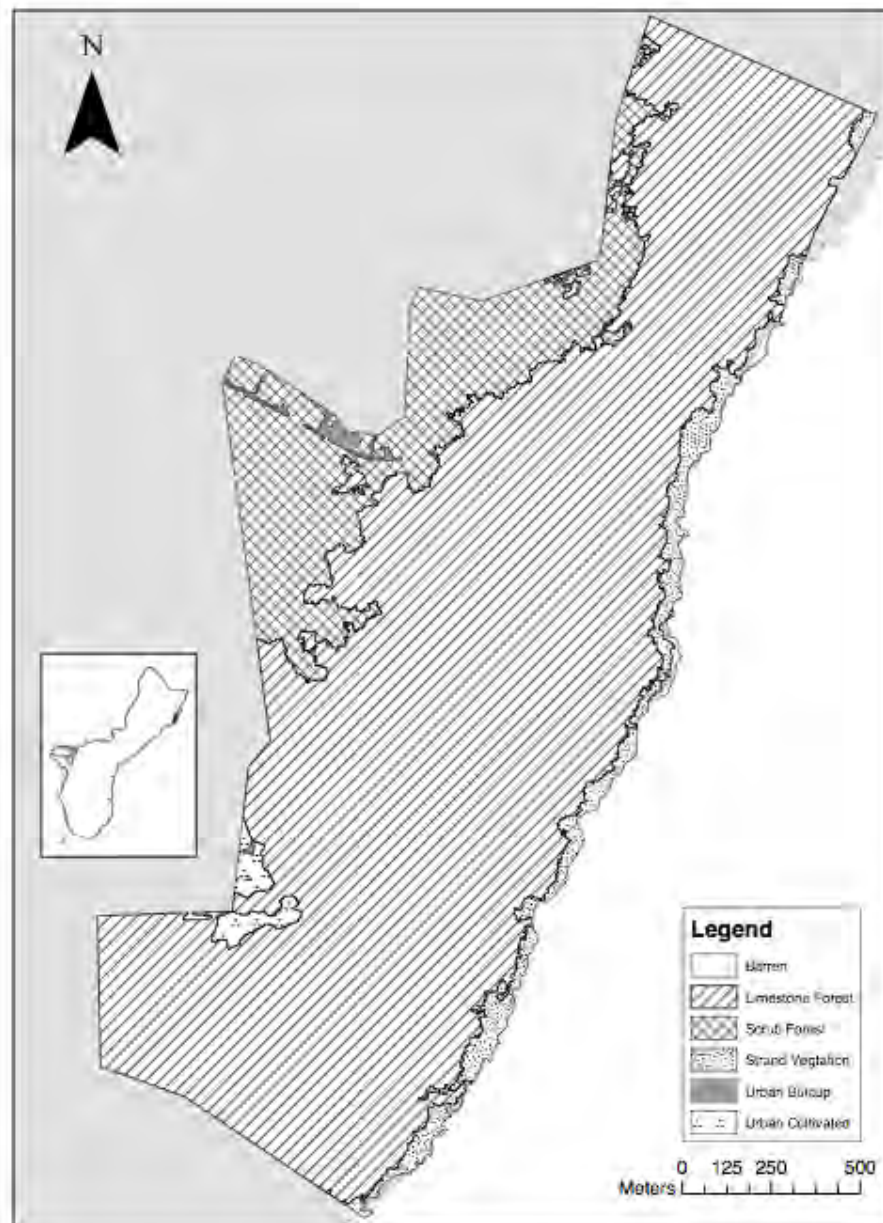


Figure 9. Habitats found within the Anao Conservation Area [USDA 2005, Brown 2005].

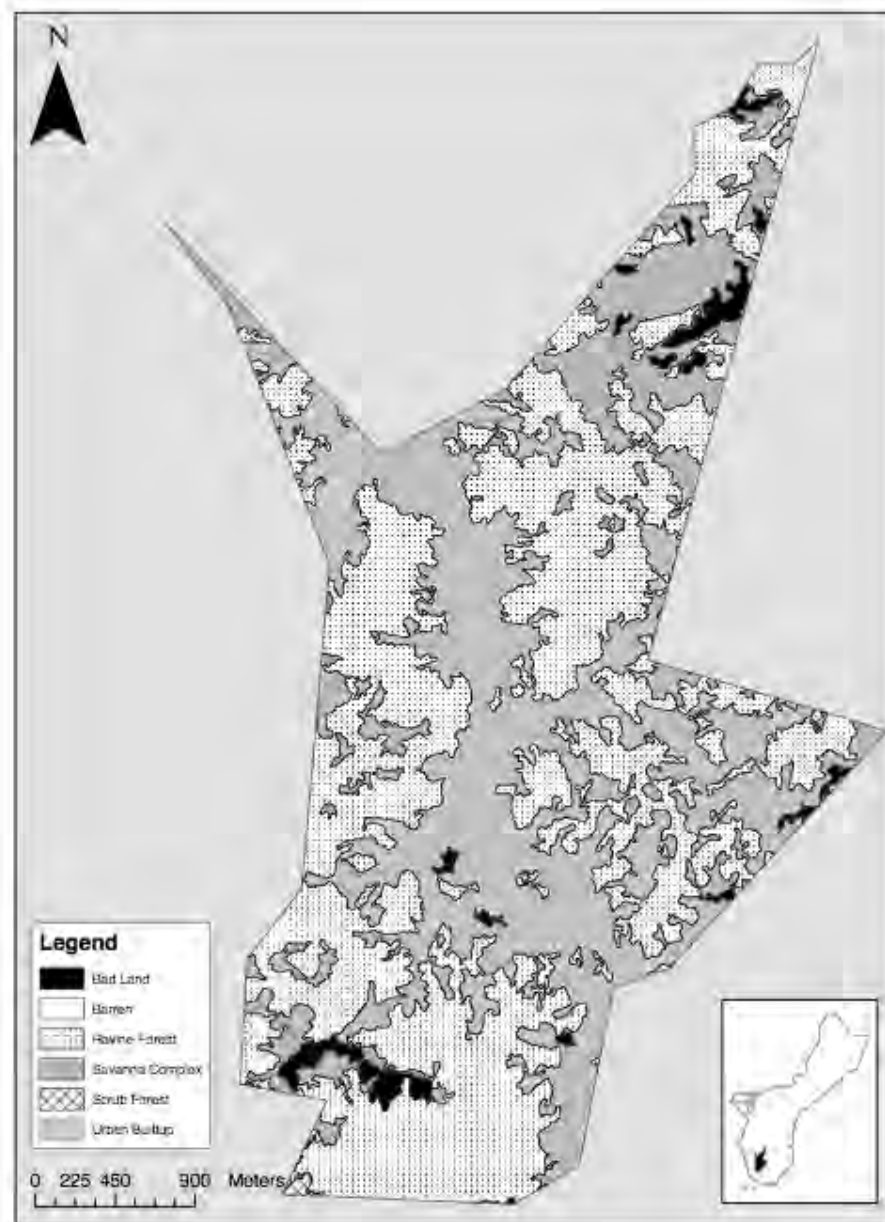


Figure 10. Habitats found within the Bolanos Conservation Area [USDA 2005, Brown 2005].

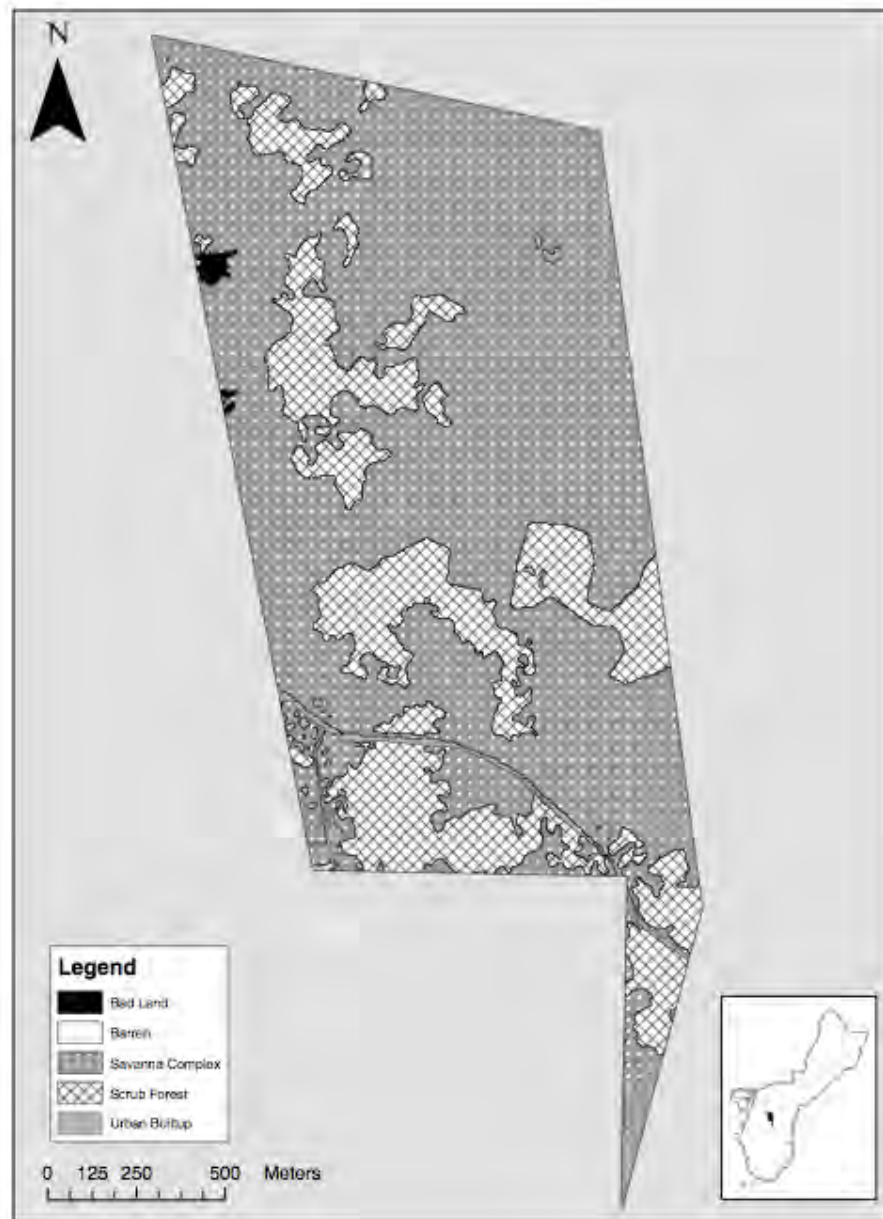


Figure 11. Habitats found within the Cotal Conservation Area [USDA 2005, Brown 2005].



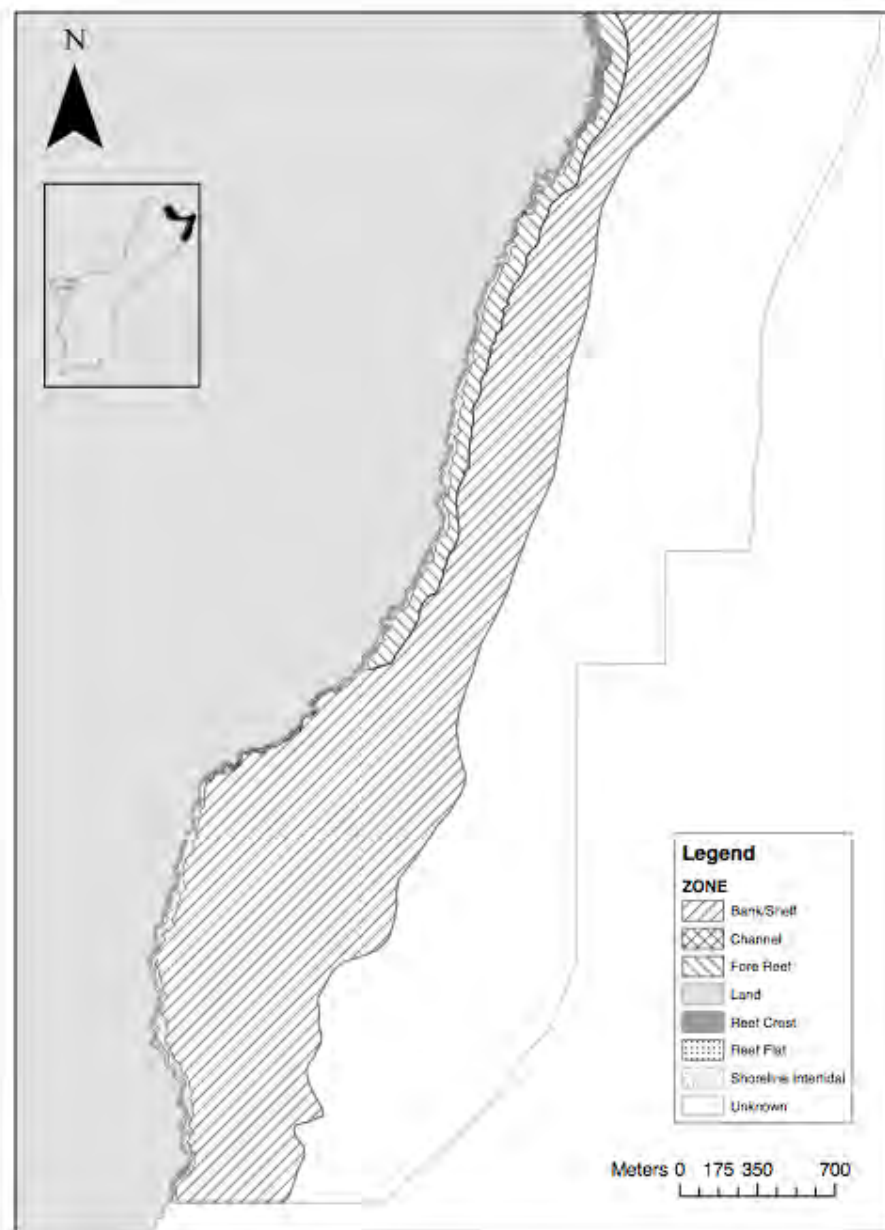


Figure 12. Habitats found within the eastern portion of the Pati Point Marine Preserve [NOAA 2005, Brown 2005].

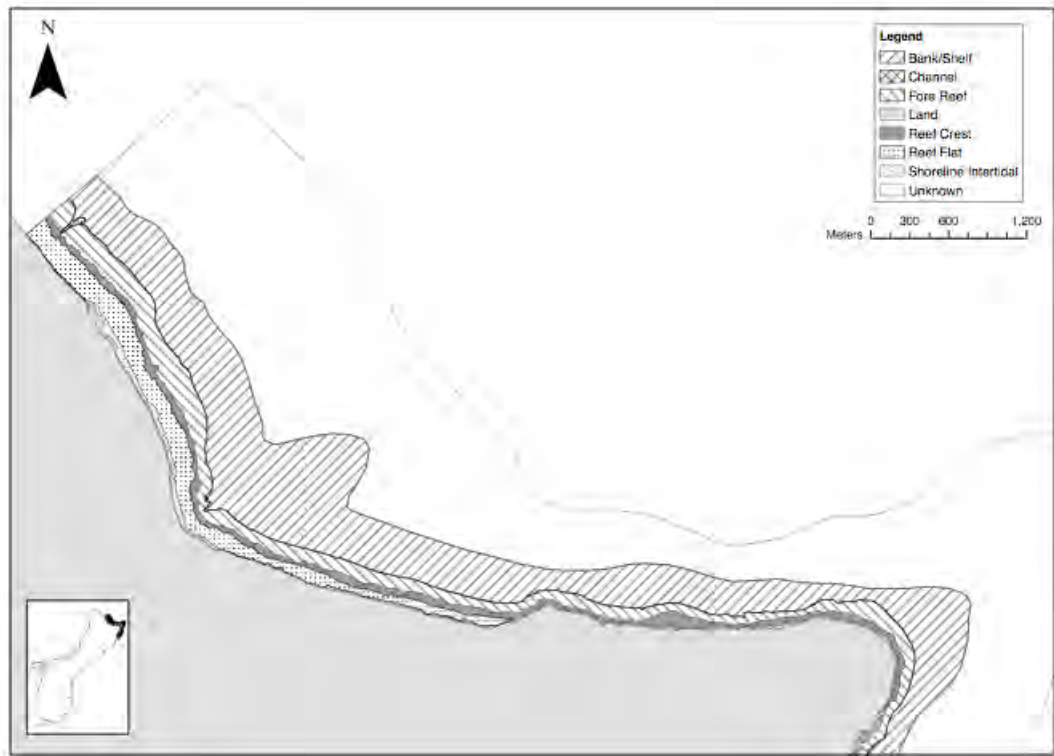


Figure 13. Habitats found within the northern portion of Pati Point Marine Preserve [NOAA 2005, Brown 2005].

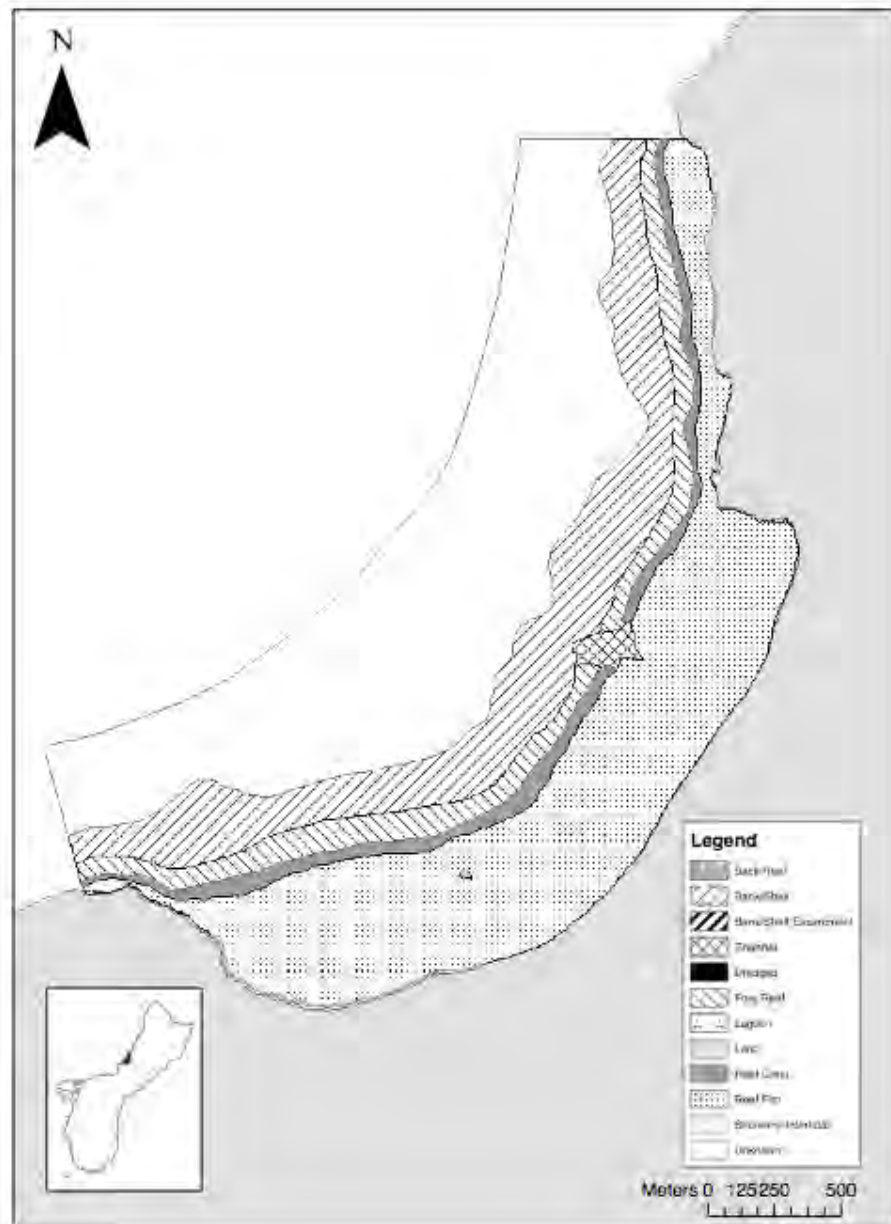


Figure 14. Habitats found in the Tumon Bay Marine Preserve [NOAA 2005, Brown 2005].

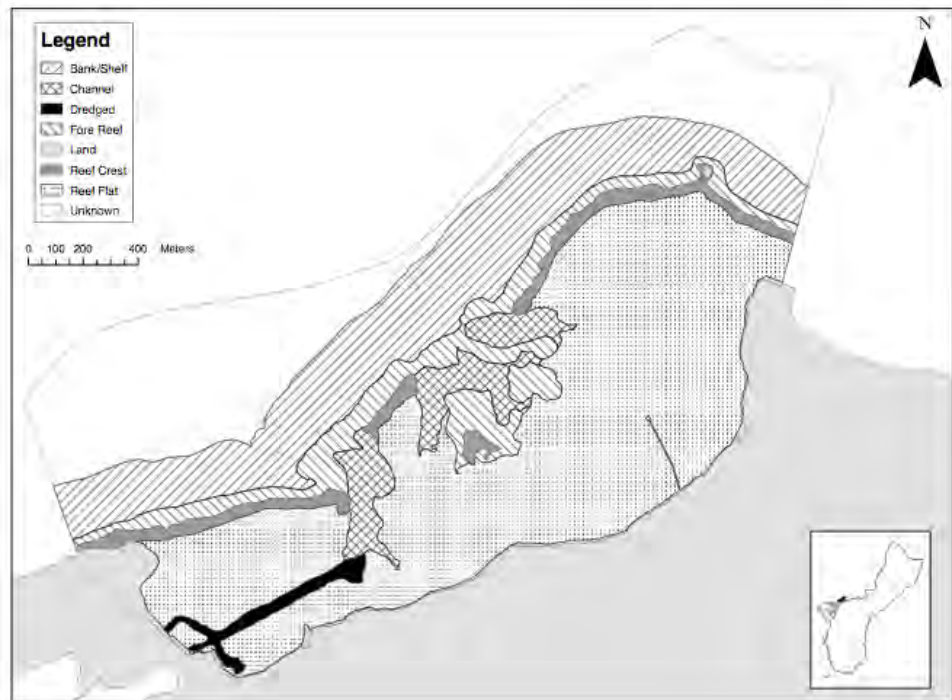


Figure 15. Habitats found within the Piti Bomb Hole Marine Preserve [NOAA 2005, Brown 2005].

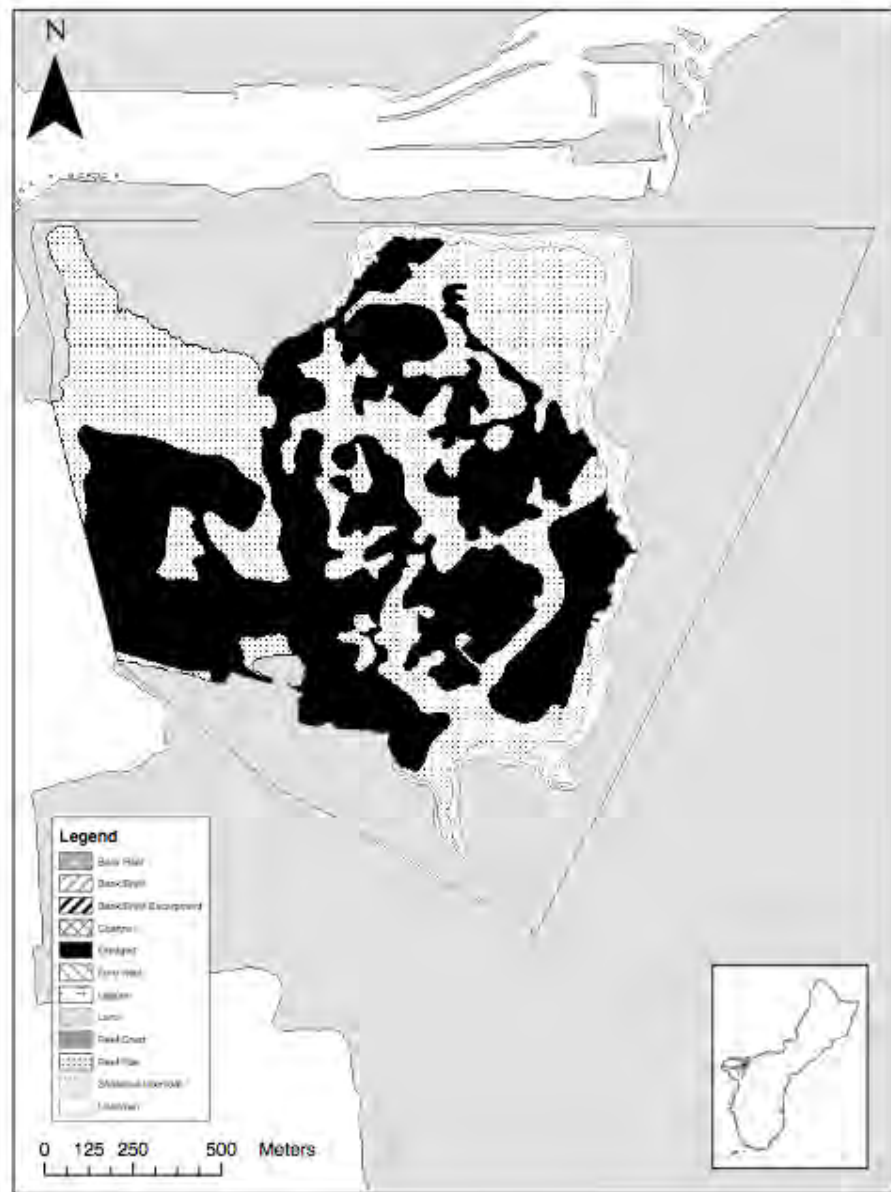


Figure 16. Habitats found within the Sasa Bay Marine Preserve [NOAA 2005, Brown 2005].

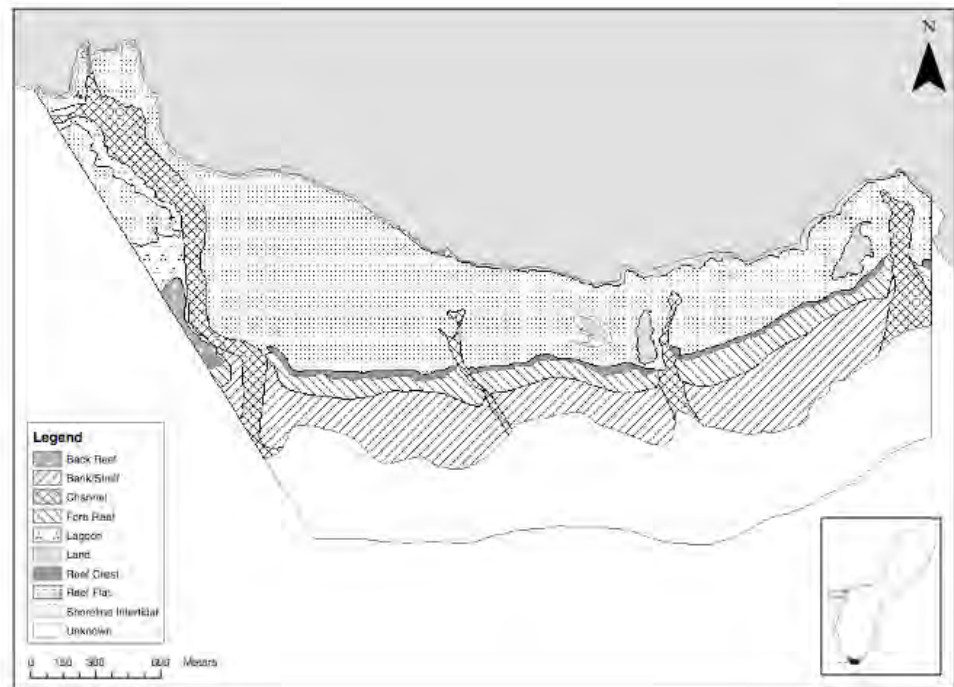


Figure 17. Habitats within the Achang Bay Marine Preserve [NOAA 2005, Brown 2005].

## **CHAPTER 3: Species of Greatest Conservation Need (SOGCN) (Elements 1 and 3)**

## **Rationale for Species of Greatest Conservation Need**

Guam's native fauna is unique in that many species have been impacted by the introduction of the brown treesnake (Savidge 1987). Historically, pesticide use and hunting have resulted in the demise of other species or reduction in numbers of certain species. Seventy-six SOGCN were included in the GWAP inventory, as well as 21 general groups of organisms. The species had to meet at least one of the following criteria for inclusion as a SOGCN:

- 1) The population of the species does not contain a self-sustained breeding population, there is no known breeding population, or is extirpated;
- 2) Population size is considered threatened or endangered;
- 3) A monitoring program is not in place;
- 4) The status of the population of the species is not known;
- 5) The range of the population is limited; or,
- 6) A funded program is not in place for that species.

A tremendous amount of work remains to determine the status of whole groups of marine mammals and terrestrial invertebrates. Insects are, by far, the most enigmatic group of animals on Guam. The number of insect species that have yet to be identified and cataloged numbers over 4000 (A. Moore *pers. comm.*). In this case, we considered the entire Order a single unit to encourage attention to this highly neglected group of native fauna.

A summary of SOGCN addressed in this chapter and species account is summarized in Table 8. The summary includes the current status, the threats that affect the species, knowledge, and, conservation actions to be developed and implemented to address the threats for the species. The information for each heading is a collection of field data and studies performed by DAWR staff, and information provided by technical experts during this review period. Because the status of Guam's wildlife and habitats has been an extreme challenge for conservation due to excessive land development (habitat loss), invasive species (predation, and competition), and extirpation of native species that has been ongoing for decades, priority levels were not fully assigned for actions. Every conservation action rendered is of highest priority, as the case in Hawaii. Because the conservation needs in Guam far exceeds the resources available, implementation of any of the strategies will benefit native wildlife and habitats. Important threats and actions were highlighted for SOGCN and habitats. However, priority levels are in dire need to be standardized and processed accordingly for effective management of Guam's natural resources, and to meet the expectations of the SWAP and the people of Guam.

### **Process of Evaluation, Selection, and Determination of SOGCN**

Biological importance SOGCN for terrestrial and aquatic species was determined by what is known about the species on Guam (and the Northern Marianas where most subspecies occur, such as fruit dove, honeyeater, rufous fantail). Evaluating population size; population trend; endemism/range size; reproductive potential; specialization; common threats and funding availability were used to help guide the process in determining the SOGCN list. DAWR biologists, with technical experts from GCZMP, UOG, GNWR, NOAA, and USFWS (Table 9) completed the SOGCN



selection and evaluating process by gathering information from historic papers, unpublished data from past and ongoing projects in Guam and the Marianas. Bird and bat species that are extirpated on Guam, but occur in Marianas, were included in Guam's SOGCN to fill gaps in niches left by the loss of the endemic subspecies.

Culturally valued species such as the coconut crab was proposed for SOGCN listing, however the coconut crab (as well many others harvested for personal consumption) were tabled until further information is made available for the next revision. During which time, research studies will be focused on the status of culturally valued species by monitoring harvest rate and population size. Conservation actions (Chapter 4) addressing reforestation and predator control/removal (specifically BTS) gives great hope for the recovery of Guam's forest birds in the near future. For translocation (birds captured from CNMI and released in Guam's forest areas) to occur, reducing predator populations (BTS and ungulates) is crucial for native species recovery (Wiles et. al, 2003).

Initially, the SOGCN developed in the 2005 Plan was based on what was described from early naturalists and more recent biologists. Selection of the list, as presented today (see Species accounts), was generated by a systematic approach for each species, subspecies, and groups based on the evaluation of each biological importance and vulnerability to extinction, and not decided solely upon ESA listing, nor a candidate of. For example, the fruit bat was identified into the SOGCN based on its' small population size, declining trend in population for the past decade, potential of successful breeding (but survival of young is less likely), range on Guam (and the Marianas), threats of the species (and if these threats are similar to other species) and the need for funding to investigate further on the population. Determination of SOGCN was based on results of how each species weighed-in the evaluation process. The Department will be investigating for a more standardized, unbiased systematic process in determining and finalizing SOGCN list for future iterations. Species lacking knowledge were automatically included into the SOGCN, in order to fill those knowledge gaps. Many of these species occurs on Guam with no known information about them, such as the native tree snails, native skinks, insects, and freshwater snails, to name a few. Unfortunately for Guam, many SOGCN species listed are identified under the federal ESA, MBTA, and MMP. These species were all included into the list.

Soon after the SOGCN list was formulated and agreed upon by technical expert's review, three public meetings were held at Talofof, Dededo, and Mangilao Mayor's office to get the community's input with the proposed SOGCN. Unfortunately, there were no public in attendance during the announced meetings. Because of the given time frame to complete the SWAP revision, DAWR decided to finalize and include the SOGCN list as is. Engaging the public and obtaining their input/comments will be approached more aggressively in the future to get a better representation for the next SWAP revision. As a result, no changes were included for the SOGCN list from the 2005 plan, however updates were made with current status, threats, and conservation actions (highlighting the need for more research to engage partners) in the SOGCN accounts.

**Table 8.** Species criteria for inclusion into Guam’s SOGCN: (1) The population of the species does not contain a self-sustained breeding population, or no known breeding population, or is extirpated; (2) Population size is considered threatened, or endangered; (3) A monitoring program is not place; (4) The status of the population of the species is not known; (5) The range of the population is limited; or, (6) A funded program is not in place for that species.

#		Lacking Self-Sustained Breeding	T & E Listed	Lacking Monitoring	Population Status Unknown	Limited Range	Lack of Funded Program
	<b>Terrestrial Mammals</b>						
1	Mariana fruit bat <i>Pteropus m. mariannus</i> *,**	X	X			X	X
2	Pacific sheath-tailed bat <i>Emballonura semicaudata rotensis</i> *,**	X	X	X	X	X	X
	<b>Forest Birds</b>						
3	Guam rail <i>Hypotaenidia owstoni</i> *,**	X	X			X	
4	White-throated ground dove <i>Gallicolumba xanthonura</i> *,**	X	X			X	X
5	Mariana fruit-dove <i>Ptilinopus roseicapilla</i> *,**	X	X			X	X
6	Mariana swiftlet <i>Aerodramus vanikorensis bartschi</i> *,**		X			X	X
7	Guam Micronesian kingfisher <i>Todiramphus cinnamominus</i> *,**	X	X			X	
8	Mariana crow <i>Corvus kubaryi</i> *,**	X	X			X	
9	Micronesian starling <i>Aplonis opaca guami</i> **		X			X	X
10	Micronesian honeyeater <i>Myzomela rubratra saffordi</i> *,**	X	X			X	X
	<b>Wetland Birds</b>						
11	Mariana common moorhen		X	X		X	X

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#		Lacking Self-Sustained Breeding	T & E Listed	Lacking Monitoring	Population Status Unknown	Limited Range	Lack of Funded Program
	<i>Gallinula chloropus guami</i> *,**						
12	Nightingale reed-warbler <i>Acrocephalus luscina luscina</i> *,**	X	X			X	X
	<b>Sea Birds</b>						
13	White-tailed tropic bird <i>Phaethon lepturus</i>		X	X		X	X
14	Pacific reef heron <i>Egretta sacra</i>		X	X		X	X
15	Brown booby <i>Sula leucogaster</i>	X		X	X	X	X
<b>16</b>	Migratory Shore birds			X	X		X
	<b>Lizards &amp; Geckos</b>						
17	Snake-eye skink <i>Cryptoblepharus poecilopleurus</i> *,**			X	X	X	X
18	Slevin's skink <i>Emoia slevini</i> *,**	X		X	X	X	X
19	Azure-tailed skink <i>Emoia cyanura</i> *,**	X	X	X	X	X	X
20	Moth skink <i>Lipina noctua</i> *,**	X	X	X	X	X	X
21	Micronesian gecko <i>Perochirus ateles</i> *,**		X	X	X		X
	<b>Gastropods</b>						
22	Humped tree snail, <i>Partula gibba</i> *,**				X	X	X
23	Guam tree snail, <i>Partula radiolata</i> *,**				X	X	X
24	Fragile tree snail, <i>Samoana fragilis</i> *,**				X	X	X
	<b>Insects</b>						
25	Forest flicker, <i>Hypolimnas octocula marianensis</i> *,**		X	X	X	X	X

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#		Lacking Self-Sustained Breeding	T & E Listed	Lacking Monitoring	Population Status Unknown	Limited Range	Lack of Funded Program
26	Marianas rusty, <i>Vagrans egistina</i> *,**		X	X	X	X	X
	<b>Terrestrial Plants</b>						
27	Tree fern <i>Cyathea lunata</i> **		X	X		X	X
28	Federico nut <i>Cycas marianensis</i> **		X	X		X	X
29	<i>Heritiera longipetiolata</i> *,**		X	X	X	X	X
30	<i>Merilliodendron megacarpum</i>		X	X	X	X	X
31	Fire tree <i>Serianthes nelsonii</i> *,**	X	X	X	X	X	X
32	<i>Tabernaemontana rotensis</i> **			X	X		X
33	<i>Bulbophyllum guamense</i> *		X	X		X	X
34	<i>Dendrobium guamense</i> *		X	X		X	X
35	<i>Eugenii bryanii</i> *		X	X		X	X
36	<i>Hehyotis megalantha</i> *		X	X		X	X
37	<i>Maesa walkeri</i> *		X	X		X	X
38	<i>Nerivilia jacksoniae</i> *		X	X		X	X
39	<i>Phyllanthus saffordii</i> *			X		X	X
40	<i>Psychotria malaspinae</i> *		X	X	X	X	X
41	<i>Solanum guamense</i> *		X	X	X	X	X
42	<i>Tinospora homosepala</i> *	X			X	X	X
43	<i>Trachoma guamense</i> *		X	X		X	X
	<b>Freshwater Fish</b>						
44	Stream goby <i>Stiphodon sp.</i>			X	X	X	
45	Redbellied goby <i>Sicyopus sp.</i>			X	X	X	
46	Marianas goby <i>Stenogobius sp.</i>			X	X	X	
47	Flagtail <i>Kuhlia rupestris</i>			X	X	X	
48	Giant marbled eel			X	X	X	

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#		Lacking Self-Sustained Breeding	T & E Listed	Lacking Monitoring	Population Status Unknown	Limited Range	Lack of Funded Program
	<i>Anguilla marmorata</i>						
	<b>Freshwater Crustaceans</b>						
49	Atyid shrimps Atyidae			X	X		X
50	<i>Macrobrachium spp.</i>			X	X		X
51	Varunid crabs Varunidae			X	X		X
	<b>Freshwater Gastropods</b>						
52	Nerite snails, Neritidae			X	X	X	
53	Thiarid snails, Thiaridae			X	X	X	
	<b>Freshwater Plants</b>						
54	Water fern, <i>Ceratopteris thalictroides</i>			X	X	X	X
55	Pond weed, <i>Potamogeton mariannense</i>			X	X	X	X
	<b>Marine Mammals</b>						
56	Bryde's Whale <i>Balaenoptera edeni</i> ****		X	X	X		X
57	Sei Whale <i>Balaenoptera borealis</i> ****		X	X	X		X
58	Humpback Whale <i>Megaptera novaeangliae</i> ****		X	X	X		X
59	Cuvier's Beaked Whale <i>Ziphius cavirostris</i> ****		X	X	X		X
60	Sperm Whale <i>Physeter macrocephalus</i> ****		X	X	X		X
61	Dwarf Sperm Whale <i>Kogia sima</i> ****		X	X	X		X
62	Pygmy Sperm Whale <i>Kogia breviceps</i> ****		X	X	X		X
63	Melonheaded Whale <i>Peponocephala electra</i> ****		X	X	X		X
64	Killer Whale <i>Orcinus orca</i> ****		X	X	X		X
65	Shortfinned Pilot		X	X	X		X

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#		Lacking Self-Sustained Breeding	T & E Listed	Lacking Monitoring	Population Status Unknown	Limited Range	Lack of Funded Program
	Whale <i>Globicephala macrorhynchus****</i>						
66	Risso's Dolphin <i>Grampus griseus****</i>		X	X	X		X
67	Spinner Dolphin <i>Stenella longirostris****</i>		X	X	X		X
68	Striped Dolphin <i>Stenella coeruleoalba****</i>		X	X	X		X
69	Dugong <i>Dugong dugon****</i>		X	X	X		X
	<b>Marine Fish</b>						
70	Napolean wrasse <i>Cheilinus undulatus***</i>		X		X	X	X
71	Bumphead parrotfish <i>Bolbometopon muricatum***</i>		X		X	X	X
72	Surgeonfish, <i>Acanthuridae</i>			X	X	X	
73	Parrotfish, <i>Scaridae</i>			X	X	X	
74	Emperors, <i>Lethrinidae</i>			X	X	X	
75	Groupers, <i>Serranidae</i>			X	X	X	
76	Rabbitfish, <i>Siganidae</i>			X	X	X	
77	Snappers, <i>Lutjanidae</i>			X	X	X	
78	Goatfish, <i>Mullidae</i>			X	X	X	
79	Butterflyfish, <i>Chaetodontidae</i>			X	X	X	
80	Angelfish, <i>Pomacanthidae</i>			X	X	X	
81	Hawkfish, <i>Cirrhitidae</i>			X	X	X	
82	Wrasse, <i>Labridae</i>			X	X	X	
83	Trevallies, <i>Carangidae</i>			X	X	X	
	<b>Marine Reptiles</b>						
84	Green sea turtle, <i>Chelonia mydas*</i> , **		X			X	X
85	Hawksbill turtle, <i>Eretmochelys imbricata*</i> , **		X			X	X
	<b>Marine Arthropods</b>						

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#		Lacking Self-Sustained Breeding	T & E Listed	Lacking Monitoring	Population Status Unknown	Limited Range	Lack of Funded Program
<b>86</b>	Spiny lobster, <i>Paniluris spp.</i>			X	X		X
	<b>Marine Mollusc</b>						
87	Giant clam, <i>Tridacna derasa</i>		X	X	X		X
88	Giant clam, <i>Tridacna maxima</i>		X	X	X		X
89	Giant clam, <i>Tridacna squamosa</i>		X	X	X		X
90	Giant clam, <i>Hippopus hippopus</i>		X	X	X		X
	<b>Marine Gastropod</b>						
91	Triton's trumpet, <i>Charonia tritonis</i>		X	X	X		X
	<b>Corals</b>						
<b>92</b>	Hard Coral, Scleractinia			X	X		X
93	<i>Acropora retusa</i> *			X	X		X
94	<i>Acropora globiceps</i> *			X	X		X
95	<i>Seriatopora acueata</i> *			X	X		X
<b>96</b>	Soft Coral, Octocorallia			X	X		X
	<b>Marine Plants</b>						
97	Sea grass, <i>Halodule uninervis</i>			X	X		X
98	Sea grass, <i>Enhalus acoroides</i>			X	X		X
99	Sea grass, <i>Halophila minor</i>			X	X		X

- \* Federally Listed Threatened or Endangered Species
- \*\* Locally Listed Threatened or Endangered Species
- \*\*\* Candidate Species
- \*\*\*\* Protected under the Marine Mammal Protection Act
- # Numbers in bold represent groups

**Table 9. List of technical experts engaged in developing SOGCN list.**

<b>Name</b>	<b>Affiliation</b>	<b>Technical expertise</b>
Valerie Brown	NOAA fisheries	Marine
David Burdick	UOG Marine Lab	Marine
Lauren Gutierrez	GNWR	Plants
Curt Fiedler	UOG	Tree snails
Aubrey Moore	UOG	Invertebrates
Anna Simeon	BSP-GCMP	Marine
Justin Santos	DoAg-Forestry	Forestry
Jennifer Farley	DoD	Biologist
Paul Wenniger	DoD	Biologist
Gretchen Grimm	DoD	Biologist
Michelle Christy	USGS (former)	Herpetologist
Leilani Takano	USFWS	Biologist
Dr. Julie Savidge	Colorado State University	Biologist

## **Threats to Terrestrial SOGCN**

There are many threats affecting Guam’s native flora and fauna species. Some of the major threats to native species include but are not be limited to:

1. Introduced and invasive plants and animals
2. Loss and/or degradation of key habitat types
3. Limited information on many native species
4. Management issues
5. Climate change

### *Threat Assessment*

Soon after the 2005 CWCS, DAWR participated in a series of workshops for the development of the Draft Conservation Action Plan for Piti Bomb Holes Marine Preserve and adjacent Watershed for Guam. During these workshops, The Nature Conservancy (TNC) introduced a threat assessment method using Miradi program (TNC 2007) to identify, review and rank threat status for the Piti watershed (Appendix 4). In this case, the Department decided to use the threat assessment completed during the workshop to address all threats throughout the island since they incorporate majority habitats and SOGCN addressed in the GWAP. Many of the threats are identified from historic publish work, as well, new findings of recent threats, unpublished. The ranking of the threats was based on how the individual participant felt about threat. The ranking may appear more bias. It was agreed upon from numerous discussions in meetings, that all threats on Guam should be considered high to highest priority levels because the numerous problems existing wildlife and habitats face today. In a short time after the workshop, the threat assessment done for Piti Watershed will need to be reviewed and updated due to quick changes occurring on the island in various areas, specifically noticeable impacts of climate change. The priority of threats for SOGCN and habitats were deemed at the highest priority level. The Department will continue to collaborate with TNC to seek assistance with threat assessment (and other services to be rendered to help improve the process and effectiveness of addressing threats and prioritization) and schedule a workshop with technical experts to address the need to solidify a threat assessment method to be used for future iterations of the plan.



Unfortunately, on Guam, many of terrestrial wildlife are extirpated, or at the brink of going extinct because of the impacts of invasive species, habitat loss and degradation, high demand for economic growth, and climate change. For species recovery to occur, the actions to reverse threats are at its highest priority.

### Introduced and Invasive Species

Guam's increasing population, growing economy, and strategic location has contributed to the escalating rate of intentional and accidental introductions of alien species.

#### *Predators.*

Invasive species introductions, both intentional and accidental, have greatly affected Guam's native ecology. Guam's native terrestrial fauna have evolved in the absence of predators. The native wildlife populations are vulnerable to introduced predators such as brown treesnakes (*Boiga irregularis*), rats (*Rattus sp.*), feral cats (*Felis catus*), amphibians, and ants. For example, high densities of feral cats in the Munitions Storage Area, AAFB have hampered reintroduction efforts of the Guam rail (*Hypotaenidia owstoni*) (GDAWR unpublished notes).

In the 1940s, the brown treesnake was accidentally introduced to Guam after World War II. The ecological damage caused by this snake to the island environment is well documented (Savidge 1987, Jaffe 1994, Conry 1988, Engbring and Fritts 1988, Wiles 1987a, Rodda and Fritts 1992, Rodda et al. 1992a, 1997). The snake is largely responsible for the extirpation or decline of the island's resident bird species (Savidge 1987, see Appendix 6). This nocturnal and arboreal snake is capable of taking advantage of a variety of habitats and prey species (Rodda et al. 1992b, 1999b). Only two of 12 native forest bird species continue to persist in the wild on Guam, they include the Micronesian starling (*Aplonis opaca guami*) and the Island swiftlet (*Aerodramus vanikorensis bartschi*). Additionally, two wetland species of birds: the Mariana common moorhen and the yellow bittern also continue to persist in the wild. Historically, the resident species were found throughout the forests of Guam (Seale 1901, Baker 1947, Marshall 1949, Jenkins 1983). The Micronesian megapode, Mariana mallard (*Anas platyrhynchos*), and White-browed rail (*Poliomnas cinereus*) were extirpated prior to the introduction of the brown treesnake (Engbring and Fritts 1988). Other invasive species, including curious skink (*Carlia ailanpalai*) has thrived in the presence of *Boiga*, making the snake not only a threat in and of itself, but also by association with other non-natives.

Rats are a serious problem throughout the Pacific (Atkinson 1985, Milberg and Tyrberg 1993, Buden 2000). They are a major hurdle to recovery of many avian species because of predation of eggs and nestlings and are known to be predators of other small native animals. Rats can be found in all habitat types but are most abundant in urban areas on Guam. In forested areas of Guam, rats are not as abundant as on islands in the CNMI due to predation by the brown treesnake.

Puerto Rican tree frogs were transported to Guam via the horticultural industry. Greenhouse frogs (*Eleutherodactylus planirostris*) were discovered on Guam in October 2003. Surveys suggest that they inhabit nearly the entire island. Two coqui

frogs (*E. coqui*) were collected live in April 2004; one at a resort in central Guam and another at a plant nursery in Tumon. Immediately following the discovery of the two live coqui, the import requirements changed for importation of live plants from Hawaii. However, despite the change in import requirements, two additional coqui were collected on Guam; one associated with pallets arriving from the Big Island Hawaii and another associated with the importation of bromeliads. The coqui's call is high-pitched, and can reach a volume of 90 dB in chorus. In Hawaii, where *E. coqui* is established, it has caused millions of dollars in losses to export plant nurseries, the visitor industry via hotel cancellations, and the real estate market through declines in property values that are frog-infested (Bliss 2015).

Other introduced amphibians are having detrimental effects on Guam as well – at least 13 frog species have been discovered since 1937. The barking frog (*Rana sp.*), probably introduced with aquacultural products, is a nuisance because of its call. The noise produced by frogs in chorus has prompted residents in southern Guam to request assistance from the Department of Agriculture and in some cases to use caustic chemicals as solutions. Cane toads, *Bufo marinus*, were intentionally introduced in 1937 as biological control for insects and the garden slug, *Laevicaulis alte*, and are now found island-wide. In recent years the crab-eating frog and the Asian grass frog, *Fejervarya cancrivora* and *Fejervarya limnocharis* respectively, have expanded their range. The crab-eating frog can survive in brackish and seawater. It can survive in brackish and seawater and has the potential have a negative impact on populations of native crab species in shoreline habitat. Aside from the nuisance, frogs consume native species and are a food source for brown tree snakes, potentially increasing the size and changing the age and population structures of the snake population.

Java Sparrows (*Padda oryzivora*), an invasive species that have become established in other tropical locations such as the main islands of Hawai'i, were first observed in December 2008 at the University of Guam (UOG) campus in Mangilao, Guam. Flocks of 10-12 birds, including both adults and juveniles, were then sighted in the same area in December 2011. Between July and September 2013, GDAWR conducted surveys in the UOG area and observed between 2-7 birds at a time. Surveys were conducted again in April and May 2014 where up to 10 birds were observed. This suggests that there is an incipient population in Mangilao. If a breeding population is established, they become another food source for the brown tree snake and add more stress to Guam's native bird population.

#### *Plants.*

Invasive plant species have changed the composition of Guam's native forests. After World War II, the US military reseeded the island's barren landscape with tangantangan (*Leucaena leucocephala*). This species has continued to out-compete many native plants and is slowly changing the soil composition, making reforestation efforts more difficult (FSRD unpublished data). The chain of love (*Antigonon leptopus*) and dodder (*Cuscuta campestris*) are extremely aggressive vines that block sunlight and compete for water with native plants, smothering them altogether. Agalondi (*Vitex parviflora*) is a non-native tree that is now one of the most dominant trees on Guam, crowding out native plants and preventing recruitment in native forest.

Invasive species may completely replace native vegetation resulting in complete loss of key native habitats. After major typhoons and brush or forest fires, those plants that recover or reproduce quickly are most likely to survive and replenish the areas lost. Most invasive plants aggressively take over uninhabited areas, preventing the slower-growing native plants from gaining a foothold. For example, the palma brava (*Heterospatha elata*) has taken over many of Guam's southern ravines and valleys after brush fires, where chiute (*Cerbera dilatata*), and lalaha (*Pouteria ovovata*) should be dominant (Stone 1970).

### *Insects.*

Guam's native cycad (*Cycas mariannensis*) has been extirpated from most of the island due to the introduction of the Asian cycad scale, *Aulacaspis yasumatsui*. The infestation causes the tree to lose its leaves. Cycads are only able to replace leaves twice before dying, usually occurring after a few months of being infected with the insect. There is a species of moth (*Chilades pandava*) that lays its eggs on the new emerging leaves of cycad. The larvae, consumes the emerging leaves of the cycad and further exacerbates the problem of recovery for this species. This cycad is listed as one of Guam's SOGCN.

Discovered in 2007, the coconut rhinoceros beetle (*Oryctes rhinoceros*) is a large scarab beetle that feeds on coconut and other palms. The adult beetles bore holes into the crowns of coconut palms and feed on the sap, leading to the palm tree's mortality. Larvae are mostly found on composing soil, which makes difficult to maintain a compost pile without harboring beetles. In southern Guam, a boring hole from an adult beetle was observed on the native *Pandanus*. (Tibbatts, *pers. comm.*) Since its discovery, adult beetles have affected nearly all the coconut palms on island.

In November 2011, the Little fire ant (*Wasmannia auropunctata*), LFA, was discovered in a landfill in northern Guam (Raymundo 2012). Since then about 11 sites have been identified harboring LFA on Guam. Currently, efforts to inspect sites critical to SOGCN are needed due to the continuous transporting of green waste between sites. LFA is known to swarm and eat on insects, snails, lizards, geckos, birds, and all animals it encounters.

### *Other Invertebrates.*

Introduced snails have been a major factor in the reduction of native snail populations, along with predation by flatworms (*Platydemus manokwari*) [Hopper and Smith 1992]. The Rosy Wolf Snail (*Euglandina rosea*) and *Gonaxis spp.* were purposely introduced in the late 1950s to control *Achatina*. It's likely *Euglandina* itself caused a lot of decline in native snail species. The flatworm came in later (1977-1984), and seems to, at least, has wiped out *Euglandina* and *Gonaxis* and is still doing a number on all terrestrial snail fauna on Guam. Freshwater snails *Pila conica*, *Pomacea canaliculata*, *Sinotaia magnificiana*, and *Planorbis spp.* compete directly for food and habitat with native genera *Clithon*, *Neritina*, *Septaria*, and *Thiaria*.

### *Pathogens.*

Disease and other pathogens can have a serious effect on the natural resources on an island. In today's global community, borders are minimized and diseases that affect humans and animals can be transmitted in a matter of hours via commercial aircraft.

Guam is a hub for all goods and services moving to and from the US mainland, Asia, and the rest of Oceania. This makes Guam and other areas of Micronesia susceptible to diseases and pathogens that affect wildlife. West Nile Virus (WNV) is a major concern for all wildlife managers as well as public health officials. On the US mainland where the virus is widespread, the mortality of crows infected is 100%. If this virus becomes established on Guam or in the CNMI, the effects may be disastrous for the Mariana crow and other forest species already in jeopardy.

*Loss of Habitat, Ungulates and Management Issues.*

The loss of key habitats throughout the island is a problem that will have long-term effects on the restoration of SOGCN. The major factors exacerbating habitat loss are ungulates, development, stochastic events, and the introduction of invasive plant and animal species. Nothing can be done to control stochastic events. However, we can slow or halt the loss of habitat by controlling the other factors. Probably the most difficult and labor-intensive factor to control is damage by feral ungulates. These animals alter the forest composition by browsing on the vegetation (deer and water buffalo) or by uprooting it (pigs). Most of the native flora is preferred by grazers because they do not possess the chemical and physical defenses found in many introduced plants. This form of artificial selection allows invasive plant species to dominate. One exception to this trend is in some areas of Pati Pt. where the native *Ochrosia mariannensis*, a plant not favored by deer, have established monotypic stands (GDAWR unpublished notes).

Ungulates have been on Guam since the arrival of the first European inhabitants of the island (Wiles et al. 1999). They have become an important part of the culture for the native Chamorro people of Guam. The three ungulate species common in the wild are the Philippine deer, feral pig, and Asiatic water buffalo (*Bubalus bubalis*). A variety of habitats provide for these animals including native forest, wetlands, shoreline, grasslands, and a mosaic of other habitat types (Stone 1970). Management practices need to address need for conservation action while fulfilling cultural needs (Wiles et al. 1999).

*Military expansion and training.*

Department of Defense has proposed the relocation of Marines from Japan to Guam in the next 10 years (DON, 2010). With the expansion comes a high demand for training and testing exercises (DON, 2015). Combined, military activities on island will become more challenging for conservation due to more areas being cleared for construction (i.e. live-firing range), minimizing hectares needed for species recovery on GNWR Overlay lands.

*Development.*

A result of the Military build-up happening is the high demand for housing. DAWR had reviewed, at average 20 clearing and grading permits per month, for residential use (DAWR, unpublished data). Many private landowners have developed their properties to meet the housing demands, creating more fragmented forested areas, especially in northern Guam (DAWR, unpublished data). As a result of development, the total amount of forested areas will decline. This will become more of a challenge for delisting and downlisting ESA species, and more critically, SOGCN on Guam.

The goal is to identify, secure, and protect additional conservation areas suitable for species recovery and management.

### *Wildland fire.*

Based upon our Guam Forestry and Soil Resources Division Fire Data and Mapping Efforts from 1979 - present, Guam has averaged roughly 515 wildfires a year, which is an annual average of approximately 3% of our island area burned annually. 3% is a HUGE percentage when you consider how large/small our island is compared to the Continental U.S (GDoAg-FSRD, 2010). Fire plays a large role in altering the native forest vegetation cover in Guam. Due to the moist conditions, fire is not a prevalent natural process. However, fires are intentionally lit to improve hunting success as animals are drawn to new shoots that sprout following the fire. Human-induced fires have affected Guam for several thousand years. Intentionally lit fires continue today, and the resulting altered vegetation cover of savanna and grasslands are adapted to the current fire regime. These altered vegetation types result in an increase of erosion following a fire; as much as 4-5 times more sediment can be eroded from burned land as from savanna; savanna/grasslands produce more sediment than heavily forested areas.

Wildfire is a primary disturbance that affects forest and watershed health and is a keystone issue that is linked with other identified stakeholder issues. Fire is a non-native disturbance and directly interferes with the establishment and expansion of native forests, threatens standing forests, leads to accelerated erosion, the delivery of sediment pollution to surface waters and domestic water supplies, and contributes to the decline of the coral reef system.

The goal of the Wildlife Conservation Strategy to restore terrestrial habitats aligns with the mission of Guam Forestry to reclaim badlands and restore native forests. Rehabilitation of native forests is a necessary step in the management and recovery of species of concern.

### *Climate change.*

Throughout the Pacific Islands region, climate change has become a major concern. With a diverse terrestrial and marine ecosystem, the Pacific Islands region is vulnerable to the effects of climate change (Keener et al., 2012). Coastal flooding and erosion as sea levels incrementally increase, loss of habitat for endangered species is expected along with increased bleaching episodes, expansion of avian, and flora pathogens to higher elevations and changes in the distribution and survival of the marine biodiversity are just a few concerns that will need adaptive management approach for SOGCN and their habitats.

In the available literature (Wang 2016), only two Representative Concentration Pathway (RCP) scenarios for climate change conditions over Guam by the late 21<sup>st</sup> century (2080-2099) were analyzed: a high greenhouse emissions scenario, RCP 8.5 and a medium emission scenario, RCP 4.5. Based on these two models, Guam's surface air temperature (SAT) is likely to increase by 1.5 – 2.0 °C for RCP 4.5 and approximately by 3.0 – 3.5 °C for RCP 8.5. The projected annual mean future rainfall changes are not statistically significant in either of the two scenarios. The frequency of weak tropical cyclones (TCs) will significantly decrease within 500 km around Guam, while that of strong TCs will increase.

Additional downscaling, including with a baseline RCP 2.6 scenario, may further refine future climate change projections over Guam. Research is needed to determine the impacts of climate change on SOGCN and key habitats. It is crucial to participate in a Vulnerability Assessment for Guam and in the formulation of an adaptation plan should such efforts be initiated.

### Terrestrial SOGCN

#### Birds.

Over 100 species of birds are documented including migrant, wetland, seabird, grassland, and forest birds (Reichel and Glass 1991, Engbring and Fritts 1988). The status of birds listed as SOGCN for Guam is covered in the species accounts found at the end of this chapter.

There are two recovery plans for the forest birds of Guam. The recovery plan for the six federally listed native forest birds of Guam and Rota (Beck and Savidge 1990) covers the Guam rail, Guam subspecies of Micronesian kingfisher (*Todiramphus cinnamominus cinnamominus*), Mariana crow, Guam flycatcher (*M. freycineti*), and the Guam bridled white-eye (*Zosterops c. conspicillata*). These species were grouped together for recovery purposes because they occupy similar habitats and face similar threats. Unfortunately, the population of flycatchers and white-eyes on Guam went extinct in the mid-1980s and were removed from the endangered species list (USFWS 2004). The Mariana Crow has been extirpated on Guam, but still remains on Rota. The Guam subspecies of the rufous fantail (*Rhipidura rufifrons uraniae*) was not federally listed and went extinct in the mid-80s. The USFWS has completed recovery plans for the Mariana crow and Micronesian kingfisher.

A separate recovery plan was prepared for the island swiftlet for the Mariana Islands from Guam to Saipan (USFWS 1991a). The island swiftlet is able to persist in spite of the brown treesnake and continues to survive in the wild, in several small colonies totaling over 900 birds. The majority of birds are found in one cave (Mahlac Cave) on the Naval Ordnance Annex in southern Guam. The swiftlet population is vulnerable to snake predation, habitat destruction, and various stochastic factors affecting cave sites, including human disturbance, typhoons and flooding. Snake trapping and video taping at Mahlac Cave suggests that snake predation is a major factor limiting the size of the colony. Prior to Typhoon Pongsona (December 2002), the population numbered over 800 birds and less than 400 one month after the typhoon. The swiftlet recovery plan identifies the need to increase the reproductive success of birds at colony sites, which should result if predation were reduced. In 2012 and 2013 DAWR received funds to translocate swiftlets to Tarague cave. The project has not yet moved forward as preliminary requirements by the military have not yet been addressed. The Micronesian honeyeater (*Myzomela rubratra saffordi*), and Mariana fruit-dove (*Ptilinopus roseicapilla*) are no longer found on Guam. Isolated observations of the white-throated ground dove (*Gallicolumba xanthonura*) had been observed in Tarague Basin, Mangilao, Talofofu, and Yona. It has not been determined if the observations made were of one individual or multiple individuals. No recovery plan exists for these birds, though recovery efforts for endangered birds should benefit these species. Conservation efforts to establish these birds would have to include translocation of birds (eggs, chicks, or birds) from the CNMI, where they still occur.

Seabirds including the red-footed booby (*Sula sula*) and white-tailed tropicbirds (*Phaethon lepturus*) inhabited Guam further deserve attention.

Most of the major objectives outlined in the *Native Forest Birds of Guam and Rota of the Northern Mariana Islands Recovery Plan* (Beck and Savidge 1990) for recovery of the Guam rail have been implemented. GDAWR maintains a captive population of over 100 rails, and as many as 13 mainland zoos maintain and breed rails in captivity. Efforts to establish an experimental population on Rota for the purposes of preserving wildness and genetic variability in the species, and to serve as a source of birds for reintroduction to Guam, began in 1989. In December 1995, successful reproduction by captive Guam rails released on Rota was documented. Since November 2010, a total of 26 Guam rails have been on the snake-free, Cocos Island, south of Guam and reproduction was confirmed for the first time in 2011. Current survey information indicates that a breeding rail population on Rota is present but further releases are still warranted (GDAWR unpublished data).

Despite considerable progress in achieving recovery plan objectives for the Micronesian kingfisher this species continues to exist only in captivity. Breeding success in kingfishers has improved dramatically since the first publication of the CWCS and the captive population is currently at 150 birds. The limiting factors in achieving the partial recovery objective of 250 captive kingfishers is space for housing birds as well as the cost associated with holding birds until a release location is available. A USFWS recovery committee meets monthly to discuss release locations on Guam (Cocos Island) as well as off-island (Kosrae) and is slowly making progress towards this goal.

A partial recovery objective of 250 captive kingfishers cannot be reached under present conditions as reproductive gain is offset annually by young adult mortality. Other limitations to population growth of captive kingfishers in captivity include mate incompatibility and aggression, rising levels of infertility, a decline in the number of fertile eggs that hatch, and continual exposure to avian tuberculosis at zoos. In May 1995, the Micronesian Kingfisher Species Survival Plan (MK SSP) Management Group held a conference to evaluate the captive-breeding program, resulting in the formulation of an action plan designed to stabilize and increase the kingfisher population. The Micronesian Kingfisher Species Survival Plan Action Plan was endorsed by GDAWR and USFWS and contains many of the critical objectives for recovery that are outlined in the recovery plan. Unless expedient recovery actions are taken to reverse the decline of the Micronesian kingfisher in captivity and to repatriate the birds to Guam, this species may yet become extinct.

Techniques to protect nests of Mariana crows from brown treesnake predation have been developed and tested. The use of electrified barriers on tree trunks was found to be effective in preventing brown treesnake intrusion (Aguon et al. 2002). These techniques could also be used to protect the nests of Micronesian kingfishers. During the 1996 breeding season, avicultural intervention on Guam in the field had protected eight fertile eggs, and two young Mariana crows were successfully hand-reared and returned to the wild (GDAWR unpublished data). A major accomplishment of GDAWR's program was achieved when two captive-reared birds produced two clutches of fertile eggs in the wild in 2003. Breeding difficulties, resulting from a

highly skewed sex ratio are believed to be the key factor in why the Mariana crow population on Guam died out.

The Mariana swiftlet continues to exist in the wild. Mariana crows have been extirpated on Guam but continue to persist on Rota. Moorhens are poorly understood and have been neglected in terms of studies of life history and dispersal patterns. Guam has limited landmass and conflicts between wetland protection and the need to develop these areas for commercial or urban use is increasing. Studies of the moorhen are needed to make appropriate management decisions to maximize moorhen productivity, increase survivorship of young birds and minimize negative impacts, e.g. human encroachment into important areas, predation of brown treesnakes, feral cats, dogs, and feral pigs.

### Mammals.

Three native mammals are known to Guam including the Marianas fruit bat, little Marianas fruit bat and Pacific sheath-tailed bat. The Marianas fruit bat is the only extant bat on Guam. The Mariana fruit bat was listed with the forest birds on the US Endangered Species List in 1984 and a recovery plan for this species was developed (USFWS 1990b). Hunting was the major reason for the decline of the fruit bat. Though poaching has been controlled, the bat population has not recovered probably due to predation by brown treesnakes. Wiles (1987b) suggested that snake predation of pups while their mothers were foraging was the main cause of poor recruitment. From 1980-82, the bat population was estimated to be about 850-1000 bats (USFWS 1990b). Currently, the population numbers less than 200. Without local recruitment Guam's population will remain highly dependent on the Rota population for migration of animals.

### Terrestrial Plants.

There are 320 native plant species known to occur on Guam. These plants are part of many different communities that are a diverse assemblage of endemic, indigenous, and introduced species. Together these plant communities are of high value to the island's ecosystem, natural resources, and people. Plants improve soil quality and reduce erosion, which helps sustain healthy coral reefs. Many native plant species were traditionally used for construction (homes, canoes, tools, and woven materials), food, and medicine.

Of the 320-native species, GDAWR and FSRD have identified seventeen terrestrial plant species to be included as SOGCN. Two of the seventeen deserve considerable and immediate attention. The first is the federally listed *Serianthes nelsonii*. In 1994, the USFWS published a recover plan for *S. nelsonii* that outlined objectives to recover the species, such as managing the Rota and Guam populations by protecting trees from feral ungulates with fences, controlling insect pests, habitat protection, and propagation and seeding of new areas (USFWS 1994). The second species requiring immediate attention and action is *Cycas micronesica*. This species was once one of the most abundant forest species. The accidental introduction of the Asian cycad scale is decimating the population throughout the island. Unfortunately, there is little funding available to implement island-wide control of the pest. Control of the scale would be extremely labor intensive and expensive.

Presently, major threats to the species include typhoons, development (other anthropogenic threats), insect pests, fire, and browsing by feral ungulates. Also, the



introduction of species and varieties of the same genera may result in new varieties through cross-pollination. A genetic study should be done to ensure that reforestation efforts maintain genetic integrity.

### **Freshwater Plants and Animals**

Guam has 101 named rivers and streams, all located in the volcanic southern half of the island (Best and Davidson 1981). These rivers are host to a wide variety of aquatic organisms, including fish, snails, shrimp, and plants. Guam's freshwater floral and faunal compositions are typical for oceanic islands. Gobies are the most abundant fish, nerites and thiarids are common snails, and *Macrobrachium* and atyid shrimp are the dominant crustaceans.

#### *Freshwater Vertebrates.*

Guam's native freshwater fish fauna consists of 11 species; two eels, one flagtail, one sleeper, and seven gobies (Table 10). All of Guam's native fishes are useful indicators of water quality and stream health. Three species of native fishes have very limited distributions and are at greatest risk from habitat loss. Two of Guam's native fish species (*Stiphodon* sp. and *Sicyopus* sp.) are found only in the southern Mariana Islands, and one species (*Stenogobius* sp.) is known only from Guam. *Stiphodon* and *Sicyopus* favor hard substrates, such as rock and clay, which can be covered by excess sedimentation or overgrown with algae due to excessive nutrients in the water. *Stenogobius* is only found over sandy and soft substrates in the lower reaches of rivers. Excessive water flow due to riverbank alteration or loss of riparian vegetation can scour a riverbed, causing the loss of sandy substrates.

All native stream fishes exhibit an amphidromous life history, in which part of the organism's life cycle, usually the larval phase, is spent in the marine environment, while the remainder is spent in a freshwater environment. All of these species except the eels spawn in freshwater. The young are carried to the ocean by river currents, where they spend between two weeks and six months as larvae. They then return to freshwater, where they metamorphose into juveniles and spend the rest of their lives. The eels mature in freshwater but migrate to the sea to spawn. After spawning, the adults die. When the eggs hatch, the young migrate back to freshwater, where they spend the rest of their lives.

Because of these life histories, native fish are vulnerable to stream blockage. It is vital that rivers are left clear of dams or other blockage for returning fish to travel upstream to find suitable habitat. An ongoing study by GDAWR is monitoring the effect a dam has on native stream fauna.

Table 10. List of Guam’s native freshwater fishes (Kami et al. 1968).

Family	Scientific Name	Common Name
Anguillidae	<i>Anguilla marmorata</i>	marbled eel
	<i>Anguilla bicolor</i>	shortfin eel
Kuhliidae	<i>Kuhlia rupestris</i>	river flagtail
Eleotridae	<i>Eleotris fusca</i>	brown sleeper
Gobiidae	<i>Awaous guamensis</i>	Guam goby
	<i>Awaous ocellaris</i>	spotfin goby
	<i>Sicyopus</i> sp.	red bellied goby
	<i>Sicyopterus macrostetholepis</i> ( <i>S. lagocephalus</i> )	red tailed goby
	<i>Stiphodon</i> sp.	river goby
	<i>Stiphodon percnopterygionus</i>	black finned goby
	<i>Stenogobius</i> sp.	Marianas goby

Freshwater Invertebrates.

Guam has seventeen species of native snails, belonging to two families (Table 11). The only freshwater invertebrates of concern on Guam are the thiarid snail (*Stenomelania plicaria*), and the neritid snail (*Neritodryas subsulcata*). *Stenomelania* has a limited distribution on Guam, being found in a few rivers. *Neritodryas* is very uncommon on Guam, though it is widespread through the Indo-Pacific.

The neritids are herbivores, feeding exclusively on algae and diatoms found growing on rocks and other solid substrates. Neritids have an amphidromous life history, similar to that of the fish. Eggs are deposited in freshwater, the young hatch, and are swept to the ocean. After a marine larval stage, they return to freshwater to mature. *Nerites* deposit their egg cases on solid substrates, including other nerites.

Thiarids are omnivorous, feeding on both plant and animal material. They are normally found on sand or other soft substrates, where they spend a good portion of the day buried. *Thiarids* live their entire life cycle in freshwater. They are live bearing, releasing crawl-away young that are miniature copies of the adults.

Table 11. Guam’s native freshwater snails.

Family	Species	Family	Species
Neritidae	<i>Clithon coronata</i>	Thiaridae	<i>Melanoides riqueti</i>
	<i>Clithon oualaniensis</i>		<i>Melanoides tuberculata</i>
	<i>Clithon sowerbiamul</i>		<i>Stenomelania plicaria</i>
	<i>Neritina auriculata</i>		<i>Thiara granifera</i>
	<i>Neritina pullicida</i>		<i>Thiara scabra</i>
	<i>Neritina pulligera</i>		
	<i>Neritina squamipicta</i>		
	<i>Neritina turrata</i>		
	<i>Neritina variegata</i>		
	<i>Neritodryas subsulcata</i>		
	<i>Septaria lineata</i>		
	<i>Septaria porcellana</i>		

Crustaceans.

Guam has at least 12 species of freshwater crustaceans: nine species of freshwater shrimp (Table 12) and at least three species of freshwater crab. As far as known, all species are amphidromous, with a marine larval stage, and a freshwater adult stage.

Two families of shrimp are represented on Guam, Atyidae and Palaemonidae. The atyids are small (less than 4 cm in length). They are herbivores or detritivores, feeding on the substrate with a series of brush-like chelae. The genera *Atyoida* and *Atyopsis* are generally found in shallow water, in high current areas. *Caradina* is generally found in slow-moving, deeper waters. *Halocaradina* has greatly reduced eyes and is found on Guam only in caves and sinkholes along the east coast. Atyid shrimp are food for both fish and birds.

The palaemonids are larger (up to 15cm in length). They are omnivores, and feed with an enlarged pair of chelipeds, or pincers. Palaemonid shrimp are widespread on Guam: found in rivers, reservoirs and caves. They are able to survive in intermittent pools in the headwaters of streams and are frequently the only fauna of such habitats. Palaemonid shrimp are frequently taken as food.

Crabs.

The freshwater crabs of Guam are poorly known. They form a rather inconspicuous part of the freshwater fauna. Three species are known to Guam: *Ptychognathus sp.*, *Sesarma sp.*, and *Varuna cf. littorata* (Family: Grapsidae).

Table 12. Native crustaceans of Guam.

Family	Species	Family	Species
Atyidae	<i>Atyoida pilipes</i>	Palaemonidae	<i>Macrobrachium lar</i>
	<i>Atyopsis spinipes</i>		<i>Macrobrachium latimanus</i>
	<i>Caridina longirostris</i>		
	<i>Caridina nilotica</i>		
	<i>Caridina serratiostris</i>		
	<i>Caridina typus</i>		
	<i>Halocaradina trigonophthalma</i>		
Grapsidae	<i>Ptychognathus sp.</i>		
	<i>Sesarma sp.</i>		
	<i>Varuna cf. Littorata</i>		

Native Aquatic Plants.

Guam has at least three species of native aquatic plants (Table 13). The genera are cosmopolitan in distribution, and two of the three species have wide distributions. One species, *Potamogeton mariannensis*, may be endemic to Guam. *Potamogeton* are flowering plants and can produce both sexually and vegetatively. *Ceratopteris* is a fern and reproduces via airborne spores. While none of these plants are abundant, they all have a fairly wide distribution on Guam. *Potamogeton* and *Ceratopteris* have relatively soft, submerged leaves, and are at risk from overfeeding by non-native snails and herbivorous fish.

Nipa palms (*Nypa fruticans*) are found on Guam only in the lower reaches of rivers that exhibit a true estuarine habitat. Nipa palms are found along only ten rivers on Guam (GDAWR unpublished data). Nipa palms were traditionally used for thatch, as the leaves are long lasting compared to coconut leaves. Due to over-harvesting and habitat loss, Nipa has become uncommon, and is now protected under Guam law.

Table 13. Guam’s native aquatic plants.

<b>Family</b>	<b>Species</b>	<b>Habitat</b>
Potamogetonaceae	<i>Potamogeton lucens</i>	Slow moving water, soft substrates
	<i>Potamogeton mariannensis</i>	Slow moving water, soft substrates
Parkeriaceae	<i>Ceratopteris thalictroides</i>	Sluggish water, mainly lakes and ponds
Areaceae	<i>Nypa fruticans</i>	Brackish to tidal freshwater creeks and rivers

Threats to Freshwater Fauna.

In addition to habitat alteration threatening Guam’s native fish fauna, non-native species are also a cause for concern. Guam has a large non-native fish population, with at least eleven species now established (Table 14). These non-native fishes have become established via numerous routes. Some, such as snakeheads and catfish, were brought to Guam for aquaculture. Others, such as guppies and swordtails, are escapees/releases from home aquaria. Still others, such as *Gambusia* and tilapia (*Oreochromis mossambicus* and *Tilapia zilli*), were introduced to help combat other pests.

The eel, flagtail, and sleeper are predators, feeding on fish, snails, and other aquatic invertebrates. The two species of *Awaous*, the *Stenogobius*, and the *Sicyopus* are omnivores, feeding on plant and animal material. *Stiphodon* and *Sicyopterus* are herbivores, grazing on algae growing on river substrates. While *Awaous* and *Anguilla* have Indo-Pacific-wide distributions, several of these species have very limited ranges. The *Stiphodon* sp. and *Sicyopus* sp. are known only from the southern Mariana Islands, while the *Stenogobius* is known only from Guam.

The eels mature in freshwater but migrate to the sea to spawn. After spawning, the adults die. When the eggs hatch, the young migrate back to freshwater, where they spend the rest of their lives. Because of this life history, it is imperative that rivers are left clear of dams or other blockage for returning fish to travel upstream to find suitable habitat. An ongoing study by GDAWR is monitoring the effect a dam has on native stream fauna. Dams affect native fauna in two ways. First, a dam acts as a physical barrier to some native organisms. Organisms not able to pass upstream of the dam are limited to the reaches of rivers below the dam.

Some organisms are able to pass the reservoir and breed. Young are passively carried downstream to the ocean for the marine portion of their life history. If the young are prevented from reaching the marine environment within the first few days of hatching, they will not survive. Young hatched above a dam can become caught in the reservoir formed behind the dam and perish. Studies by GDAWR indicate the

diversity of native organisms is much lower in the three rivers feeding into the reservoir than in three controlled rivers located outside the Fena watershed, as well as the control river leading from the Fena dam.

While hard data is lacking, anecdotal evidence collected by GDAWR indicates an impact on native fish fauna by some non-native species. In rivers with heavy non-native populations, native fish are either less numerous, or distributed in a different way than in streams without non-natives. Tilapia competes with native fish for food, while predators such as *Cichla*, *Channa*, and *Clarias*, feed on native fish and invertebrates. Currently, there are no efforts being made to control established non-native fishes. Guam DAWR and USFWS do regulate species coming into Guam via a permitting system and shipment inspections.

Table 14. Guam’s non-native freshwater fishes.

<b>Family</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Means of Introduction</b>
Clariidae	<i>Clarias batrachus</i>	Walking catfish	Escape from aquaculture facility
Cichlidae	<i>Cichla ocellaris</i>	Peacock bass	Purposeful introduction
	<i>Oreochromis mossambicus</i>	Mosambique tilapia	Purposeful introduction
	<i>Tilapia zilli</i>	red belly tilapia	Purposeful introduction
Poeciliidae	<i>Gambusia affinis</i>	mosquito Fish	Purposeful introduction
	<i>Poecilia reticulata</i>	Guppy	*Pet trade
	<i>Poecilia veliferum</i>	sailfin molly	*Pet trade
	<i>Xiphophorus helleri</i>	Swordtail	*Pet trade
	<i>Xiphophorus maculata</i>	Platy	*Pet trade
Channidae	<i>Channa striata</i>	Asian snakehead	Escape from aquaculture facility
Cyprinidae	<i>Cyprinus carpio</i>	Koi	*Pet trade

\* Pet trade is the trade of living wildlife species, whether semi-domesticated or bred in captivity for the purpose of trade, as companion animals.

*Non-Native Aquatic Snails.*

Guam has at least seven species of non-native freshwater snails (Table 15). It is unknown if the introduced snails have had an impact on native flora or fauna, though herbivorous species probably fed on native aquatic plants. The introduced snails, however, can pose a human health risk. Two introduced species (*Pomacea* and *Pila*) are known vectors for schistosome parasites of humans. Additionally, some species are agricultural pests in other parts of Asia, especially where aquatic crops such as rice are grown.

Table 15. Guam’s non-native freshwater snails.

Family	Species	Common Name	Means of Introduction
Ampullaridae	<i>Pila conica</i>	apple snail	Escape from aquaculture facility
Ampullaridae	<i>Pomacea canalicula</i>	apple snail	Escape from aquaculture facility
Viviparidae	<i>Sinotaia magniciano</i>	live bearing	Escape from aquaculture facility
Planorbidae	<i>Planorbis spp. (2)</i>	Ramshorn snail	*Pet trade
Lymnaeidae	<i>Lymnaea viridis</i>		**Accidental/native
Physidae	<i>Physid sp.</i>		*Pet trade

\* Pet trade is the trade of living wildlife species, whether semi-domesticated or bred in captivity for the purpose of trade, as companion animals.

\*\* *Lymnaea viridis* was described from Guam in 1832 by Quoy and Gaimard. It is not clear if the species is native to Guam. For the purpose of the Plan, we excluded using “unk.” to bring attention for future research on the species.

*Non-Native Aquatic Plants.*

Guam has many species of non-native aquatic plants and animals. The pet trade, aquaculture, and introductions by government entities are primary routes of introduction.

Guam has at least 5 species of non-native aquatic plants (Table 16). Virtually all these have arrived on Guam via the ornamental plant trade.

Duckweed, water lettuce, and water hyacinth are confined to one or two bodies of water. Water Lillies are found in ponds in yards and parks throughout Guam. *Hydrilla* is found throughout southern Guam and is the most serious aquatic plant pest on island. *Hydrilla* occasionally clogs pumps at the Ugum water treatment plant, and many man-hours are spent each year clearing *Hydrilla* from around pump intakes (Ron Topasna, per. comm.). *Hydrilla* has also overwhelmed the Fena and Masso reservoirs, restricting sunlight to native plants.

Other factors affecting the freshwater fauna of Guam include uncontrolled clearing of riparian vegetation and the introduction of chemicals into Guam’s streams. This has several deleterious effects on freshwater habitat. The loss of shade trees along the banks of rivers leads to an increase in water temperature. During the dry season on Guam, it is not uncommon for the headwaters of streams to become a series of disconnected pools as water levels drop. These pools, if not shaded, can become too warm for native organisms to live. When the rainy season comes, these pools act as a bank from which freshwater animals can repopulate streams. Without these reservoirs, stream repopulation is a much longer process, as animals must migrate from the lower reaches.

Table 16. Guam’s non-native freshwater plants.

<b>Family</b>	<b>Species</b>	<b>Common Name</b>	<b>Means of Introduction</b>
Lemnaceae	<i>Lemna minor</i>	Duckweed	Ornamental plant trade also escape from aquaculture facilities
Hydrocharitaceae	<i>Hydrilla verticillata</i>	water weed	Unknown
Nymphaeaceae	<i>Nymphaea sp.</i>	water lillies	Ornamental plant trade
Araceae	<i>Pistia stratiotes</i>	water lettuce	Ornamental plant trade
Pontederiaceae	<i>Eichornia crassipes</i>	water hyacinth	Ornamental plant trade

The loss of shade can also lead to an increase in algae in streams where excess sunlight falls. Heavy algae growth can affect water chemistry, as well as deplete dissolved oxygen during evening hours, or when the algae dies. Heavy algae growth can also smother preferred habitat, forcing fish to move to new sites not conducive to their survival.

Frequently, following typhoons or other heavy rain events, GDAWR offices will receive calls regarding fish kills in rivers. These are sometimes caused by the intrusion of saltwater into habitats where fish have little or no tolerance for increased salinity levels, but the cause appears to be chemical. Possible sources include farms and gardens from which fertilizers and other chemicals are washed into the rivers, and excess soil from cleared land washes into rivers and reduces oxygen levels.

Guam DAWR law enforcement officers have responded to calls where rivers have been bleached. This is usually the result of people collecting freshwater shrimp. A net is set across a stream, bleach is poured into the water upstream from the net, and the resulting dead and dying animals are collected as they drift downstream into the net. This method is especially destructive, as non-target as well as target species are killed. The evidence of this method is large numbers of undersize shrimp and fish left dead in the river. After a bleaching event, a river takes years to recover.

**Marine Animals and Plants**

Guam’s aquatic species face a number of threats. Many of these threats start as small problems in the upper reaches of Guam’s watersheds and increase in severity near coastal areas and in marine ecosystems. Threats include loss of habitat due to development and associated impacts such as increased pollution, erosion, and sedimentation. Development can also result in physical barriers to migration for riverine fauna. Other threats include unsustainable harvest, use of destructive fishing methods, recreational impacts, and invasive species. Threats beyond local control include: typhoons, climate change, and ineffective regulation of fisheries resources in federally-control waters of Guam’s Exclusive Economic Zone (EEZ).

Guam DAWR recognizes these threats and has focused its aquatic research efforts on assessing the impacts of fishing, pollution, and development on aquatic species and their habitats. A special effort is devoted to determining the impacts of dams on

freshwater species. This research is complemented by a number of conservation actions aimed to raise public awareness of these impacts.

In addition to these focused research activities, GDAWR continuously monitors the status of aquatic species. Monitoring programs include biological surveys of rivers, nearshore reefs, and beaches and creel surveys to assess both the inshore and offshore fisheries. These efforts are complimented by Haggan-Watch and Reef Check, volunteer monitoring programs for sea turtles and coral reefs.

Guam DAWR believes that through continued monitoring, research, and community involvement we can proactively manage Guam's aquatic species of concern to ensure the continued sustainability of these species in Guam's waters.

### Marine Vertebrates

#### Sea Turtles.

Three species of sea turtle inhabit the waters of Guam: hawksbill, *Eretmochelys imbricata* (Linnaeus 1766), green, *Chelonia mydas* (Linnaeus 1758), and leatherback, *Dermochelys coriacea* (Vandelli 1761) [Eldredge 2003b]. Hawksbills and greens also nest on Guam. The US Endangered Species Act of 1973 protects all three species of sea turtles. Hawksbills were listed as endangered in 1973, greens as threatened in 1978 and then up listed to endangered in 2016, and leatherbacks as endangered in 1970. In addition, hawksbills and greens are protected under local law (5 GCA Chapter 63 §63101-63117): hawksbills as endangered and greens as threatened.

Recently, NOAA/USFWS undertook a global green turtle status review and in March 2015 proposed to list eleven Distinct Population Segments (DPSs) of green sea turtles (*Chelonia mydas*) as Endangered or Threatened (USFWS 2015a, 80 FR 15271). NOAA/USFWS proposed to remove the current global range-wide listing of the green sea turtle and, in its place, list 8 DPSs as threatened and 3 DPSs as endangered. A public hearing was held in Guam on July 15, 2015, and the public comment period closed September 25, 2015. If accepted as proposed, green turtles within the Central West Pacific DPS, which includes Guam, would be up listed from threatened to endangered. On April 6, 2016, the final rule was published in the Federal Register listing the eight DPSs as threatened and three DPSs as endangered (USFWS 2015b, 81 FR 20057).

The green sea turtle is herbivorous and circumtropical in distribution. Individuals of this low-level nesting population are sighted throughout the year, particularly during December to February and May to June (NMFS-USFWS 1998a). Numerous individuals have been reported from northern Guam (Wiles et al. 1995).

Hawksbill turtles feed on sponges and are listed as endangered throughout their circumtropical range. Nesting individuals are virtually unknown on Guam; the first reported hawksbill turtle nest on Guam was in November 1991 (NMFS-USFWS 1998b).

The leatherback turtle is the largest species of marine turtle and is listed as endangered throughout its range. Individuals thrive on a diet of jellyfish and other soft-bodied animals. Although rare in the area, a 250-pound individual was rescued



from southeast of Cocos Island, Guam, on April 1978 (Anon. 1987). During aerial surveys (October 1989-April 1991), 2.6 % of the turtles recorded were leatherbacks (NMFS-USFWS 1998c).

*Threats.*

The life cycle of a sea turtle renders it vulnerable to various threats, both anthropogenic and natural. As eggs, they are vulnerable to predation by invasive species such as fire ants, pigs, and monitor lizards. Humans also occasionally take eggs. On shore, ghost crabs and birds, and then fish and other predators eat hatchlings when they enter the water. Juveniles and adults fall prey to sharks. Turtles also experience mortality due to anthropogenic effects such as oil spills, being trapped in fishing nets, and hooked as by-catch on longlines. Marine debris such as plastic bags can also be mistaken for jellyfish and other food items. Mating pairs and nesting females are vulnerable to poaching for human consumption. Turtle meat is culturally very important to Pacific Islanders and the rich protein source was certainly a contributing factor to their success at migrating throughout the Pacific (Amesbury and Hunter-Anderson 2003). Even though illegal, turtle meat is still commonly found in the backrooms at many island fiestas. Nesting beaches are impacted by development, especially loss of sand above mean high tide and the presence of high-intensity lighting. Light pollution confuses hatchlings, attuned to heading for the surf, normally the brightest part of the horizon.

*Reef Fish.*

While many reef-associated species on Guam have shown declines in average size and abundance, two species are of particular concern; the humphead wrasse (*Cheilinus undulatus*), and the bumphead parrotfish (*Bolbometapon muricatum*).

The humphead wrasse or tanguisson, as it is known on Guam, is one of the largest reef fish, reaching a size of over seven feet, and a weight of over four hundred pounds (Myers 1999). It grows slowly, taking up to nineteen years to reach a weight of 70 pounds (Myers 1999). This slow growth rate, coupled with its habit of sleeping in caves in relatively shallow water, leaves the humphead vulnerable to overfishing. This species is one of the most popular and valuable in the live reef fish food trade in east Asia and is therefore subject to a great deal of collecting pressure. Foreign fishing vessels have to travel further and further into the Pacific to meet demand. In 2004, the humphead wrasse was listed in CITES appendix II as a species of concern, primarily due to overfishing of the species throughout its range. Adult tanguisson are generally found on fore reef areas and are very uncommon on Guam. Juveniles may be seen more frequently on reef flats, especially in the Marine Preserves.

The bumphead parrotfish, known as atuhong on Guam, is another large reef fish vulnerable to overfishing. It is also slow growing, and its habit of sleeping in large groups in shallow water makes it vulnerable to overfishing, particularly scuba spearfishing. This fish, like the tanguisson, is uncommon in heavily populated areas. However, in remote areas, or areas with low human populations, it can still be found in large numbers (Myers 1999). This species is not used in the live reef fish trade and is not subjected to intense foreign fishing pressure that the humphead is. The atuhong is now almost completely absent from Guam's waters.

Other groups of reef fish that are a concern on Guam include groupers (Serranidae) and fish collected for the aquarium trade (Chaetodontidae, Pomacanthidae, Cirrhitidae). Groupers' life history makes them vulnerable to overfishing. They are slow growing with maturity coming after several years for most species (Myers 1999). Groupers are not migratory. Individuals usually find a cave or other structure to act as a home base, and seldom venture far from it. Not only does this make them easy to find but also replacement of individuals taken is a slow process. Groupers are voracious ambush predators, that will readily strike at lures or bait. They form seasonal spawning aggregations, based on a lunar cycle, and individuals may migrate for miles to congregate in favored sites (Myers 1999)

Aquarium fish collecting is not currently a major part of fish taken on Guam. In the 1980s and 1990s, however, Guam was a major source for aquarium fish in Japan and the United States. Hundreds of fish were shipped from Guam each month. The most popular species were rusty angelfish (*Centropyge shepardi*), flame hawkfish (*Neocirrhites armatus*), and butterfly fish (Chaetodontidae) (GDAWR). While no quantitative data has been taken, the populations of these species certainly had to be impacted by this level of collecting for multiple years. Flame hawkfish are common in areas without aquarium fish collecting (Myers 1999). On Guam, however, this is not a common species.

### Marine Mammals.

According to Eldredge (2003a), there have been 13 species of marine mammal recorded for Guam. The most common species are spinner dolphins, pilot whales, and sperm whales. Recent surveys by NOAA researchers have increased the number of marine mammals recorded from Guam's waters to at least 20, to include, 4 dugongs, 4 species of baleen whales, and at least 16 species of toothed whales (Val Brown, *pers.comm.*). Species that have been reported from Guam and the Mariana Islands are listed in Table 17.

### *Status*

The Marine Mammal Protection Act of 1972 protects all marine mammals found in the waters of Guam. Information about the marine mammals around Guam is limited to incidental reports (see Table 17). No rigorous study of populations has been undertaken to date.

### *Threats*

Marine mammals are threatened by loss of nearshore habitat and feeding grounds due to land-based sources of pollution and overfishing. They are threatened by climate change, marine debris, getting caught as by-catch in nets and on longlines, oil spills, overzealous tour operators, in-water military training exercises, etc.

Table 17. Records of Marine Mammals

<b>Species</b>	<b>Record</b>	<b>Reference</b>
<i>Balaenoptera edeni</i> Anderson, 1879 [Bryde's Whale]	A decomposed carcass washed ashore some 500 m north of Sella Bay, Guam, on August 31, 1978.	Davis, 1978
<i>Balaenoptera borealis</i> Lesson, 1828 [Sei Whale]	A single specimen was sighted west of Saipan. Two tagged sei whales from the Northern Mariana Islands were later killed several hundred kilometers south of the western Aleutian Islands.	Masaki, 1972 Horwood, 1987.
<i>Megaptera novaeangliae</i> (Borowski, 1781) [Humpback Whale]	Stories of sightings and killings of 9 whales in one season were recorded in the southern Mariana Islands. Two whales were reported about 100 m off the reef margin at Uruno Point on February 25, 1978. Three were sighted off the west coast of Guam on February 13, 1991. A group of three was photographed off Saipan in February 1991. A mother and calf were sighted off the east coast of Rota in late February 1991. A group of six or more was photographed at the entrance to Apra Harbor in January 1996.	Beane, 1905  Eads, pers. comm.  Eads, 1991  Darling & Mori, 1993  Stinson, pers. comm.  Anon., 1996
<i>Ziphius cavirostris</i> Cuvier, 1823 [Cuvier's Beaked Whale]	This species has been reported in the Mariana and Bonin Islands area.	Masaki, 1972, DAWR 2015
<i>Physeter macrocephalus</i> Linnaeus, 1758 [Sperm Whale]	Sightings throughout the year between 1761 and 1920, especially around the Marianas, Pohnpei, and Kosrae. One 15-m albino sperm whale was found beached at Acho Bay, Inarajan, Guam on September 5, 1962. One stranding reported. Eight sperm whales were sighted June 15, 2001, including a young calf with a trailing umbilical cord.	Townsend, 1935  Bordallo, 1965, Martin 1987  Kami & Lujan, 1976 <a href="http://www.mdaguam.com">www.mdaguam.com</a> , accessed February 9, 2005
<i>Kogia sima</i> Owen, 1866 [Dwarf Sperm Whale]	One whale washed ashore at Asan, March 25, 1970. One whale washed ashore at Rizal Beach, December 6, 1974. Two specimens from Guam are deposited in the U.S. National Museum. A dead dwarf sperm whale was	Kami & Lujan, 1976  Kami & Lujan, 1976  Reeves et al., 1999

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Species	Record	Reference
	found floating in Cocos Lagoon on August 24, 2002.	Radway, 2002
<i>Kogia breviceps</i> (de Blainville, 1838) [Pygmy Sperm Whale]	A partially decayed specimen was found at NSD Beach at Naval Station (Apra Harbor), Guam on February 9, 1989.	Sherwood, 1989
<i>Peponocephala electra</i> (Gray, 1846) [Melonheaded Whale]	A stranded male melon-headed whale was reported from Inarajan, Guam, on April 1980.	Kami & Hosmer, 1982
<i>Orcinus orca</i> (Linnaeus, 1758) [Killer Whale]	One killer whale was found beached at Orote Point, Guam n August 1, 1981 Two large male and two female killer whales were observed just offshore between Orote Point and Facpi Point, Guam during the summer of 1987.	Kami & Hosmer, 1982  Naughton, pers. comm.; Eldredge, 1991
<i>Globicephala macrorhynchus</i> Gray, 1846 [Shortfinned Pilot Whale]	A large school of about ten individuals were reported near Uruno Point, Guam. The first known beaching of an individual on Guam was reported on July 6, 1980.	Birkeland, 1977a  Kami & Hosmer, 1982; Donaldson, 1983
<i>Grampus griseus</i> (Cuvier, 1812) [Risso's Dolphin]	One group of Risso's dolphin was reported northwest of Guam. Additional sighting in the Mariana Islands and Guam were made during the winters 1993-1995.	Miyazaki & Wada, 1978  Miyashita et al., 1996
<i>Stenella longirostris</i> (Gray, 1828) [Spinner Dolphin]	A photo of two in the waters of Guam was published in 1984. Groups of 20 to 30 individuals were found at Pugua Patch Reef (Double Reef), Guam in April and May 1986 and in June 1988. Stinson (1994) reported spinner dolphins common throughout the Mariana Islands. Groups were common around Double Reef and Merizo throughout the late 90's and were the subjects of a dolphin-watching tourist industry.	Rock, 1984  Naughton, pers. comm.    Paulay, pers. comm.
<i>Stenella coeruleoalba</i> (Meyen, 1833) [Striped Dolphin]	A single freshly dead female was found at Dadi Beach, Agat Bay, Guam on July 24, 1985. One additional record occurs from Guam.	Nitta, pers. comm.  Wilson et al., 1987
<i>Dugong dugon</i> (Muller, 1776) [Dugong]	One recorded a single verified sighting of a dugong at the southern end of Cocos Lagoon in 1975. Eldredge (2003b) also mentions that several dugong sightings along the southeastern coast of Guam were reported in 1985. Sketches made by	Randall et al., 1975

Species	Record	Reference
	observers at the time matched the description of a dugong.	

Marine Invertebrates.

Several marine invertebrates are of concern. Four mollusks of concern are the giant clam and the gastropod, Triton’s trumpet snail. Guam currently has four species of giant clam; *Tridacna derasa* (transplanted) *Tridacna maximai*, *Tridacna squamosa*, and *Hippopu hippopus*. Local law on Guam currently restricts the taking of giant clams to individuals larger than 7 inches across. In addition, no more than three may be taken per day for food, no more than ten shells may be taken per day for shell collecting, and no giant clams may be taken for commercial purposes.

Giant clams of the family Tridacnidae are widespread through the Indo-Pacific. *Tridacna* clams are notable for their mantle, which is large and brightly colored, and for their life history. Giant clams do not feed, but instead rely on symbiotic algae living in their mantle to produce food for them. Giant clams are collected for their meat, for their shells, and for the aquarium trade. Giant clams are a popular source of meat in many islands. The shells may be harvested for the shell trade or may be used to make jewelry by indigenous peoples, including the Chamorro people of Guam. In recent years, the aquarium trade has come to rely almost exclusively on farmed clams, and the take of wild clams for the aquarium trade is minimal. Due to over-harvesting, giant clams are becoming uncommon or even extinct in many parts of their native ranges. Giant clams are listed under CITES Appendix II as species of concern, thus international trade in these bivalves is restricted.

Corals.

Corals are the backbone of the reef community, but they are also some of the most sensitive creatures in this ecosystem. Pollution, development, sedimentation, and climate change all pose serious threats to Guam’s corals. Many of Guam’s reefs have declined in health over the past 40 years. The average live coral cover on the fore reef slopes was approximately 50% in the 1960s (Randall 1971), but by the 1990s had dwindled to less than 25% live coral cover with only a few having over 50% live cover (Birkeland 1997b). Still, in the past, Guam’s reefs have recovered after drastic declines. For example, an outbreak of the crown-of-thorns starfish in the early 1970s reduced coral cover in some areas from 50-60% to less than 1%. Twelve years later, greater than 60% live coral cover was recorded for these areas (Colgan 1987). A more distressing indicator of the health of Guam’s coral reefs is the marked decrease in rates of coral recruitment. In 1979, Birkeland et al. (1982) obtained 0.53 coral recruits per Plexiglas fouling panel. The use of similar materials and experimental design in 1989 and 1992 resulted in just 0.004 and 0.009 coral recruits per Plexiglas fouling plates, respectively (Birkeland1997b).

In September 2014, three species of corals known to Guam were added to the Endangered Species list as threatened; *Acropora globiceps*, *Acropora retusa*, and *Seriatopora aculeata* (ESA, 1973). None of the three species is common on Guam’s reefs, but surveys will be conducted to identify their location and abundance. In 2015, National Oceanic and Atmospheric Administration proposed a potential 4(d) Rule for the ESA listed coral species in the Pacific Island Region to include Guam. When

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species are listed as “threatened”, there is no automatic prohibition against take even though they are now listed under the ESA. Since the corals are listed as threatened and there is no 4(d) Rule, the take of listed corals is not illegal under the federal ESA. 4(d) provides flexibility for the federal government to implement threatened listings in the most effective way for conservation of the species. Comments for the 4(d) Rule were due March 16, 2015.

## SOGCN INDIVIDUAL SPECIES ACCOUNT

### Terrestrial Animals and Plants

#### Mammals

**Common name:** Mariana fruit bat  
**Chamorro name:** fanihi  
**Scientific name:** *Pteropus mariannus mariannus*



**Historic and current status:** The Mariana fruit bat is an endemic (subspecies) mammal to Guam and the Mariana Islands. Historically, several thousand bats occurred on Guam in 1950s and dwindled to as low as 50 in 1978<sup>1</sup>. By 1982, the bat population increased to 850-1000<sup>2</sup> fruit bats. The sudden rise in population may have resulted from a migrant population from Rota to Guam<sup>3</sup>. In 1984, along with many of Guam’s native birds, the fruit bat was listed on the Endangered Species List. Currently, the population survives with less than 200 bats throughout Guam with no known roost colony site.

**Threats:** Poaching, predation uses of pesticides or chemical fertilizers, loss of habitat, and human disturbance may threaten this species to decrease. Brown tree snake may be contributing to the high mortality of young bats in the Guam population.

**Habitat(s):** Native mature limestone and ravine forest.

**Goal:** Restore population to a manageable number and implement Recovery Plan actions.

**Objectives:** To establish permanent colonies in the southern and northern part of Guam by creating areas controlled of poaching and brown treesnake predation. To survey for bats throughout Guam annually to monitor the status of the population throughout Guam. To restore or provide safe foraging and roosting sites for fruitbats.

**Action plan:** Introduced predators: Investigate limiting factors on the remaining population at known roost sites and foraging areas to develop effective control measures to be implemented. Habitat degradation and loss: Reduce deer and feral pig numbers at the colony and adjacent areas and outplant trees preferred by bats diet. Small or extirpated population: Investigate current population and the response to current weather trends. Outreach and Awareness: Revitalize “Prutehi I Fanihi” campaign. Establish partnership with other agencies and groups, and CNMI partners to develop and implement the campaign.

**References:**

1. U.S. Fish and Wildlife Service. 1990b. Guam Mariana fruit bat and little Mariana fruit bat Recovery Plan. Portland, Oregon.
2. Wiles, G. J. 1981-1984. The status, distribution, and natural history of the Mariana fruit bats. Guam Aquatic and Wildlife Resources Division Annual Reports, FY 1981-1984. Department of Agriculture, Guam.

3. Wiles, G. J., C. F. Aguon, G. W. Davis and D. Grout. 1995. The status and distribution of endangered animals and plants in Northern Guam. *Micronesica* 28: 31-49.



**Common name:** Pacific sheath-tail bat  
**Chamorro name:** finihi lihyang  
**Scientific name:** *Emballonura semicaudata rotensis*



**Historic and current status:** The sheath-tail bat is a subspecies endemic to Guam, Rota, Tinian, Saipan, and Aguiguan. Once occurred on Guam, the Pacific sheath-tailed bat was last seen in 1972<sup>1</sup>. Little is known with its ecological and historical past. This cave dwelling mammal now only exists in the island of Aguiguan, with an estimated 400-500 individuals<sup>2</sup>. Currently the Pacific sheath-tailed bat does not occur on Guam.

**Threats:** Predation, competition, human disturbance, and pesticides may have caused this species to be extirpated on Guam.

**Habitat(s):** Forages in forested areas, roost in caves in southern and northern Guam.

**Goal** Reduce snake numbers at historic roosting caves. Research the biology, behavior and other pertinent information to increase knowledge of the species (and similar species). Investigate and obtain information of current roost caves in CNMI to compare with caves on Guam scheduled for enhancement and preparation for future species reintroduction.

**Objectives:** To establish a small population of bats in a historic snake-free cave in northern Guam. To assist CNMI efforts to conduct surveys and restore population in Aguiguan. To determine the feasibility of implementing a captive breeding program.

**Action plan:** Introduced predators & competition: Investigate snake population at historic caves and plan for predator control measures to be implemented. Investigate Black drongo population near historic caves and bat's foraging areas. Knowledge gaps: Explore partnership with CNMI to establish a project to study the Natural History of the Sheath-tail bat to encourage research opportunities and increase monitoring efforts of the current population in Mariana Islands. Habitat degradation and loss: Prevent the destruction, and human disturbance of caves historically known to harbor sheath-tailed bats. Reduce deer and feral pig numbers at the colony and adjacent areas, develop and implement reforestation techniques in Guam's local and federal conservation areas. Outreach and Awareness: Expand "Prutehi I Fanihi" campaign to address Sheath-tail bat. Establish partnership with other agencies and groups, and CNMI partners to develop and implement the campaign.

**References:**

1. Wiles, G. J., C. F. Aguon, G. W. Davis and D. Grout. 1995. The status and distribution of endangered animals and plants in Northern Guam. *Micronesica* 28: 31-49.
2. Esselstyn J. A, G. J. Wiles, and A. Amar. 2004. Habitat use of the Pacific sheath-tailed bat (*Emballonura semicaudata*) on Aguiguan, Mariana Islands. *Acta Chiropterologica* 6: 303-308.

*Birds*

**Common name:** Guam rail  
**Chamorro name:** ko'ko'  
**Scientific name:** *Gallirallus owstoni*



**Historic and current status:** The Guam rail, endemic to Guam, was formerly found island-wide. In 1960, an estimated 60,000 birds were throughout the island<sup>1</sup>. The rail disappeared from southern Guam in the early 1970's and observed in central and north Guam<sup>2</sup>. In 1981, an estimated 2,300 birds were found only in northern Guam with the largest concentration on Andersen Air Force Base<sup>3</sup>. Over 2,000 rails were produced in captivity since the start of captive breeding in 1984<sup>4</sup>. Attempts to re-introduce the rails in a snake-controlled habitat occurred in 1998 and 2003. Several nests were found in the release site in Andersen Air Force Base, known as Area 50, and hatchlings were observed. The birds failed to establish themselves and were possible victims to feral cat predation. An experimental release program of rails on Rota began in 1989 with over 1,000 birds released to date. Currently there are approximately 150 rails on Rota and 129 birds in captivity on Guam in the Department's breeding facility. Additionally, there are 40 birds in the participating United States zoos and approximately 30 birds on Cocos Island.

**Threats:** The principal cause of decline and extinction in the wild is brown tree snake predation. Other causes that may have contributed to the decline may include: habitat loss and modification, human exploitation, typhoons, pesticides, competition, disease, and feral cat, feral dog, monitor lizard predation.

**Habitat(s):** The Guam rail has been observed in all habitats except wetlands.

**Goal:** To re-establish a breeding population of rails on Guam and Cocos Island.

**Objectives:** To maintain captive breeding population to provide for releases in the wild. To establish rails in designated predator-controlled sites on Guam.

**Action plan:** Introduced predators: Continue and expand brown tree snake and feral cat control efforts at potential release sites, and to continue supporting efforts to improve brown tree snake studies and measures. Small or extirpated populations: Continue captive breeding efforts, continue participation in Guam Rail Species Survival Plan, complete efforts to establish experimental population on Rota, CNMI, and determine additional sites for Guam rail introduction on Guam.

**References:**

1. Jenkins, J. M. 1979. Natural history of the Guam rail. *Condor* 81: 404-408.
2. Beck, R. E., Jr., and J. A. Savidge. 1990. Native forest birds of Guam and Rota of the Commonwealth of the Northern Mariana Islands Recovery Plan. Region 1 USFWS. Department of Agriculture, Government of Guam.
3. Engbring, J., and F. L. Ramsey. 1984. Distribution and abundance of the forest birds of Guam: results of a 1981 survey. U.S. Fish and Wildlife Service FWS/OBS-84/20.
4. Guam rail studbook, American Zoo and Aquarium Association (AZA).

**Common name:** White-throated ground dove

**Chamorro name:** paluman apaka (male) and paluman fache' (female)

**Scientific name:** *Gallicolumba xanthonura*

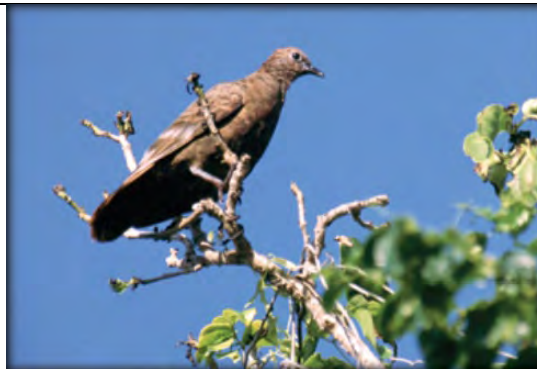


Photo of female dove.

**Historic and current status:** This subspecies of White-throated ground dove is endemic to the Mariana Islands and Yap. Historically this species was found in all habitats on Guam. Once abundant throughout Guam, by the 1980's the population was limited to northern Guam numbering about 548 individuals<sup>1</sup>. However, species is extirpated on Guam and was last seen in 1987 in northern Guam<sup>2</sup> there were sightings of 2 males in 2003 in Andersen Air Force Base and another sighting of a male in January 2005, flying along the Talofofo ridgeline on southern Guam<sup>3</sup>. The three sightings are presumably of birds from nearby Island of Rota. Incidental sightings of this species have been recorded between 2006-2015 in northern and southern Guam.

**Threats:** The principal cause of decline and extinction in the wild is brown tree snake predation. Other causes that may have contributed to the decline may include: habitat loss and modification, human exploitation, typhoons, pesticides, competition, disease, and feral cat, feral dog, monitor lizard predation.

**Habitat(s):** The ground dove was observed occupying various habitats throughout Guam, but principally prefers native limestone and ravine forests.

**Goal:** To restore a population of ground doves in northern and southern Guam.

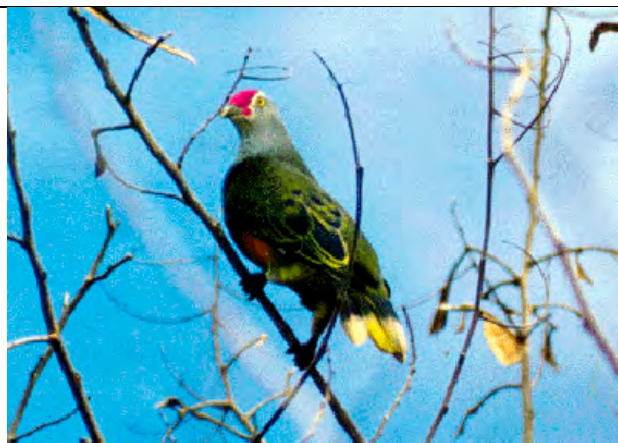
**Objectives:** To reintroduce a breeding population to Guam by translocating eggs, chicks, and/or adults from the Northern Mariana Islands to Guam, and releasing birds into the wild in predator-controlled sites. To explore the potential for captive breeding this species. To determine if individuals observed on Guam are migrating or established individuals.

**Action plan:** Introduced predators: Implement and expand area-wide brown treesnake control at potential release sites. Habitat degradation and loss: Reduce deer and feral pig numbers at potential release sites and adjacent areas, develop and implement reforestation techniques in Guam's conservation areas and military conservation lands. Small or extirpated populations: Explore the feasibility to capture and band individuals observed on Guam, and those found in Rota.

**References:**

1. Engbring, J., and F. L. Ramsey. 1984. Distribution and abundance of the forest birds of Guam: results of a 1981 survey. U.S. Fish Wildlife Service, FWS/OBS-84/20.
2. Wiles, G. J., C. F. Aguon, G. W. Davis, and D. Grout. 1995. The status and distribution of endangered animals and plants in Northern Guam. *Micronesica* 28: 31-49.
3. Division of Aquatic and Wildlife Resources field notes. 2003-2005. Unpublished Data.
4. Division of Aquatic and Wildlife Resources field notes. 2006-2015. Unpublished Data.

**Common name:** Mariana fruit-dove  
**Chamorro name:** totot  
**Scientific name:** *Ptilinopus roseicapilla*



**Historic and current status:** Endemic to Guam and the Northern Mariana Islands, the Mariana fruit dove was once found throughout Guam, excluding coastal strand and grassland. Surveys conducted in the 1970's indicated that the Mariana fruit dove population in southern Guam no longer existed and a severely reduced population in northern Guam<sup>1</sup>. This forest bird was extirpated on Guam in 1985<sup>2</sup>. Although they are not currently found on Guam, the Mariana fruit-dove still occurs in neighboring islands. A local resident reported an inconclusive sighting on 2012 in the Anao area.

**Threats:** The principal cause of decline and extinction in the wild is brown tree snake predation. Other causes that may have contributed to the decline may include: habitat loss and modification, human exploitation, typhoons, pesticides, competition, disease, and feral cat, feral dog, monitor lizard predation.

**Habitat(s):** The fruit-doves were observed in all forested habitats including native limestone and ravine forest, except savanna complex and beach strands.


**Goal:** To restore a population of fruit-doves on in northern and southern Guam.

**Objectives:** To reintroduce a breeding population to Guam by translocating eggs, chicks, and/or adults from the Northern Mariana Islands to Guam, and releasing birds into the wild in predator-controlled sites. To explore the potential for captive breeding this species.


**Action plan:** Introduced predators: Implement and expand area-wide brown treesnake control at potential release sites. Habitat degradation and loss: Reduce deer and feral pig numbers at potential release sites and adjacent areas, develop and implement reforestation techniques on Guam's conservation areas and federal conservation lands. Knowledge gaps: Explore partnership with CNMI to establish a project to study the Natural History of the totot to encourage research opportunities and increase monitoring efforts of the current population in Mariana Islands. Small or extirpated populations: Work with CNMI to translocate Mariana fruit-dove eggs and chicks from Rota to Guam.

**References:**

1. Division of Aquatic and Wildlife Resources (GDAWR). 1970-1999. Annual Reports. Federal Aid to Wildlife Restoration (Pittman-Robertson Act). Department of Agriculture, Government of Guam.
2. Wiles, G. J., C. F. Aguon, G. W. Davis, and D. Grout. 1995. The status and distribution of endangered animals and plants in Northern Guam. *Micronesica* 28: 31-49.

<p><b>Common name:</b> Mariana swiftlet  <b>Chamorro name:</b> yayaguak  <b>Scientific name:</b> <i>Aerodramus vanikorensis bartschi</i></p>	
<p><b>Historic and current status</b> The Island swiftlet is endemic to the Mariana islands of Guam, Rota, Aguigan, Tinian and Saipan. Historically the Island swiftlet was widely distributed and common on Guam. This species was described the most common in 1945 surveys<sup>1</sup>. After being described as the most common bird on Guam, the swiftlets underwent a drastic decline during the late 1960's through the 1970's<sup>2</sup>. Today, the swiftlet population is estimated at over 1,000 birds a result of snake control efforts at the Mahlac, Maemong, and Fachi caves (south colony), Naval Ordnance Area. In early 2000, GDAWR received a report of a small number (less than 20 birds) in northern Guam, Janum Point<sup>3</sup>.</p>	
<p><b>Threats:</b> Habitat loss and degradation (loss of foraging habitat and cave disturbance), predation by the brown tree snake on Guam, nest damage by insects, and climate change are ongoing threats; the current threats from pesticides is unknown<sup>4</sup>.</p>	
<p><b>Habitat(s):</b> The swiftlet nests and roosts on cave walls and ceiling. They forage in various habitats on Guam.</p>	
<p><b>Goal:</b> To restore populations in northern Guam and restore and implement predator control at other cave habitats within swiftlets range in southern Guam.</p>	
<p><b>Objectives:</b> To expand the distribution of this population by recolonizing a cave in northern Guam by the translocation of swiftlets from the south colony. To maintain and enhance the population in the southern colony. To continue monitoring the population of swiftlets.</p>	
<p><b>Action plan:</b> <u>Introduced predators &amp; competition:</u> Continue snake control measures at the Mahlac, Maemong, and Fachi caves, and implement and expand area-wide brown treesnake control to potential release sites. Investigate impacts from Black drongo to determine if reducing drongo population is needed. <u>Habitat degradation and loss:</u> Prevent the loss of cave historically used by swiftlets, and reduce deer and feral pig numbers around potential release sites. Develop and implement reforestation measures on Guam conservation areas and national wildlife refuge overlay lands. <u>Small or extirpated population:</u> Monitor population abundance and distribution. Translocate birds from the southern population and re-introduce to historical swiftlet caves in the north. <u>Climate change:</u> Research climate change impacts effecting swiftlet colony at the Fachi cave during prolonged rain events (flooding) and other limiting factors of climate change that may alter the swiftlets.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. U.S. Fish and Wildlife Service. 1991a. Recovery Plan for the Mariana Islands population of the Vanikoro swiftlet, <i>Aerodramus vanikorensis bartschi</i>. U.S. Fish and Wildlife Service, Portland, Oregon.</li> </ol>	

2. Jenkins, J. M. 1983. The native forest birds of Guam. Ornithological Monographs No. 31, The American Ornithologists' Union Washington, D.C.
3. Division of Aquatic and Wildlife Resources field notes. 2003-2005. Unpublished Data.
4. U.S. Fish and Wildlife Service. 2015d. Mariana Swiftlet or Chachaguak (*Aerodramus bartschi*) 5-Year Species Review.

<p><b>Common name:</b> Guam Micronesian kingfisher  <b>Chamorro name:</b> sihek  <b>Scientific name:</b> <i>Todiramphus cinnamominus cinnamominus</i></p>	
<p><b>Historic and current status:</b> Micronesian kingfisher is endemic to Guam. Historically they occurred throughout the island, but were not as abundant in ravine and coastal forests of southern Guam<sup>1</sup>. The kingfisher was last recorded in southern Guam by mid-1960<sup>1</sup>. In 1981, a population occurred only in northern Guam with an estimated 3,023 individuals<sup>2</sup>. In 1984, 19 individuals were captured captive for breeding. By 1988, this species was no longer found in wild on Guam<sup>3</sup>. Currently, 11 birds are in captivity on Guam and about 150 in various U.S mainland zoos.</p>	
<p><b>Threats:</b> The principal cause of decline and extinction in the wild is brown tree snake predation. Other causes that may have contributed to the decline may include: habitat loss and modification, human exploitation, typhoons, pesticides, competition, disease, and feral cat, feral dog, monitor lizard predation.</p>	
<p><b>Habitat(s):</b> This species once occupied all habitats throughout Guam, except savanna complex and wetlands. As this species nests in cavities, forests with <i>Pisonia grandis</i> trees are particularly important.</p>	
<p><b>Goal:</b> To restore a wild population on Guam.</p>	
<p><b>Objectives:</b> To continue captive breeding efforts to maintain a sufficient supply of birds for upcoming releases.</p>	
<p><b>Action plan:</b> <u>Introduced predators:</u> Implement and expand area-wide brown tree snake and feral cat (predator) control at potential release sites. <u>Habitat degradation and loss:</u> Reduce deer and feral pig numbers at potential release sites and adjacent areas, develop and implement reforestation measures on Guam’s conservation areas and national wildlife refuge overlay lands. <u>Small or extirpated populations:</u> Continue participation in Micronesian kingfisher SSP, to continue captive breeding on Guam, and determine potential sites for Micronesian kingfisher re-introduction on Guam.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Jenkins, J. M. 1983. The native forest birds of Guam. Ornithological Monographs No. 31, The American Ornithologists’ Union Washington, D.C.</li> <li>2. Micronesia kingfisher SSP, American Zoo and Aquarium Association (AZA).</li> <li>3. Wiles, G. J., C. F. Aguon, G. W. Davis, and D. Grout. 1995. The status and distribution of Endangered Animals and Plants in Northern Guam. Micronesica 28: 31-49.</li> </ol>	



**Common name:** Mariana crow  
**Chamorro name:** åga  
**Scientific name:** *Corvus kubaryi*



**Historic and current status:** The Mariana crow is endemic to Guam and Rota. Historically, the crow was once abundant throughout Guam. In 1981, the crow population was restricted to parts of the northern plateau with an estimated 350 birds<sup>1</sup>. By 1999, fewer than 7 wild crows remained strictly on AAFB property<sup>2</sup>. The last Mariana crow died in captivity on Guam in 2013. There are no wild crows on Guam and less than 150 crows remaining on Rota.

**Threats:** The principal cause of population the decline has been the brown tree snake. Other factors may include: habitat loss and modification, human exploitation, typhoons, pesticides, competition, disease, predation, food resources, inbreeding, and senescence<sup>3</sup>. Restoration of the crow could be hampered by the loss of forest habitat required by this species.

**Habitat(s):** The Mariana crow was found in most habitats on Guam, except the savanna. They were commonly observed in mature native forest, second growth and mix-woodlands<sup>4</sup>.

**Goal:** To restore the crow population to 1984 levels in Guam of about 300 birds. To collaborate efforts with CNMI-DFW to restore crow population on Rota.

**Objectives:** To translocate birds from Rota to Guam to start a captive breeding program that will mirror and supplement a captive breeding program being established on Rota. To work with the CNMI Fish and Wildlife to translocate eggs or chicks from Rota to Guam. To implement artificial incubation and hand rearing during breeding season on Rota.

**Action plan:** Introduced predators: Continue implementing electrical nest barriers to protect active crow nests, continue and expand area-wide brown tree snake control at release site and adjacent areas, and assess brown tree snake threshold for crow nesting efforts. Habitat degradation and loss: To manage deer and feral pig numbers on AAFB, develop and implement reforestation measures on conservation areas on Guam. Small or extirpated populations: Work with CNMI to translocate Mariana crow eggs and chicks from Rota to Guam and continue to implement aviculture enhancement techniques to increase the size of the Guam' crow population and to supplement the Rota population.

**References:**

1. Engbring J., and F. L. Ramsey. 1984. Distribution and abundance of the forest birds of Guam: results of a 1981 survey. United States Fish and Wildlife Service FWS/OBS-84/20.
2. Jenkins, J. M. 1983. The native forest birds of Guam. Ornithological Monograph No. 31, The American Ornithologists' Union Washington, D.C.
3. National Research Council. 1997. The Scientific Bases for Preservation of the Mariana Crow. National Academy Press.
4. Division of Aquatic and Wildlife Resources (GDAWR). 1982-1999. Annual Reports. Department of Agriculture, Government of Guam. Unpublished Reports.

**Common name:** Micronesian starling  
**Chamorro name:** sãli  
**Scientific name:** *Aplonis opaca guami*



**Historic and current status:** A subspecies endemic to Guam, Rota, Tinian, and Saipan, the Micronesian starling is a cavity nester. Historically, the starling was found throughout Guam occupying all habitats, but commonly in forested areas<sup>1</sup>. A survey in 1981 determined that the starling on Guam was one of the most abundant species during the survey<sup>2</sup>. Starlings are still found in AAFB housing area, and nearby Mount Santa Rosa. A bird survey in 2005 recorded small numbers of juveniles and family groups observed along the Mount Santa Rosa and Andersen housing routes. More recently, groups of starlings have also been found in Agana, Tamuning, Harmon, Dededo, Tumon Bay, and Inarajan villages<sup>3</sup>. In addition, an isolated population of approximately 100 birds is found on Cocos Island, south of Guam.

**Threats:** The principal cause of decline in the wild is brown tree snake predation. Other sources of mortality may include: habitat loss and modification, human exploitation, typhoons, pesticides, competition, disease, and feral cat, feral dog, monitor lizard predation.

**Habitat(s):** The starling utilized all habitat types although they were more common in forested areas.

**Goal:** To increase population numbers and distribution in Guam.

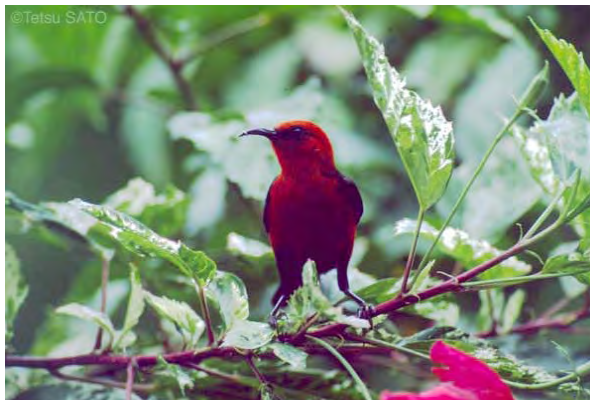
**Objectives:** To promote successful nesting in AAFB and Cocos Island, and other designated sites. To translocate birds from Cocos Island to snake-free areas.

**Action plan:** Introduced predators & competition: Implement and expand area-wide brown treesnake control at potential release sites. Investigate impacts from Black drongo to determine if reducing drongo population is needed. Habitat degradation and loss: Reduce deer and feral pig numbers impacting starling foraging areas. Small and extirpated populations: Explore the feasibility in implementing nest boxes across central Guam. Outreach & awareness: Establish a campaign addressing human exploitation, pesticide use, and encouraging partnerships with community to increase conservation efforts.

**References:**

1. Jenkins, J. M. 1983. The native forest birds of Guam. The American Ornithologists' Union Washington, D. C.
2. Engbring, J., and F. L. Ramsey. 1984. Distribution and abundance of the forest birds of Guam: results of a 1981 survey. U.S. Fish Wildlife Service, FWS/OBS-84/20.
3. Division of Aquatic and Wildlife Resources field notes. 2005-2015. Unpublished Data.

**Common name:** Micronesian honeyeater  
**Chamorro name:** egigi  
**Scientific name:** *Myzomela rubratra saffordi*



**Historic and current status:** This subspecies of honeyeater is endemic to the Mariana Islands. Historically, this species was abundant throughout Guam occupying all habitats including urban areas<sup>1</sup>. In 1980, the declining population was found only in the Northwest field in AAFB<sup>2</sup>. By 1986, the bird was extirpated in Guam<sup>3</sup>. Currently, the honeyeater is found in neighboring islands of Rota and Saipan where healthy populations exist.

**Threats:** The principal cause of decline and extinction in the wild is brown tree snake predation. Other causes that may have contributed to the decline may include: habitat loss and modification, human exploitation, typhoons, pesticides, competition, disease, and predation by feral cats, dogs, rats and monitor lizards.

**Habitat(s):** A versatile species, the honeyeater was once found in various habitat types on Guam including strand forest, scrub forest, limestone forest, urban and agriforest areas.


**Goal:** To restore populations of honeyeaters on Guam.

**Objectives:** Obtain information to better understand the biology of the species. Enhance habitat on Guam to allow for reintroduction. Translocate honeyeaters from Rota or Saipan.


**Action plan:** Introduced predators: Implement and expand area-wide brown treesnake, feral cat and rodent control at potential release sites. Knowledge gaps: Explore partnership with CNMI to establish a project to study the Natural History of the honeyeater to encourage research opportunities and increase monitoring efforts of the current population in Mariana Islands. Small or extirpated populations: Partner with CNMI to increase efforts to survey and monitor population in Rota and/or Saipan.


**References:**

1. Jenkins, J. M. 1983. The native forest birds of Guam. The American Ornithologists' Union Washington, D.C.
2. Engbring, J., and F. L. Ramsey. 1984. Distribution and abundance of the forest birds of Guam: results of a 1981 survey. U.S. Fish Wildlife Service, FWS/OBS-84/20.
3. Wiles, G. J., C. F. Aguon, G. W. Davis, and D. Grout. 1995. The status and distribution of Endangered Animals and Plants in Northern Guam. *Micronesica* 28: 31-49.


<p><b>Common name:</b> Mariana common moorhen  <b>Chamorro name:</b> pulattat  <b>Scientific name:</b> <i>Gallinula chloropus guami</i></p>	
<p><b>Historic and current status:</b> The Mariana common moorhen is an endemic subspecies to Guam, Saipan, Tinian and Pagan. Before 1951, the population was noticeably abundant in freshwater areas<sup>1</sup>. The species has experienced population declines in recent years. Results from a 1981 survey showed that the moorhen was rare, with only 2 birds accounted for during the survey<sup>2</sup>. By 1999, moorhens were found throughout the southern and central parts of Guam, with population estimated at 100-125 birds<sup>3</sup>. Currently, the population numbers about 90 birds<sup>4</sup>. Sightings of adult pairs with chicks are being made in wetland habitats throughout the island.</p>	
<p><b>Threats:</b> Possible causes that may lead to the decline of this species include: habitat loss and modification, competition, human disturbance, development and encroachment of undesirable vegetation and predation.</p>	
<p><b>Habitat(s):</b> The Mariana common moorhen is abundant in freshwater habitats both natural and manmade throughout Guam.</p>	
<p><b>Goal:</b> To restore and maintain a population throughout Guam’s wetlands.</p>	
<p><b>Objectives:</b> To maintain wetland habitat and prevent encroachment by development and invasive species.</p>	
<p><b>Action plan:</b> <u>Introduced predators:</u> Implement and expand area-wide brown treesnake control at potential sites, as well as, control for other predators. <u>Habitat degradation and loss:</u> Reduce and prevent loss of wetlands, and encroachment by invasive plants. To inventory the wetlands and implement a plan to open areas being choked by <i>Phragmites karka</i>. To assess the status of mitigation wetland areas and take appropriate management actions. Strengthen protection of wetlands throughout Guam. <u>Small or extirpated populations:</u> Partner with CNMI to establish a project to determine current population status and explore techniques to improve breeding habitats (habitat preference model). <u>Climate change:</u> Investigate impacts of prolonged droughts and increase rain events effecting moorhens.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Baker, R. H. 1951. The avifauna of Micronesia, Its origin, evolution, and distribution. University of Kansas Publications Museum of Natural History 3: 1-359.</li> <li>2. Engbring, J., and F. L. Ramsey. 1984. Distribution and abundance of the forest birds of Guam: results of a 1981 survey. U.S. Fish Wildlife Service, FWS/OBS-84/20.</li> <li>3. Division of Aquatic and Wildlife Resources (GDAWR). 1999. Annual Reports. Federal Aid to Wildlife Restoration (Pittman-Robertson Act). Department of Agriculture, Government of Guam. Unpublished Data.</li> </ol>	

4. Takano, L. 2003. Seasonal movement, home range, and abundance of the Mariana common moorhen (*Gallinula chloropus guami*) on Guam and the Northern Mariana Islands. Master's Thesis, Oregon State University.

<p><b>Common name:</b> Nightingale reed-warbler  <b>Chamorro name:</b> ga' kaliso/ga'karriso  <b>Scientific name:</b> <i>Acrocephalus luscinia luscinia</i></p>	
<p><b>Historic and current status:</b> The Nightingale reed-warbler is an endemic subspecies to Guam, Saipan, and Almagan. Historically, this bird was known to be rare on Guam being restricted to wetlands<sup>1</sup>. By the 1960s, the Nightingale reed-warbler was considered common in four locales: Agana Swamp, Atantano River Marsh, Masso River Mouth, and an undescribed location in Agat<sup>2</sup>. After 1969, this bird species was not found in areas it once occupied<sup>2</sup>. Presently, the Nightingale reed-warbler no longer inhabits the wetlands in Guam.</p>	
<p><b>Threats:</b> The principal cause of decline and extinction in the wild is brown tree snake predation. Other causes that may have contributed to the decline may include: habitat loss and modification, wild fires, human exploitation and development, typhoons, pesticides, competition, disease, and ungulates.</p>	
<p><b>Habitat(s):</b> Restricted to adjacent areas in and near fresh and brackish water marshes.</p>	
<p><b>Goal:</b> To restore a viable population to Guam.</p>	
<p><b>Objectives:</b> Obtain information to better understand the biology of the species. Enhance habitat on Guam to allow for reintroduction. Translocate reed-warblers from CNMI to Guam.</p>	
<p><b>Action plan:</b> <u>Introduced predators:</u> Implement area-wide brown treesnake control in the wetlands on Guam. <u>Habitat degradation and loss:</u> Reduce deer and feral pig numbers, develop and implement habitat preparation techniques on wetlands, and strengthen and enforce regulations on development and usage of the wetlands. <u>Knowledge gaps:</u> Explore partnership with CNMI to establish a project to study the Natural History of the reed-warbler to encourage research opportunities and increase monitoring efforts of the current population in Mariana Islands. <u>Small or extirpated population:</u> Work with CNMI to increase monitoring efforts (population abundance and distribution). <u>Climate change:</u> Research climate change impacts effecting reed-warbler nesting sites during prolonged rain events (flooding) and other limiting factors of climate change that may alter the species.</p>	
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>1. Baker, R. H. 1951. The avifauna of Micronesia, Its origin, evolution, and distribution. University of Kansas Publications Museum of Natural History 3: 1-359.</li> <li>2. Reichel, J. D., G. J. Wiles, and P. O. Glass. 1992. Island extinctions: the case of the endangered nightingale reed-warbler. Wilson Bulletin 104: 44-54.</li> </ol>	

<p><b>Common name:</b> White-tailed tropicbird  <b>Chamorro name:</b> utak or fakpe  <b>Scientific name:</b> <i>Phaethon lepturus</i></p>	
<p><b>Historic and current status:</b> The White-tailed tropicbird occurs in all but the easternmost Pacific areas. Surveys in 1945 indicated a nesting colony in crevices along the cliff walls on northern Guam. In 1985, a small breeding population nested along the northern cliff at Two Lover's Point, Guam. Currently, no breeding pairs have been recorded. However, this species continues to be observed around Guam mainly as a visitor from the neighboring island of Rota.</p>	
<p><b>Threats:</b> Predation by the brown tree snake is the most likely reason for the loss of the resident population on Guam.</p>	
<p><b>Habitat(s):</b> Foraging from reef flat to open deep sea, nest in crevice located on cliff walls.</p>	
<p><b>Goal:</b> To restore a nesting population to northern Guam.</p>	
<p><b>Objectives:</b> To maintain snake free habitats along northern cliff walls.</p>	
<p><b>Action plan:</b> <u>Introduced predators:</u> Implement and expand area-wide brown tree snake control at potential roost and nest sites. <u>Habitat degradation and loss:</u> To prevent loss of historic cliffline roost sites. <u>Small or extirpated populations:</u> Collect information on this species distribution and abundance. Identify potential nest and roosting sites on Guam, and respond appropriately to promote nest success in these areas.</p>	
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>1. Baker, Rollin H. 1951. The avifauna of Micronesia, Its origin, evolution, and distribution. University of Kansas Publications Museum of Natural History 3: 1-359.</li> <li>2. Division of Aquatic and Wildlife Resources (GDAWR). 1985. Annual Reports. Federal Aid to Wildlife Restoration (Pittman-Robertson Act). Department Agriculture, Government of Guam</li> </ol>	



<p><b>Common name:</b> Pacific reef heron  <b>Chamorro name:</b> chuchuko'  <b>Scientific name:</b> <i>Egretta sacra</i></p>	 <p>© H. &amp; J. Beste</p>
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**Historic and current status:** The Pacific reef heron occurs in many areas of the tropical Pacific. The Pacific reef heron is an endemic shorebird to Guam. Historically, a breeding population occurred throughout the western coast (Orote Peninsula) to Cocos Island<sup>1</sup>. In 1981, sightings were common in northern Guam during a survey, and several individuals were seen along the Cocos Island coast<sup>2</sup>. There is no evidence of this species breeding on Guam, though sightings of individuals still occur near Cocos Island and the southern shores. Currently, reef herons may be seen foraging along the reef flats during the day around Guam.

**Threats:** A possible cause that may lead to the absence of this species includes: snake and rat predation and habitat loss and modification.

**Habitat(s):** Pacific reef herons are found on reef flats and occupying coastal strands and islets.


**Goal:** To determine the population and breeding status of reef herons on Guam.

**Objectives:** To determine the status of the Guam population. To identify nesting areas and roost sites and implement appropriate protective measures.

**Action plan:** Determine population status: Investigate current population status for reef herons on Guam and locate nest and/or roost sites. Introduced predators: Investigate cause of decline of the population and lack of successful nests at known nest and roost sites. Effective monitoring: Investigate natural history of reef herons to obtain and analyze data to help develop a management plan.

**References:**

1. Baker, R. H. 1951. The avifauna of Micronesia, Its origin, evolution, and distribution. University of Kansas Publications Museum of Natural History 3: 1-359.
2. Engbring, J. and F. L. Ramsey. 1984. Distribution and abundance of the forest birds of Guam: results of a 1981 survey. U.S. Fish Wildlife Service. FWS/OBS-84/20.

<p><b>Common name:</b> Brown booby  <b>Chamorro name:</b> lu'ao  <b>Scientific name:</b> <i>Sula leucogaster</i></p>	
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**Historic and current status:** The Brown booby occurs throughout the tropical Pacific and south to Australia. Historically, brown boobies were not seen abundantly throughout Micronesia<sup>1</sup>. Twenty-five birds were seen roosting on Orote Point from June to August 1997<sup>2</sup>. Recently, incidental sightings of individuals ranging from the Orote peninsula to the north, extending to the eastern and southeastern shores of Guam had been made.

**Threats:** Predation by the brown tree snake and rats may have caused this species to be extirpated from Guam.

**Habitat(s):** Brown boobies nest on the ground or in cliff walls, and forage along reef flats, and are usually seen in flight along steep rocky cliffs.


**Goal:** To restore a population on Guam.

**Objectives:** Predator control in areas identified as historic nesting and roosting locations.

**Action plan:** Introduced predators: Implement and expand area-wide brown tree snake control at historical roost and nest sites. Small or extirpated populations: Survey coastal areas for potential brown booby roost sites.

**References:**

1. Baker, R. H. 1951. The avifauna of Micronesia, Its origin, evolution, and distribution. University of Kansas Publications Museum of Natural History 3: 1-359.
2. Division of Aquatic and Wildlife Resources (GDAWR). 1997. Annual Reports. Federal Aid to Wildlife Restoration (Pittman-Robertson Act). Department Agriculture, Government of Guam.

<p><b>Common Name (group):</b> Migratory Shorebirds  <b>Chamorro Name (group):</b> Dulili  <b>Scientific Name:</b> N/A (multiple species)</p>	
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**Historic and current status:** Over 40 species of migratory shorebirds representing Charadriidae and Scolopacidae are known to winter in Guam<sup>1,2,3</sup>. In addition, various species of terns, raptors, and egrets winter on Guam as vagrants, though in much smaller numbers. Studies indicate that a great majority of migrants fly over Guam<sup>4</sup>. Wetland, estuaries, tidal flats, grasslands, and uplands are important habitats for migrant shorebirds and resident shorebirds<sup>3</sup>. While some species are not considered important to the overall survivorship of the species, a few species of considered important.

**Threats:** Predators and loss of habitat remain significant factors in reducing the number of migrants on Guam. Though it is believed that a great number of species make Guam a minor stopover in the migration, conservation actions remain important in supporting the survivorship of these species.

**Habitat:** Mud flats, reef flats, and open fields are important habitats for many of the shorebirds.

**Goal:** Restore and maintain habitat for migratory shorebirds.


**Objectives:** 1.) Determine the abundance and distribution of shorebirds. 2.) Reduce brown tree snakes and rats in areas used by the different species. 3.) Prevent habitat loss.

**Action Plan:** Monthly shorebird surveys: Conduct monthly surveys for 2-years to determine the abundance and distribution of migratory shorebirds on Guam. Predator control: Where appropriate control predation on shorebirds. Habitat degradation and loss: Reduce or prevent the loss the habitat important to shorebirds.

**Reference:**

1. Reichel, J. D., and P. O. Glass. 1991. Checklist of the birds of the Mariana Islands. *Ele'apio* 51: 3-11.
2. Wiles, G. J., D. Worthington, R. E. Beck, Jr., C. F. Aguon, and R. L. Pyle. 2000. Noteworthy bird records for Micronesia, with summary of raptor sightings within the Mariana Islands, 1988-1999. *Micronesica* 32: 257-284.
3. Engilis, A., Jr., and M. Naughton. 2004. U. S. Pacific Islands regional shorebird conservation plan. U. S. Fish and Wildlife Service, Portland.
4. Williams, T. C., and J. M. Williams. 1988. Radar and visual observations of autumnal (southward) shorebird migration on Guam. *Auk* 105: 160-466.

*Reptiles*

<p><b>Common Name:</b> Snake-eye skink  <b>Chamorro Name:</b> guali'ek halom tano'  <b>Scientific Name:</b> <i>Cryptoblepharus poecilopleurus</i></p>	
<p><b>Historic and current status:</b> The snake-eye skink was known to have a widespread range throughout Guam and the Marianas Islands<sup>1</sup>. The last recorded specimen found on Guam was in 1969<sup>2</sup>. Its status on Guam is unknown, although they still occur in Cocos Island.</p>	
<p><b>Threats:</b> Possible cause of decline of this species may include: predation by introduced species and competition with introduced skink species.</p>	
<p><b>Habitat:</b> Observed near coastal strands, often found in loose, sandy soil.</p>	
<p><b>Goal:</b> To restore populations to coastal areas of Guam.</p>	
<p><b>Objectives:</b> To determine the status of this species on Guam and Cocos Island. To implement actions to improve species status.</p>	
<p><b>Action Plan:</b> <u>Introduced predators:</u> Implement and expand area-wide brown tree snake, musk shrew, feral cat, rat control at potential habitat preference. <u>Habitat degradation and loss:</u> Prevent loss of habitats deemed important to the skinks. <u>Small or extirpated populations:</u> Identify lizard population abundance where they occur and consider the potential of captive propagation for future releases in protected areas on Guam.</p>	
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>1. Rodda G. H, T. H. Fritts, and J. D. Reichel. 1991. The distributional patterns of reptiles and amphibians in the Mariana Islands. <i>Micronesica</i> 24: 95-210.</li> <li>2. Extinction and loss of species from Guam: lizards. <a href="http://www.mesc.usgs.gov">www.mesc.usgs.gov</a></li> </ol>	

**Common Name:** Slevin’s skink  
**Chamorro Name:** guali’ek halom tano’  
**Scientific Name:** *Emoia slevini*



**Historic and current status:** An endemic species to Guam, Cocos Island, Rota, Tinian, Guguan, Alamagan, Asuncion, and Maug. Historically this species was found throughout Guam and the other islands where it occurs. On Guam, it has not been recorded since 1945. It was probably not common<sup>1</sup>. This species occurs in a small area of Cocos Island. Currently, the Slevin’s skink is found in the northern islands of Sarigan, Guguan, Alamagan, Pagan, and Asuncion<sup>2,3</sup>.

**Threats:** Possible causes to the decline of this species may include: predation and competition.

**Habitat:** Forested areas; found on the forest floors, in old fields, and low on tree trunks.

**Goal:** To restore the species to Guam and improve numbers on Cocos island.

**Objectives:** To supplement the current population on Guam and Cocos Island from other islands (CNMI).

**Action Plan:** Introduced predators: Continue area-wide brown tree snake, monitor lizard, musk shrew, feral cat, and rat control on Cocos Island to increase abundance.

Habitat degradation and loss: Prevent loss of habitats deemed important to the skinks.

Small or extirpated population: Identify abundance of lizard population where they occur and consider the potential of captive propagation for future releases in protected sites on Guam. Explore possible ways of habitat expansion on Cocos Island.

**References:**

1. Extinctions and Loss of Species from Guam: Lizards. USGS [www.mesc.usgs.gov](http://www.mesc.usgs.gov)
2. Rodda G. H, T. H. Fritts, and J. D. Reichel. 1991. The distributional patterns of reptiles and amphibians in the Mariana Islands. *Micronesica*. 24: 195-210.
3. Vogt, S. R., and L. L. Williams. 2004. Common flora and fauna of the Mariana Islands. Williams and Vogt Published.

**Common Name:** Azure-tailed skink  
**Chamorro Name:** guali'ek halom tano'  
**Scientific Name:** *Emoia cyanura*



**Historic and current status:** The Azure-tailed skink was once found in southern Guam in the area of the Geus River, which drains into the Cocos lagoon<sup>1</sup>. Currently, this species can only be found on Cocos Island. The status of the species on Cocos Island is unknown. Guam's population has been extirpated. This species is easily confused with the Blue-tailed skink (*Emoia caeruleocauda*).

**Threats:** Possible cause to the decline of this species may include: predation and competition with introduced skink species.

**Habitat:** Reportedly prefers hot, dry, open areas especially those near the coast<sup>2</sup>.

**Goal:** To restore this species to Guam.

**Objectives:** To determine status on Guam and Cocos Island. Reintroduce to native range on Guam.

**Action Plan:** Population survey: Survey Guam and Cocos Island to determine the current size and distribution of the population. Introduced predators: Implement and expand area-wide introduced species control of curious skinks, shrews, and rats. Habitat degradation and loss: Prevent loss of key coastal habitats deemed important to the skinks. Small and extirpated populations: Determine the status of this species on Guam and implement a captive propagation for future releases in protected areas on Guam.

**Reference:**

1. Rodda G. H, T. H. Fritts, and J. D. Reichel. 1991. The distributional patterns of reptiles and amphibians in the Mariana Islands. *Micronesica*. 24: 195-210.
2. McCoy, M. 1980. Reptiles of the Solomon Islands. Wau Ecology Institute Handbook No. 7., Wau Papua New Guinea.

**Common Name:** Moth skink  
**Chamorro Name:** guali'ek halom tano'  
**Scientific Name:** *Lipinia noctua*



**Historic and current status:** The Moth skink is found in much of the western Pacific, in the Mariana Islands, it is found only on Guam<sup>3</sup>. A native species to the Marianas, this species was not common on Guam. However, four individuals were collected on a single day in 1986<sup>1</sup>. In the early 1990's, the Moth skink was known to occur at three areas: Hilaan Point, Haputo Beach, and Achae Point along the northwestern coast<sup>2</sup>. However, Vogt and Williams<sup>3</sup> indicate it occurs in central parts of Guam and abundant in the Naval Ordnance Annex area, but there is conflicting information on its status<sup>1</sup>.

**Threats:** Possible cause to the decline of this species may include: predation and competition with introduced skink species.

**Habitat:** Moth skinks use large tree trunks with loose bark in forested areas.

**Goal:** To determine the status of this species and take appropriate actions.

**Objectives:** To survey population of the Moth skink in Hilaan Point, Haputo Beach, Achae Point, Naval Ordnance and other potential areas on Guam.

**Action Plan:** Introduced predators: Implement and expand area-wide introduced species control, of curious skinks, shrew, and rats. Habitat degradation and loss: Prevent loss of key-forested habitats deemed important to the skinks. Small and extirpated populations: Determine the status of this species on Guam and implement a captive breeding program for future releases in protected areas on Guam.

**References:**

1. Extinctions and Loss of Species from Guam: Lizards. USGS, [www.mesc.usgs.gov](http://www.mesc.usgs.gov).
2. Wiles, G. J., C. F. Aguon, G. W. Davis, and D. Grout. 1995. The status and distribution of endangered animals and plants in northern Guam. *Micronesica* 28(1): 31-49.
3. Vogt, S. R., and L. L. Williams. 2004. Common flora and fauna of the Mariana Islands. Williams and Vogt Published.

<p><b>Common Name:</b> Micronesian gecko  <b>Chamorro Name:</b> guali'ek halom tano'  <b>Scientific Name:</b> <i>Perochirus ateles</i></p>	
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**Historic and current status:** The Micronesian gecko is native to the Micronesia Islands, including Guam, Rota, Tinian, and Saipan. Historic reports indicated that this species was abundant during the pre-human period in the Marianas<sup>1</sup>. This gecko was present through the post-war period on Guam and in the southern Mariana Islands<sup>2</sup>. Currently, the Micronesian gecko is considered rare and information on this species is lacking.

**Threats:** Predation by brown tree snake, Oceanic gecko (*Gehrya oceanica*), and feral cats is most likely the major reason for the loss of this species.

**Habitat:** Knowledge of this species' habitat preferences is poorly known. Historic records indicated specimens were found and collected in limestone forest and beach strands.

**Goal:** To locate and determine status for this species.

**Objectives:** To conduct population surveys in historic sites as well as in limestone and beach strand habitats.


**Action Plan:** Introduced predators: Implement and expand area-wide control for predatory species, such as rats, cats, and snakes. Small and extirpated population: Work closely with private individual stakeholders and explore the feasibility of captive propagation for this species. Habitat degradation and loss: Prevent loss of key habitats for this species and implement a captive breeding program for future releases in protected areas on Guam.

**Reference:**

1. Pregill, G. K. 1998. Squamate reptiles from prehistoric sites in the Mariana Islands, Micronesia. *Copeia* 1998: 64-75.
2. Rodda, G. H., T. H. Fritts, and J. D. Reichel. 1991. The distributional patterns of reptiles and amphibians in the Mariana Islands. *Micronesica* 24: 195-210.




*Terrestrial Gastropods*

<p><b>Common Name:</b> Humped tree snail  <b>Chamorro Name:</b> akaleha'  <b>Scientific Name:</b> <i>Partula gibba</i></p>	 <p style="writing-mode: vertical-rl; transform: rotate(180deg); font-size: small;">USFWS/Dave Kopper</p>
<p><b>Historic and current status:</b> The humped tree snail is endemic species to Guam and the Northern Mariana Islands. It was discovered and collected in 1819 during the Freycinet Uranie expedition in 1817-1819<sup>1</sup>. Upon its discovery, this tree snail was considered to the most abundant on Guam. In 1920, Crampton collected 3,204 to determine geographic differences in shell patterns in 33 of his 39 sites studied<sup>1</sup>. No significant studies occurred until late 1980's and early 1990's. In 1989, historical sites were re-evaluated to determine population status. Thirty-four of Crampton's 39 sites, plus 13 new sites were studied. The Crampton's sites visited in 1989 supported no snails and one of the 13 new sites supported a small population<sup>2,3</sup>. In a 1995 survey, two humped tree snail populations were found in coastal areas<sup>4</sup>. In the same year, USFWS surveyed 15 sites on the Naval Magazine Ordnance area and found an abundance of ground shells but no living populations<sup>4</sup>. Currently, there are only about 100 individuals at the southern basin and slope of Haputo (NCTS, HERA) (C. Fiedler, pers. comm.). Of recent, the humped tree snail was awarded protection under the U.S. Endangered Species Act on October 1, 2015.</p>	
<p><b>Threats:</b> The primary cause of decline for this species was from the predation by the introduced triclad flatworm, <i>Platydemus manokwari</i>. Other causes of decline may include: intensive use of pesticides, extensive collecting of snails by naturalists and explorers, and habitat loss due to land clearing for agricultural/commercial development, wildland grass fires, and ungulates.</p>	
<p><b>Habitat:</b> The Mariana tree snail prefers cool, shaded forest habitats with high humidity. They occur on a variety of plants, including trees, shrubs, herbaceous plants, and even ferns, and are more likely to be found on leaves and less often on stems, branches, and tree trunks. Sometimes, they are found on the ground.</p>	
<p><b>Goal:</b> To conserve and restore the population of humped tree snails on Guam.</p>	
<p><b>Objectives:</b> To determine the status of the species and if feasible, implement a captive breeding program. To determine the feasibility of captive propagation and implement program.</p>	
<p><b>Action Plan:</b> <u>Conduct survey for snails:</u> Conduct survey of areas previously known to harbor snails. Closely monitor the remaining population at Haputo for changes and presence of flatworm predators. <u>Introduced predators:</u> In selected sites, control predatory snails and flatworms. <u>Habitat degradation and loss:</u> Reduce deer and feral pig numbers around known colonies, develop and implement reforestation techniques on Guam's conservation areas and national wildlife refuge overlay lands. <u>Small or extirpated population:</u> Work closely with stakeholders, CNMI Fish, and Wildlife Service to monitor populations within the Mariana Islands, and possibly translocate</p>	

snails to Guam to supplement the existing population. Explore the feasibility of captive propagation of this snail. Examine feasibility of predator free enclosures within appropriate habitats for propagation of this species. Genetic techniques: Use modern genetic techniques to determine genetic variation of Guam's remaining population and compare with this species elsewhere in the CNMI.

**Reference:**


1. Crampton, H. E. 1925. Studies on the variation, distribution, and evolution of the genus *Partula*. The species of the Mariana Islands, Guam and Saipan. Carnegie Institute Washington Publication 228A. vii + 116., 14 plates.
2. Hopper, D. R., and B. D. Smith. 1992. The status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. *Pacific Science* 46: 77-85.
3. Kanehira, R. 1936. Forests of Rota. *Bot. Zool.* 4: 63-70.
4. Smith, B. D. 1995. Tree snails, tropical storms, and drought in the Mariana Islands. (Abstract only). Programs and abstracts, American Malacological Union, 61<sup>st</sup> Annual Meeting, Hilo, Hawaii.
5. U.S. Fish and Wildlife Service. 2015c. 80 FR 59423. Endangered and Threatened Wildlife and Plants; Endangered Status for 16 Species and Threatened Status for 7 Species in Micronesia.

<p><b>Common Name:</b> Guam tree snail  <b>Chamorro Name:</b> akaleha'  <b>Scientific Name:</b> <i>Partula radiolata</i></p>	
<p><b>Historic and current status:</b> The Guam tree snail is the only endemic tree snail to Guam. In 1819, French naturalists failed to recognize specimens from this species as distinct from other partulid species inhabiting Guam<sup>1</sup>. During a return visit in 1828, zoologists collected samples of partulids but did not indicate population density<sup>1</sup>. Surveys in 1989 and 1991 were conducted to evaluate the population size of this species. At both times, this species was considered the predominant tree snail<sup>2</sup>. Currently, the Guam tree snail is known to be the most abundant representation of native tree snails on Guam, occurring in habitats along the western and southeastern coasts of Guam. Of recent, the Guam tree snail was awarded protection under the U.S. Endangered Species Act on October 1, 2015.</p>	
<p><b>Threats:</b> The primary cause of decline for this species was from the predation by the introduced triclad flatworm, <i>Platydemus manokwari</i>. Other causes of decline may include: intensive use of pesticides, extensive collecting of snails by naturalists and explorers, and habitat loss due to land clearing for agricultural/commercial development, wildland grass fires, and ungulates.</p>	
<p><b>Habitat:</b> The Guam tree snail prefers cool shaded forested areas with high humidity. They occur on a variety of plants, including trees, shrubs, herbaceous plants, and even ferns, and are more likely to be found on leaves and less often on stems, branches, and tree trunks. Sometimes, they are found on the ground.</p>	
<p><b>Goal:</b> To conserve and restore the Guam tree snail population on Guam.</p>	
<p><b>Objectives:</b> To determine the status of the Pacific tree snail and continue annual population surveys. To provide a protected sanctuary for breeding and longevity to occur. To determine the feasibility of captive propagation and implement program.</p>	
<p><b>Action Plan:</b> <u>Introduced predators:</u> To implement an area wide control for <i>P. manokwari</i> in areas where this species is known to occur. To test flatworm preference for this partulid species. To identify other predators and implement control measures. <u>Habitat degradation and loss:</u> To control and monitor land clearing and prevent wildfires to preserve the native forest habitat for this species. Reforest native flora and control ungulates in the habitat where snails are found will allow the required preservation of this species. <u>Small or extirpated population:</u> To conduct surveys on Guam to determine current population size, structure, and distribution of this species. To develop a captive breeding program for this snail to restore the population and eliminate any possible extinction to Guam. To perform needed dietary studies with</p>	

the species since it is the most common and widespread native tree snail on Guam. To determine the degree of diversity within and between populations to assess the genetic connectivity amongst populations. To track individual snails using telemetry to determine their ability to disperse and their activity patterns.

**Reference:**


1. Crampton, H. E. 1925. Studies on the variation, distribution, and evolution of the genus *Partula*. The species of the Mariana Islands, Guam and Saipan. Carnegie Institute Washington Publication 228A. vii + 116 pages, 14 plates.
2. Hopper, D. R., and B. D. Smith. 1992. The status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. *Pacific Science* 46: 77-85.
3. U.S. Fish and Wildlife Service. 2015c. 80 FR 59423. Endangered and Threatened Wildlife and Plants; Endangered Status for 16 Species and Threatened Status for 7 Species in Micronesia.

<p><b>Common Name:</b> Fragile tree snail  <b>Chamorro Name:</b> akaleha'  <b>Scientific Name:</b> <i>Samoana fragilis</i></p>	 <p style="text-align: right; font-size: small;">USFWS/Dave Kopper</p>
<p><b>Historic and current status:</b> In the Mariana Islands, the Fragile tree snail was reported on Guam and Rota. Historically, it was considered rare when discovered in 1819 during the Freycinet Uranie expedition of 1817-1819<sup>1</sup>. Smith et al.<sup>4</sup> mentions a population at Pugua Point (NCTS, HERA). Three other Guam populations have been confirmed but not in large numbers with the highest count of 140 individuals (C. Fiedler, pers. comm.). Of recent, the fragile tree snail was awarded protection under the U.S. Endangered Species Act on October 1, 2015.</p>	
<p><b>Threats:</b> The primary cause of decline for this species was from the predation by the introduced triclad flatworm, <i>Platydemus manokwari</i>. Other causes of decline may include: intensive use of pesticides, extensive collecting of snails by naturalists and explorers, and habitat loss due to land clearing for agricultural/commercial development, wildland grass fires, and ungulates.</p>	
<p><b>Habitat:</b> Fragile tree snail prefers cool shaded forest habitats with high humidity. They occur on a variety of plants, including trees, shrubs, herbaceous plants, and even ferns, and are more likely to be found on leaves and less often on stems, branches, and tree trunks. Sometimes, they are found on the ground.</p>	
<p><b>Goal:</b> To implement a SSP for all native snails on Guam and continue annual surveys.</p>	
<p><b>Objectives:</b> To determine the status of the fragile snail and continue annual population surveys. To provide a protected sanctuary for breeding and longevity to occur. To determine the feasibility of captive propagation and implement program.</p>	
<p><b>Action Plan:</b> <u>Introduced predators:</u> Implement and expand area-wide control of <i>P. manokwari</i>. <u>Habitat degradation and loss:</u> Reduce deer and feral pig populations at colony and adjacent areas, develop and implement reforestation techniques on Guam's conservation areas and national wildlife refuge overlay lands. <u>Small or extirpated population:</u> To conduct surveys on Guam to determine current population size, structure, and locales of this species. To develop a captive breeding program for this snail to restore the population and eliminate any possibly extinction to Guam. Work closely with stakeholders and CNMI Fish and Wildlife Service to monitor populations within the Mariana Islands. To determine if the populations on Guam and Rota are the same species. To translocate the species from Guam to Rota dependent on if the populations are the same.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Crampton, H. E. 1925. Studies on the variation, distribution, and evolution of the genus <i>Partula</i>. The species of the Mariana Islands, Guam and Saipan. Carnegie Inst. Washington Publication 228A. vii + 116., 14 pl.</li> </ol>	

2. Hopper, D. R., and B. D. Smith. 1992. The status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. *Pacific Science* 46: 77-85.
3. Kanehira, R. 1936. Forests of Rota. *Botanica Zoological* 4: 63-70.
4. Smith, B. D., R. Cooper-Nurse, and A. M. Gawel. 2008. Survey of endangered tree snails on Navy-owned land in Guam. 22 pages.
5. U.S. Fish and Wildlife Service. 2015c. 80 FR 59423. Endangered and Threatened Wildlife and Plants; Endangered Status for 16 Species and Threatened Status for 7 Species in Micronesia.

*Insects*

<p><b>Common Name:</b> Mariana eight spot butterfly  <b>Chamorro Name:</b> None  <b>Scientific Name:</b> (<i>Hypolimnas octocula marianensis</i>)</p>	<p>No Photo Available</p>
<p><b>Historic and current status:</b> Swezey collected one single female from a <i>Hibiscus</i> flower on October 17, 1936<sup>1</sup>. Of the fourteen species of butterfly recorded by Swezey, <i>Hypolimnas octocula marianensis</i> appears to be the rarest<sup>2</sup>. Muniappan collected three specimens on a limestone plant, <i>Procris pedunculata</i> at Hilaan Point, on August 1975, one specimen from the AAFB on April 1982 and two specimens at Hilaan Point on September 2001 (Guam Agricultural Experiment Station Collection). Adults, eggs, and/or larvae have been documented on host plants at Ritidian, AAFB Northwest Field cliffline, AAFB cliffline, Pagat, NCTS (Pugua Point, Haputo ERA.), Hilaan, Asiga, Tanguisson Beach, and Guam racetrack (C. Fiedler, pers. comm.). <i>H. mariannensis</i> was listed as endangered under the U.S. Endangered Species Act on October 1, 2015). The Mariana eight-spot butterfly’s status is in decline (USFWS 2015c).</p>	
<p><b>Threats:</b> Degradation and loss of habitat due to development, military training, ungulates, and nonnative plants, and predation of caterpillar by an ichneumonid wasp are believed to be causes of this species rarity.</p>	
<p><b>Habitat:</b> Limestone forests where the host plants, <i>Procris pedunculata</i> and <i>Elatostema calcareum</i>, occur.</p>	
<p><b>Goal:</b> To protect habitat and establish a viable population of <i>H. o. mariannensis</i> in Guam.</p>	
<p><b>Objectives:</b> To survey on habitats containing the butterfly’s host plants. To study the biology and seasonal population dynamics of <i>H. o. mariannensis</i>, culture <i>H. o. mariannensis</i> in the laboratory, survey natural enemies, and release laboratory reared butterflies in the <i>Procris</i> habitats. To examine genetic diversity within the meta population on Guam, as well as connectivity between populations at the locations listed in status.</p>	
<p><b>Action Plan:</b> <u>Habitat degradation and loss:</u> Identify and map occurrences of butterflies and host plants. Reduce impacts of ungulates and invasive plants in limestone forests areas where host plants occur. <u>Small or extirpated population:</u> Conduct monthly surveys at the Hilaan Point to observe seasonal activity for this butterfly species, and cultivate caterpillars of this species and rear them to adult stage in a parasite and predation free enclosure for propagation. Release reared in the lab adults in limestone habitats where the host plant is abundant and especially in conservation areas Guam. <u>Caterpillar predation:</u> investigate efficacy of controlling ichneumonid wasp in areas caterpillars occur.</p>	
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>1. Swezey, O. H. 1942. Insects of Guam. Lepidoptera (Butterflies of Guam.) Bull. B.P. Bishop Museum 172: 31-38.</li> <li>2. Sampson, C. 1986. The <i>Hypolimnas octocula</i> complex, with notes on <i>H. inopinata</i> (Lepidoptera, Nymphalidae) Tyô to Ga 37: 15-43.</li> <li>3. U.S. Fish and Wildlife Service. 2015c. 80 FR 59423. Endangered and Threatened Wildlife and Plants; Endangered Status for 16 Species and Threatened Status for 7 Species in Micronesia.</li> </ol>	

<p><b>Common Name:</b> Marianas rusty  <b>Chamorro Name:</b> None  <b>Scientific Name:</b> <i>Vagrans egistina</i></p>	
<p><b>Historic and current status:</b> This butterfly species was described from Guam and is confined to the Marianas. In 1932, Swezey found this species rare but widespread on Guam. In 1970's, several specimens were collected from <i>Maytenus thompsonii</i>. Not much is known for the status on Guam.</p>	
<p><b>Threats:</b> Causes for this species to be rare includes; habitat loss of the host plants by introduced plant species, and predation of caterpillar by an ichneumonid wasp.</p>	
<p><b>Habitat:</b> Limestone forests where the host plant, <i>Maytenus thompsonii</i>, occurs.</p>	
<p><b>Goal:</b> To establish a viable population of <i>Vagrans egistina</i> in Guam.</p>	
<p><b>Objectives:</b> To survey <i>Maytenus thomponsii</i> habitats on Guam, determine seasonal population dynamics of <i>V. egistina</i>, and in the laboratory, culture <i>V. egistina</i>. To survey for natural enemies of <i>Vagrans</i> and study its biology. To release laboratory reared butterflies in habitats containing <i>Maytenus</i>.</p>	
<p><b>Action Plan:</b> <u>Habitat degradation and loss:</u> Identify and map localities with <i>Maytenus thompsonii</i>, and reduce and prevent the development, and possible encroachment of invasive plants in these areas. <u>Small or extirpated population:</u> Conduct monthly surveys to determine its seasonality. To cultivate caterpillars of this species and rear them to adult stage in a parasite and predation free enclosures for propagation. Release lab reared adults in limestone habitats where the host plant is abundant especially in conservation areas. <u>Caterpillar predation:</u> investigate efficacy of controlling ichneumonid wasp in areas caterpillars occur.</p>	
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>Schreiner, I. H., and D. M. Nafus. 1997. Butterflies of Micronesia. Agricultural Experiment Station, College of Agriculture and Life Sciences, Univ. of Guam. 30p.</li> </ol>	



*Terrestrial Plants*

**Common name:** Tree fern  
**Chamorro name:** chacha  
**Scientific name:** *Cyathea lunalata*



**Historic and current status:** The tree fern has always been considered rare and is found in hills in southern Guam<sup>1</sup>. This species is still rare but can still be found in southern mountains in muddy drainage slopes.

**Threats:** Presently, major threats include typhoons and wildland fires reducing the habitat in which this species lives.

**Habitat(s):** Southern hills of Guam, wet ravines and muddy drainage slopes


**Goal:** To restore tree fern populations.


**Objectives:** To survey the island and determine the density and distribution of the fern. To protect remaining areas harboring the tree fern. To propagate this species and out plant in conservation areas in southern Guam.


**Action plan:** Small or extirpated population: Identify locations of species and collaborate with the University of Guam or people who are knowledgeable of fern propagation. Protect existing populations from wildland fires. Conduct studies into the ecology and biology of this species. Begin propagating this species for outplanting.


**Reference:**


1. Stone, B. C. 1970. The flora of Guam. Micronesica 6: 1-659.
2. Moore, P. H. and P. D. McMakin. 1979. Plants of Guam. University of Guam, College of Agriculture and Life Sciences.


<p><b>Common name:</b> Federico nut  <b>Chamorro name:</b> fadang  <b>Scientific name:</b> <i>Cycas mariannensis</i></p>	
<p><b>Historic and current status:</b> The fadang was historically considered common, being found throughout Guam in undisturbed limestone areas, coastal areas, and can be found in ravine forests and savanna summits<sup>1</sup>. Though still common throughout Guam, the recent introduction of the Asian scale, <i>Aulacaspis yasumatsui</i>, in 2003 is causing significant mortality among trees and will soon place it in the endangered species status if immediate action to avert this problem is not taken (Aubrey Moore, pers. comm. 2005). Currently efforts to monitor the fadang population are ongoing with a sizable number of individuals appearing healthy and free from the Asian scale.</p>	
<p><b>Threats:</b> Presently, the recent introduction of the Asian cycad scale, poses the most significant threat to fadang. Other threats include ungulate damage, typhoons, wild land fires, and development.</p>	
<p><b>Habitat(s):</b> Limestone areas, coastal areas, ravine forests, and savanna summits.</p>	
<p><b>Goal:</b> To prevent extirpation of the fadang population.</p>	
<p><b>Objectives:</b> To prevent further loss of cycads due to the Asian cycad scale infestation by the application of appropriate treatments. To propagate seedlings in a scale-free enclosure to prevent further fadang loss.</p>	
<p><b>Action plan:</b> <u>Introduced herbivores:</u> To quickly implement biological control treatment program to protect remaining fadang trees against the Asian scale especially in conservation areas. To reduce deer and pig numbers in areas where cycads are most abundant. <u>Small or extirpated population:</u> Collect seeds and propagate at least 100-300 bi-annually for distribution.</p>	
<p><b>Reference:</b>  1. Stone, B. C. 1970. The flora of Guam. Micronesica 6: 1-659.</p>	

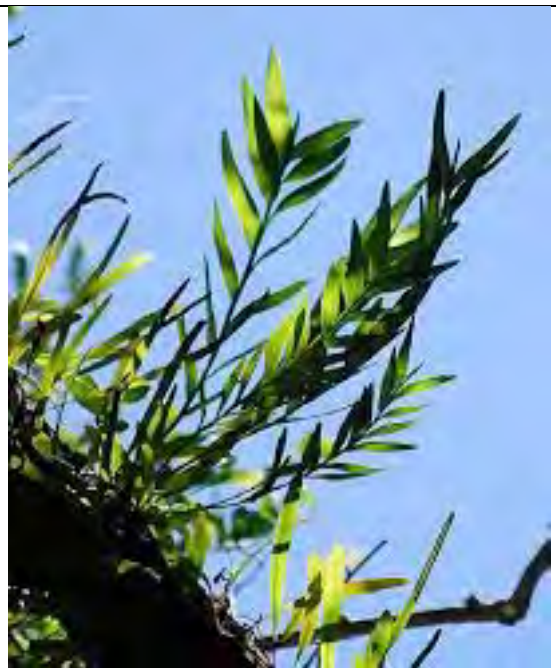
<p><b>Common name:</b> None  <b>Chamorro name:</b> ufa halomtano'  <b>Scientific name:</b> <i>Heritiera longipetiolata</i></p>	
<p><b>Historic and current status:</b> This species is endemic to Guam, Rota, and Saipan<sup>1</sup>. Historically restricted to limestone cliffs and plateaus<sup>1,2</sup>. Currently ufa is considered rare. It is rarely found flowering and fruiting presenting a challenge for nursery propagation experts.</p>	
<p><b>Threats:</b> Presently, major threats include ungulate damage, typhoons, and the rare occurrence of flowering and fruiting hinders this species.</p>	
<p><b>Habitat(s):</b> Limestone cliffs and plateaus on Guam.</p>	
<p><b>Goal:</b> To maintain a viable population throughout the island.</p>	
<p><b>Objectives:</b> To collect seeds from fruiting trees and develop a nursery of seedlings for out planting. To increase the number of trees in conservation areas by outplanting seedlings. To increase the number of trees in the wild by outplantings plants grown in nurseries.</p>	
<p><b>Action plan:</b> <u>Introduced herbivores:</u> To reduce deer and feral pig numbers in areas where ufa occurs. To monitor trees to prevent insect infestation. <u>Small or extirpated population:</u> Collect seeds seasonally and propagate at least 100-300 bi-annually for distribution. To install enclosures around trees to protect seeds and seedlings from deer and feral pigs.</p>	
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>1. Stone, B. C. 1970. The flora of Guam. Micronesica 6: 1-659.</li> <li>2. Moore, P. H., and P. D. McMakin. 1979. Plants of Guam. University of Guam, College of Agriculture and Life Sciences.</li> </ol>	

<p><b>Common name:</b> None  <b>Chamorro name:</b> faniok  <b>Scientific name:</b> <i>Merrilliodendron megacarpum</i></p>	
<p><b>Historic and current status:</b> Faniok is considered rare in Guam's limestone forest<sup>1</sup>. Trees have been found only in few locations including Hilaan Point, Haputo, Mount Lam Lam, Mount Tenjo and 1 known tree in the Agana spring area<sup>1,2</sup>. The status of this species in these areas is unknown.</p>	
<p><b>Threats:</b> Threats to the species include ungulate damage, typhoons, development, and possible insect infestation.</p>	
<p><b>Habitat(s):</b> Limestone forest.</p>	
<p><b>Goal:</b> To restore population throughout the island.</p>	
<p><b>Objectives:</b> To determine the abundance and distribution of this species throughout Guam. To monitor trees quarterly for opportunities to collect seeds to propagate in a nursery. To outplant seedlings in areas protected from deer and feral pigs.</p>	
<p><b>Action plan:</b> <u>Introduced herbivores:</u> To reduce deer and feral pig numbers where faniok occurs. <u>Small or extirpated population:</u> Monitor population and distribution of this species. Collect seeds seasonally and propagate at least 100 bi-annually for distribution.</p>	
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>1. Stone, B. C. 1970. The flora of Guam. Micronesica 6: 1-659.</li> <li>2. Moore, P. H. and P. D. McMakin. 1979. Plants of Guam. University of Guam, College of Agriculture and Life Sciences.</li> </ol>	


<p><b>Common name:</b> Fire Tree  <b>Chamorro name:</b> tronkon guafi, hayun lagu  <b>Scientific name:</b> <i>Serianthes nelsonii</i></p>	
<p><b>Historic and current status:</b> Tronkon guafi is endemic to Guam and Rota<sup>1</sup>. Historic records of this tree are only known from the north of Guam<sup>1,2</sup>. However, there are quite a few trees remain on Rota. This species was federally listed as endangered on February 18, 1987 (52 CFR 4907-4910). Only one adult tree is known to remain on Guam, and over 60 adult trees on Rota. Currently, efforts to outplant tronkon guafi are ongoing with GNWR staff and other partners with about 50 seedlings planted on Guam.</p>	
<p><b>Threats:</b> Threats to the species include herbivory by ungulates (deer and feral pigs), damage caused by mealy bugs, and butterfly (<i>Eurema blanda</i>), typhoons, insect damage.</p>	
<p><b>Habitat(s):</b> Limestone and Ravine forests.</p>	
<p><b>Goal:</b> To increase population throughout the island.</p>	
<p><b>Objectives:</b> To protect only remaining adult tree and to propagate seedlings.</p>	
<p><b>Action plan:</b> <u>Habitat loss:</u> To prevent further damage to the remaining adult tree and surrounding forest. <u>Small populations:</u> To collect plant material from Guam and Rota, and propagate at least 200-300 bi-annually and outplant seedlings in protective enclosures from ungulates. Monitor plants for insect infestations.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Stone, B. C. 1970. The flora of Guam. Micronesica 6: 1-659.</li> <li>2. USFWS. 1994. Recovery plan for <i>Serianthes nelsonii</i>. U. S. Fish and Wildlife Service, Portland, OR.</li> </ol>	

<p><b>Common Name:</b> None  <b>Chamorro Name:</b> None  <b>Scientific Name:</b> <i>Tabernaemontana rotensis</i></p>	
<p><b>Historic and current status:</b> <i>Tabernaemontana</i> is endemic to Guam and Rota. The population on Guam previously believed to be composed of only one adult tree. Recent observations have expanded that number to well over 200 individual plants found in various parts of northern and southern Guam<sup>1</sup>. On Rota, less than 60 trees have been as well. Historically this species of plant was found in the mature limestone forests. This species endemic status to only two islands warrants it being in the SOGCN.</p>	
<p><b>Threats:</b> Herbivory and insect infestations probably are major factors limiting its abundance.</p>	
<p><b>Habitat:</b> This species is found in native limestone forest. Efforts to improve the state of condition of the forest should improve the status of this species.</p>	
<p><b>Goal:</b> To maintain a healthy population of <i>Tabernaemontana</i>.</p>	
<p><b>Objectives:</b> To determine the status and distribution of this species.</p>	
<p><b>Action Plan:</b> <u>Population Assessment:</u> Conduct an island-wide survey of the plant to determine its status on Guam and to implement appropriate management actions.</p>	
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>1. Division of Aquatic and Wildlife Resources (GDAWR). Unpublished Data. Department of Agriculture, Government of Guam.</li> </ol>	

<p><b>Common name:</b> None  <b>Chamorro name:</b> cebello halumtano  <b>Scientific name:</b> <i>Bulbophyllum guamense</i></p>	
<p><b>Historic and current status:</b> Widely distributed occurrences on Guam and Rota, historically recorded from cliff lines encircling the island, and on the slopes of Mt. Lam Lam and Mt. Almagosa<sup>1</sup>. In 1992, this species was reported to occur in large mat-like formations on trees all over the island of Guam<sup>2</sup>. Currently, the numbers of occurrences are declining, totaling fewer than 250 individuals on Guam and fewer than 30 individuals on Rota<sup>1</sup>.</p>	
<p><b>Threats:</b> Presently, major threats include habitat loss, destruction from agriculture, urban development, nonnative animals and plants, typhoons, wildland fires, and predation by nonnative slugs.</p>	
<p><b>Habitat(s):</b> Grow on trees mostly on limestone and ravine habitats.</p>	
<p><b>Goal:</b> To restore cebello halumtano populations and minimize threats to the species.</p>	
<p><b>Objectives:</b> To survey the island and determine the density and distribution of the orchid. To protect remaining areas harboring the orchid. To propagate this species and outplant in conservation areas in southern Guam.</p>	
<p><b>Action plan:</b> <u>Small or extirpated population:</u> Identify locations of species and collaborate with the University of Guam or people who are knowledgeable of orchid propagation. Protect existing populations from wildland fires and other threats. Conduct studies into the ecology and biology of this species. Begin propagating this species for outplanting.</p>	
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>1. Federal Register, 2014. Endangered and Threatened wildlife and plants; Proposed Endangered Status for 21 species and Proposed Threatened status for two species in Guam and CNMI.</li> <li>2. Raulerson and Rinehart. 1992, Ferns and Orchids of the Mariana Islands. p.90.</li> </ol>	

<p><b>Common name:</b> None  <b>Chamorro name:</b> None  <b>Scientific name:</b> <i>Dendrobium guamense</i></p>	
<p><b>Historic and current status:</b> An epiphyte orchid known from Guam, Rota, and Tinian. As recent to 1980's, this species was common in trees on Guam with 12 occurrences and Rota with 17 occurrences<sup>1</sup>. Currently totaling approximately 550 individuals distributed 9 occurrences in the islands. On Guam, there are 4 occurrences with fewer than 250 individuals<sup>1</sup>.</p>	
<p><b>Threats:</b> Presently, major threats include habitat loss, destruction from agriculture, urban development, nonnative animals and plants, typhoons, wildland fires, and predation by nonnative slugs.</p>	
<p><b>Habitat(s):</b> Grow on trees where moist.</p>	
<p><b>Goal:</b> To restore <i>Dendrobium</i> populations and minimize threats to the species.</p>	
<p><b>Objectives:</b> To survey the island and determine the density and distribution of the orchid. To protect remaining areas harboring the orchid. To propagate this species and outplant in conservation areas in southern and northern Guam.</p>	
<p><b>Action plan:</b> <u>Small or extirpated population:</u> Identify locations of species and collaborate with the University of Guam or people who are knowledgeable of orchid propagation. Protect existing populations from wildland fires and other threats. Conduct studies into the ecology and biology of this species. Begin propagating this species for outplanting.</p>	
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>1. Federal Register, 2014. Endangered and Threatened wildlife and plants; Proposed Endangered Status for 21 species and proposed Threatened status for 2 species in Guam and CNMI.</li> </ol>	



<p><b>Common name:</b> None  <b>Chamorro name:</b> None  <b>Scientific name:</b> <i>Eugenia bryanii</i></p>	
<p><b>Historic and current status:</b> Endemic to Guam, <i>E. bryanii</i>, occurred on windy, exposed cliff lines along the west and east coasts of the island in abundance<sup>1</sup>. Currently this species is known from 5 occurrences with less than 420 individuals on Guam<sup>2</sup>.</p>	
<p><b>Threats:</b> Presently, major threats include habitat loss, destruction from agriculture, urban development, nonnative animals and plants, typhoons, combined with ungulate browsing.</p>	
<p><b>Habitat(s):</b> Windy, exposed cliff lines.</p>	
<p><b>Goal:</b> To restore <i>E. bryanii</i> populations and minimize threats to the species.</p>	
<p><b>Objectives:</b> To survey the island and determine the density and distribution of <i>E. bryanii</i>. To protect remaining areas harboring the species. To propagate this species and out plant in conservation areas in southern and northern Guam.</p>	
<p><b>Action plan:</b> <u>Small or extirpated population:</u> Identify locations of species and collaborate with the University of Guam or Forestry Division. Protect existing populations from threats. Conduct studies into the ecology and biology of this species. Begin propagating this species for outplanting.</p>	
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>1. Stone, B. C. 1970. The flora of Guam. Micronesica 6: 1-659.</li> <li>2. U.S. Fish and Wildlife Service. 2015c. 80 FR 59423. Endangered and Threatened Wildlife and Plants; Endangered Status for 16 Species and Threatened Status for 7 Species in Micronesia.</li> </ol>	

**Common name:** None  
**Chamorro name:** paudedo  
**Scientific name:** *Hedyotis megalantha*



**Historic and current status:** Endemic to Guam, paudedo is a perennial herb known only to occur on the savanna ecosystem. Historically, this species ranged from the mid-central mountains and west coast of Guam, south to Mt. Lamlam<sup>1</sup>. Currently, fewer than 1,000 individuals occur on southern Guam<sup>2</sup>.

**Threats:** Presently, major threats include habitat loss, destruction from agriculture, urban development, nonnative animals and plants, fires, and typhoons, combined with direct damage by recreational vehicles.

**Habitat(s):** Savanna.

**Goal:** To restore *H. megalantha* populations and minimize threats to the species.


**Objectives:** To survey the savanna lands and determine the density and distribution of *H. megalantha*. To protect remaining areas harboring the species. To propagate this species and outplant in conservation areas in southern Guam.

**Action plan:** Small or extirpated population: Identify locations of species and collaborate with the University of Guam or Forestry Division. Protect existing populations from threats. Conduct studies into the ecology and biology of this species. Begin propagating this species for outplanting.

**Reference:**

1. Bishop Museum 2013- Online Herbarium Database.
2. U.S. Fish and Wildlife Service. 2015c. 80 FR 59423. Endangered and Threatened Wildlife and Plants; Endangered Status for 16 Species and Threatened Status for 7 Species in Micronesia.

<p><b>Common name:</b> None  <b>Chamorro name:</b> None  <b>Scientific name:</b> <i>Maesa walkeri</i></p>	<p>No photo found.</p>
<p><b>Historic and current status:</b> Endemic to the Mariana Islands, <i>M. walkeri</i> occurs at edges or in open sunny sites on limestone<sup>1</sup>. Historically, <i>M. walkeri</i> was known from at least 13 occurrences on Guam and 9 occurrences on Rota<sup>2</sup>. Currently, there are 2 known individuals on Guam and 50 individuals on Rota<sup>3</sup>.</p>	
<p><b>Threats:</b> Major threats include habitat loss, destruction from agriculture, urban development, nonnative animals and plants, fires, and typhoons.</p>	
<p><b>Habitat(s):</b> Edges or open sunny sites on limestone.</p>	
<p><b>Goal:</b> To restore <i>M. walkeri</i> populations and minimize threats to the species.</p>	
<p><b>Objectives:</b> To survey limestone forests and determine the density and distribution of <i>M. walkeri</i>. To protect remaining areas harboring the species. To propagate this species and out plant in conservation areas on Guam.</p>	
<p><b>Action plan:</b> <u>Small or extirpated population:</u> Identify locations of species and collaborate with the University of Guam or Forestry Division. Protect existing populations from threats. Conduct studies into the ecology and biology of this species. Begin propagating this species for outplanting.</p>	
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>1. Raulerson and Rinehart. 1991, Trees and Shrubs of the Northern Mariana Islands. p.67.</li> <li>2. Bishop Museum. 2014. Online Herbarium Database.</li> <li>3. U.S. Fish and Wildlife Service. 2015c. 80 FR 59423. Endangered and Threatened Wildlife and Plants; Endangered Status for 16 Species and Threatened Status for 7 Species in Micronesia.</li> </ol>	

<p><b>Common name:</b> None  <b>Chamorro name:</b> None  <b>Scientific name:</b> <i>Nerivilia jacksoniae</i></p>	
<p><b>Historic and current status:</b> Historically known to occur central to northern Guam and southwestern point of Rota in the forest ecosystem<sup>1</sup>. Currently on Guam, there are fewer than 200 individuals and on Rota fewer than 320 individuals<sup>2</sup>.</p>	
<p><b>Threats:</b> Major threats include habitat loss, destruction from agriculture, urban development, nonnative animals and plants, fires, typhoons and predation by invasive slugs.</p>	
<p><b>Habitat(s):</b> Shady places on sandy soil or humus.</p>	
<p><b>Goal:</b> To restore <i>N. jacksoniae</i> populations and minimize threats to the species.</p>	
<p><b>Objectives:</b> To survey forests and determine the density and distribution of <i>N. jacksoniae</i>. To protect remaining areas harboring the species. To propagate this species and out plant in conservation areas on Guam.</p>	
<p><b>Action plan:</b> <u>Small or extirpated population:</u> Identify locations of species and collaborate with the University of Guam or Forestry Division. Protect existing populations from threats. Conduct studies into the ecology and biology of this species. Begin propagating this species for outplanting.</p>	
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>1. Federal Register, 2014. Endangered and Threatened wildlife and plants; Proposed Endangered Status for 21 species and proposed Threatened status for two species in Guam and CNMI.</li> <li>2. U.S. Fish and Wildlife Service. 2015c. 80 FR 59423. Endangered and Threatened Wildlife and Plants; Endangered Status for 16 Species and Threatened Status for 7 Species in Micronesia.</li> </ol>	

**Common name:** None  
**Chamorro name:** None  
**Scientific name:** *Phyllanthus saffordii*



**Historic and current status:** Endemic to Guam, *P. saffordii* was historically known in southern and south-central Guam within the savanna habitat<sup>1</sup>. Currently, its range is restricted on southern Guam with less than 1,400 individuals<sup>2</sup>.

**Threats:** Major threats include habitat loss, destruction from agriculture, urban development, nonnative animals and plants, fires, typhoons and direct damage by recreational vehicles.

**Habitat(s):** savanna habitat.

**Goal:** To restore *P. saffordii* populations and minimize threats to the species.

**Objectives:** To survey savanna habitats and determine the density and distribution of *P. saffordii*. To protect remaining areas harboring the species. To propagate this species and out plant in conservation areas on Guam.


**Action plan:** Small or extirpated population: Identify locations of species and collaborate with the University of Guam or Forestry Division. Protect existing populations from threats. Conduct studies into the ecology and biology of this species. Begin propagating this species for outplanting.

**Reference:**


1. Stone. B.C. 1970. The Flora of Guam. Micronesica Vol 6. Univ. of Guam.
2. U.S. Fish and Wildlife Service. 2015c. 80 FR 59423. Endangered and Threatened Wildlife and Plants; Endangered Status for 16 Species and Threatened Status for 7 Species in Micronesia.

<p><b>Common name:</b> None  <b>Chamorro name:</b> Aplokhating palaoan  <b>Scientific name:</b> <i>Psychotria malaspinae</i></p>	<p>No Photo Available.</p>
<p><b>Historic and current status:</b> Endemic in the Mariana Islands<sup>1</sup>, historically, <i>P. malaspinae</i>, was only known from Guam occurring on the northeastern and southwestern sides of Guam in the forest ecosystem<sup>2</sup>. Currently, there are only 3 individuals known to the island.</p>	
<p><b>Threats:</b> Major threats include habitat loss, destruction from agriculture, urban development, nonnative animals and plants, and typhoons.</p>	
<p><b>Habitat(s):</b> Limestone soils, forest edges and perhaps understories.</p>	
<p><b>Goal:</b> To restore <i>P. malaspinae</i> populations and minimize threats to the species.</p>	
<p><b>Objectives:</b> To survey savanna habitats and determine the density and distribution of <i>P. malaspinae</i>. To protect remaining areas harboring the species. To propagate this species and outplant in conservation areas on Guam.</p>	
<p><b>Action plan:</b> <u>Small or extirpated population:</u> Identify locations of species and collaborate with the University of Guam or Forestry Division. Protect existing populations from threats. Conduct studies into the ecology and biology of this species. Begin propagating this species for outplanting.</p>	
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>1. Raulerson, L. and Rinehart, A. 1991. Trees and Shrubs of the Northern Mariana Islands. p. 83.</li> <li>2. Federal Register, 2014. Endangered and Threatened wildlife and plants; Proposed Endangered Status for 21 species and proposed Threatened status for two species in Guam and CNMI.</li> </ol>	

<p><b>Common name:</b> None  <b>Chamorro name:</b> Berenghenas halomtano  <b>Scientific name:</b> <i>Solanum guamense</i></p>	<p>No Photo Available.</p>
<p><b>Historic and current status:</b> Endemic in the Mariana Islands, historically, <i>S. guamense</i>, was known to be abundant its range across multiple islands<sup>1</sup>. Currently, there is only one occurrence of one individual on Guam<sup>2</sup>.</p>	
<p><b>Threats:</b> Major threats include habitat loss, destruction from agriculture, urban development, nonnative animals and plants, typhoons and herbivory by pigs and deer.</p>	
<p><b>Habitat(s):</b> Limestone cliffs and terraces near the sea.</p>	
<p><b>Goal:</b> To restore <i>S. guamense</i> populations and minimize threats to the species.</p>	
<p><b>Objectives:</b> To locate species habitat and determine the density and distribution of <i>S. guamense</i>. To protect remaining areas harboring the species. To propagate this species and outplant in conservation areas on Guam.</p>	
<p><b>Action plan:</b> <u>Small or extirpated population:</u> Identify location of species and collaborate with the University of Guam or Forestry Division. Protect existing populations from threats. Conduct studies into the ecology and biology of this species. Begin propagating this species for outplanting.</p>	
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>1. Stone, B. C. 1970. The Flora of Guam. Micronesica Vol. 6.</li> <li>2. Federal Register, 2014. Endangered and Threatened wildlife and plants; Proposed Endangered Status for 21 species and proposed Threatened status for two species in Guam and CNMI.</li> </ol>	


<p><b>Common name:</b> None  <b>Chamorro name:</b> None  <b>Scientific name:</b> <i>Tinospora homosepala</i></p>	
<p><b>Historic and current status:</b> A climbing vine, <i>T. homosepala</i> was historically known to be endemic to Guam and very rare<sup>1</sup>. Currently, there are about 30 male individuals that produce clonally, with no known female representatives<sup>2</sup>.</p>	
<p><b>Threats:</b> Major threats include habitat loss, nonnative animals and plants, typhoons and by genetic limitations because of the possible loss of potential sexual reproduction.</p>	
<p><b>Habitat(s):</b> forest ecosystem.</p>	
<p><b>Goal:</b> To rediscover and restore <i>T. homosepala</i> populations and minimize threats to the species.</p>	
<p><b>Objectives:</b> To locate species habitat and determine the density and distribution of <i>T. homosepala</i>. To protect remaining areas harboring the species. To propagate this species and outplant in conservation areas on Guam.</p>	
<p><b>Action plan:</b> <u>Small or extirpated population:</u> Identify location of species and collaborate with the University of Guam or Forestry Division. Protect existing populations from threats. Conduct studies into the ecology and biology of this species. Begin propagating this species for outplanting.</p>	
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>1. Stone, B. C. 1970. The Flora of Guam. Micronesica Vol. 6.</li> <li>2. Federal Register, 2014. Endangered and Threatened wildlife and plants; Proposed Endangered Status for 21 species and proposed Threatened status for two species in Guam and CNMI.</li> </ol>	




<p><b>Common name:</b> None  <b>Chamorro name:</b> None  <b>Scientific name:</b> <i>Tuberolabium guamense</i> (<i>Trachoma guamense</i>).</p>	
<p><b>Historic and current status:</b> Endemic to the Mariana Islands, <i>T. guamense</i>, was historically found in shade in very low positions on trees and shrubs all over the island<sup>1</sup>. <i>T. guamense</i> was also reported in Rota, Tinian, and Aguiguan. Currently, there had been three occurrences reported in Rota and Guam, one individual on Guam and two occurrences on Rota<sup>2</sup>.</p>	
<p><b>Threats:</b> Major threats include habitat loss, destruction from agriculture, urban development, nonnative animals and plants, typhoons, fires, herbivory by slugs, and low genetic representation.</p>	
<p><b>Habitat(s):</b> Shady forest ecosystem.</p>	
<p><b>Goal:</b> To rediscover and restore <i>T. guamense</i> populations and minimize threats to the species.</p>	
<p><b>Objectives:</b> To locate species habitat and determine the density and distribution of <i>T. guamense</i>. To protect remaining areas harboring the species. To propagate this species and out plant in conservation areas on Guam.</p>	
<p><b>Action plan:</b> <u>Small or extirpated population:</u> Identify location of species and collaborate with the University of Guam or Forestry Division. Protect existing populations from threats. Conduct studies into the ecology and biology of this species. Begin propagating this species for outplanting.</p>	
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>1. Raulerson, L. and Rinehart A. 1992. Ferns and Orchids of the Mariana Islands. p. 127.</li> <li>2. Federal Register, 2014. Endangered and Threatened wildlife and plants; Proposed Endangered Status for 21 species and proposed Threatened status for two species in Guam and CNMI.</li> </ol>	


**Aquatic Animals and Plants**

*Freshwater Fishes*

<p><b>Common name:</b> Stream Goby  <b>Chamorro name:</b> atot  <b>Scientific name:</b> <i>Stiphodon</i> sp.</p>	
<p><b>Historic and current status:</b> Only known from the southern Mariana islands. The most abundant fish in almost all freshwater habitats on Guam. Has a marine larval stage. Must reach salt water during early life history.</p>	
<p><b>Threats:</b> Introduced fish and plants, degradation of water quality.</p>	
<p><b>Habitat(s):</b> Generally found on hard substrates, most common in medium to fast flowing water. Herbivorous, mainly feeds on algae attached to rocks and clay.</p>	
<p><b>Goal:</b> To maintain current population status.</p>	
<p><b>Objectives:</b> To control introduced predators, maintain water quality.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To maintain information on its status on Guam. <u>Protect habitat:</u> control sedimentation to protect hard substrates. Ensure water quality is maintained and passage to the ocean is maintained to allow for spawning to be successfully completed.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Kami, H. T., I. T. Ikahara, and F. P. Deleon. 1968. Checklist of Guam Fishes. <i>Micronesica</i> 4 (1): 95-131.</li> </ol>	

<p><b>Common name:</b> Redbellied Goby  <b>Chamorro name:</b> atos  <b>Scientific name:</b> <i>Sicyopus</i> sp.</p>	<p>No Photo Available</p>
<p><b>Historic and current status:</b> Only known from the southern Mariana islands. Widespread, but relatively uncommon. Has a marine larval stage. Must reach salt water during early life history.</p>	
<p><b>Threats:</b> Introduced species, degradation of water quality.</p>	
<p><b>Habitat(s):</b> Generally found on hard substrates, most common in medium to fast flowing water. Omnivorous, feeds on small aquatic invertebrates as well as some algae.</p>	
<p><b>Goal:</b> To maintain current population status.</p>	
<p><b>Objectives:</b> To control introduced predators, maintain water quality.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To determine the status of this species on Guam. <u>Protect habitat:</u> Control sedimentation to protect hard substrates. Ensure water quality is maintained and passage to the ocean is maintained to allow life history to be successfully completed.</p>	
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>Best, B. R., and C. E. Davidson. 1981. Inventory and Atlas of the Inland Aquatic Ecosystems of the Marianas Archipelago. University of Guam Marine Laboratory Technical Report 75.</li> </ol>	

<p><b>Common name:</b> Marianas Goby  <b>Chamorro name:</b> atot  <b>Scientific name:</b> <i>Stenogobius</i> sp.</p>	
<p><b>Historic and current status:</b> Discovered in 1994, it is only known from Guam. Widespread on Guam, and relatively common. Omnivorous, feeding on plant and animals it sifts from the sand. Has a marine larval stage. Must reach salt water during early life history. As very few endemics seem to fair well, its placement in SOGCN is warranted.</p>	
<p><b>Threats:</b> Loss of habitat, degradation of water quality.</p>	
<p><b>Habitat(s):</b> Lower reaches of rivers on soft sandy or muddy substrates.</p>	
<p><b>Goal:</b> To maintain current population status.</p>	
<p><b>Objectives:</b> To control loss of habitat, maintain water quality.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To determine the status of this species on Guam. <u>Protect habitat:</u> To control loss of riparian vegetation to limit loss of substrate. Ensure water quality is maintained and passage to the ocean is maintained to allow life history to be successfully completed.</p>	
<p><b>Reference:</b>  1. New Record for Guam.</p>	

<p><b>Common name:</b> Flagtail  <b>Chamorro name:</b> umatan  <b>Scientific name:</b> <i>Kuhlia rupestris</i></p>	
<p><b>Historic and current status:</b> Indigenous to the western and southern Pacific. Found in freshwater lentic habitats, it has a marine larval stage and must reach the salt water during its early life history.</p>	
<p><b>Threats:</b> Introduced fish and diseases.</p>	
<p><b>Habitat(s):</b> Rivers and streams across the western and southern Pacific.</p>	
<p><b>Goal:</b> To maintain current population.</p>	
<p><b>Objectives:</b> To protect from habitat loss and introduced competitors and diseases.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To determine the status of this species on Guam. <u>Protect habitat:</u> Ensure water quality is maintained and passage to the ocean is maintained to allow for spawning to be successfully completed. <u>Invasive species control:</u> removal of freshwater invasive species that may have a negative impact to umatan island-wide.</p>	
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>1. Kami, H. T., I. T. Ikahara, and F. P. Deleon. 1968. Checklist of Guam Fishes. <i>Micronesica</i> 4 (1): 95-131.</li> </ol>	

**Common name:** Giant Marbled Eel  
**Chamorro name:** hasule  
**Scientific name:** *Anguilla marmorata*



**Historic and current status:** Widespread throughout the Indo-Pacific. They are common food species for many Pacific indigenous peoples. This species migrates to the ocean to spawn. The young eel then returns to freshwater after an extended larval stage.

**Threats:** Overfishing and habitat modification.

**Habitat(s):** Tropical rivers and streams. Spawns in the western Pacific.

**Goal:** Maintain current population.


**Objectives:** To protect from overfishing, maintain habitat to allow passage to spawning grounds.


**Action plan:** Protect habitat: Ensure water quality is maintained and passage to the ocean is maintained to allow for spawning to be successfully completed. Harvest regulation: Investigate the take of the species to help develop a management plan to maintain sustainable fisheries.

**Reference:**


1. Kami, H. T., I. T. Ikahara, and F. P. Deleon. 1968. Checklist of Guam Fishes. *Micronesica* 4 (1): 95-131.

*Freshwater Crustaceans*


<p><b>Common name:</b> Atyid shrimp (at least 6 species)  <b>Chamorro name:</b> uhang  <b>Scientific name:</b> Atyidae</p>	
<p><b>Historic and current status:</b> Common and widespread on Guam, especially in the upper reaches of rivers. Some genera prefer fast moving water, while others prefer slow moving backwaters and pools. All species have a marine larval stage. Must reach salt water during early life history. These shrimp feed on algae and other benthic material.</p>	
<p><b>Threats:</b> Introduced predators</p>	
<p><b>Habitat(s):</b> Rocky and hard substrates in rivers throughout the Pacific.</p>	
<p><b>Goal:</b> To maintain current population.</p>	
<p><b>Objectives:</b> To maintain substrate and water quality.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To determine the status of each of the species on Guam. <u>Protect habitat:</u> Ensure water quality is maintained and passage to the ocean is maintained to allow for spawning to be successfully completed.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Leberer, T., and Y. Cai. 2003. Shrimps of the family Atyidae from Guam, Mariana Islands. <i>Micronesica</i> 35-36: 353-358.</li> <li>2. Best, B. R., and C. E. Davidson. 1981. Inventory and atlas of the inland aquatic ecosystems of the Marianas Archipelago. University of Guam Marine Laboratory Technical Report 75.</li> </ol>	

<p><b>Common name:</b> Tahitian prawns (2 species)  <b>Chamorro name:</b> uhang  <b>Scientific name:</b> <i>Macrobrachium</i> spp.</p>	 <p style="text-align: right; font-size: small;">(c) Kai A. Quante</p>
<p><b>Historic and current status:</b> Common to abundant in rivers on Guam, especially in upper reaches. Omnivores, feeding on detritus, plant and animal material. All species have a marine larval stage. <u>Commonly trapped for food by local anglers.</u></p>	
<p><b>Threats:</b> Introduced predators, loss of habitat, over fishing, and destructive fishing methods.</p>	
<p><b>Habitat(s):</b> Practically all freshwater habitats on Guam.</p>	
<p><b>Goal:</b> To maintain current population.</p>	
<p><b>Objectives:</b> Maintain substrate and water quality.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To maintain current information on the status of this species on Guam. <u>Protect habitat:</u> Ensure water quality is maintained and passage to the ocean is maintained to allow for spawning to be successfully completed.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Paulay, G., R. Kropp, P. K. L. Ng, and L. G. Eldridge. 2003. The Crustaceans and Pycnogonids of the Mariana Islands. <i>Micronesica</i> 35-36: 456-513.</li> <li>2. Best, B. R., and C. E. Davidson. 1981. Inventory and atlas of the inland aquatic ecosystems of the Marianas Archipelago. University of Guam Marine Laboratory, Technical Report 75.</li> </ol>	



<p><b>Common name:</b> Freshwater crabs (&gt; 3 species)  <b>Chamorro name:</b> None  <b>Scientific name:</b> <i>Varunid</i> crabs</p>	
<p><b>Historic and current status:</b> Common and widespread on Guam, especially in the upper reaches of rivers. Most found in fast moving waters on rocky or hard substrates. All species have a marine larval stage. Must reach salt water during early life history. These crabs feed on algae and other benthic material.</p>	
<p><b>Threats:</b> Introduced predators, loss of water quality.</p>	
<p><b>Habitat(s):</b> Rocky and hard substrates in rivers throughout the Pacific.</p>	
<p><b>Goal:</b> To maintain current population.</p>	
<p><b>Objectives:</b> Maintain substrate and water quality.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To determine the status of this species on Guam. <u>Protect habitat:</u> Ensure water quality is maintained and passage to the ocean is maintained to allow for spawning to be successfully completed.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Paulay, G., R. Kropp, P. K. L. Ng, and L. G. Eldridge. 2003. The crustaceans and Pycnogonids of the Mariana Islands. <i>Micronesica</i> 35-36: 456-513.</li> <li>2. Best, B. R., and C. E. Davidson. 1981. Inventory and atlas of the inland aquatic ecosystems of the Marianas Archipelago. University of Guam Marine Laboratory Technical Report 75.</li> </ol>	

*Freshwater Gastropods*

<p><b>Common name:</b> Nerite snails (12 species)  <b>Chamorro name:</b> akaleha'  <b>Scientific name:</b> <i>Neritidae</i></p>	
<p><b>Historic and current status:</b> Nerite snails are common and widespread on Guam, especially in the upper reaches of rivers. This snail has a marine larval stage. Must reach salt water during early life history. Feeds on algae and other benthic material.</p>	
<p><b>Threats:</b> Introduced predators.</p>	
<p><b>Habitat(s):</b> Rocky and hard substrates in rivers throughout the Pacific.</p>	
<p><b>Goal:</b> To maintain current population.</p>	
<p><b>Objectives:</b> To maintain substrate and water quality.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To determine the current size and distribution of the 12 species of snails. <u>Protect habitat:</u> Ensure water quality is maintained and passage to the ocean is maintained to allow for spawning to be successfully completed.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Smith, B. 2003. Prosobranch Gastropods of Guam Micronesica. 35-36: 244-270.</li> <li>2. Best, B. R., and C. E. Davidson. 1981. Inventory and atlas of the inland aquatic ecosystems of the Marianas Archipelago. University of Guam Marine Laboratory Technical Report 75.</li> </ol>	

**Common name:** Thiarid snails (5 species)

**Chamorro name:** akaleha'

**Scientific name:** *Thiaridae*



**Historic and current status:** Some of the species of this snail are common to abundant in rivers on Guam, especially lower reaches. However, some species are very limited in distribution and abundance. The snails give birth to live young with no marine stage. The snails feed principally on detritus and organic debris.

**Threats:** Introduced predators, loss of habitat.

**Habitat(s):** Soft substrates in rivers and lakes.

**Goal:** To maintain current populations.


**Objectives:** To determine the distribution and abundance of the various species of snails. To maintain substrate and water quality of the river and lake environments.


**Action plan:** Assess current population structure and size: To survey the various rivers and lakes on Guam to determine the abundance and distribution of the various species of snails. Protect habitat: To protect the aquatic environment from land-based pollution by the implementation of programs that minimize siltation of rivers and streams.

**References:**

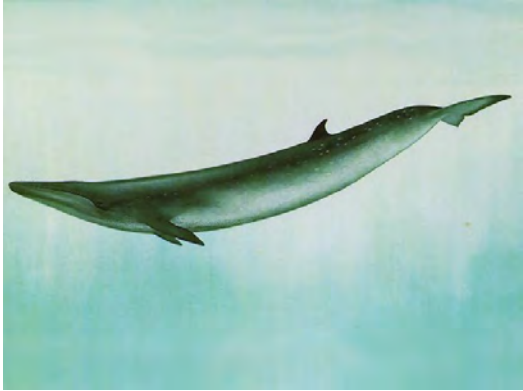
1. Smith, B. 2003. Prosobranch Gastropods of Guam. *Micronesica* 35-36: 244-270.
2. Best, B. R., and C. E. Davidson. 1981. Inventory and atlas of the inland aquatic ecosystems of the Marianas Archipelago. University of Guam Marine Laboratory Technical Report 75.


*Freshwater Plants*


<p><b>Common name:</b> Water Fern <b>Chamorro name:</b> None <b>Scientific name:</b> <i>Ceratopteris thalictroides</i></p>	
<p><b>Historic and current status:</b> The native water fern is common in Fena Lake. Elsewhere, it is widespread, but nowhere common on Guam. This water may be an endemic species.</p>	
<p><b>Threats:</b> Introduced predators and loss of habitat.</p>	
<p><b>Habitat(s):</b> Slow moving or stagnant water, ponds, lakes.</p>	
<p><b>Goal:</b> Identify species and maintain current population.</p>	
<p><b>Objectives:</b> To protect from habitat loss and from predators. To determine the taxonomic status of this species.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To determine the status of this species. <u>Protect habitat:</u> Ensure habitat is kept free of invasive plants and animals.</p>	
<p><b>Reference:</b></p> <ol style="list-style-type: none"><li>1. Stemmerman, L. 1981. A guide to Pacific wetland plants. Army Corps of Engineers, Honolulu District.</li></ol>	

<p><b>Common name:</b> Pond Weed  <b>Chamorro name:</b> chaiguan gadook  <b>Scientific name:</b> <i>Potamogeton mariannensis</i></p>	
<p><b>Historic and current status:</b> Chaiguan gaddok may be endemic to Guam. This species of pondweed is widespread, but nowhere common.</p>	
<p><b>Threats:</b> Introduced plants and animals, loss of substrate</p>	
<p><b>Habitat(s):</b> Usually found in slow moving stretches of rivers with soft sandy or muddy substrate.</p>	
<p><b>Goal:</b> To preserve suitable habitat for this species.</p>	
<p><b>Objectives:</b> Remove and/or control potential threats</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To determine the status of this species. <u>Protect habitat:</u> Remove introduced predators, control loss of substrate.</p>	
<p>1. Stemmerman, L. 1981. A Guide to Pacific Wetland Plants. Army Corps of Engineers, Honolulu District.</p>	

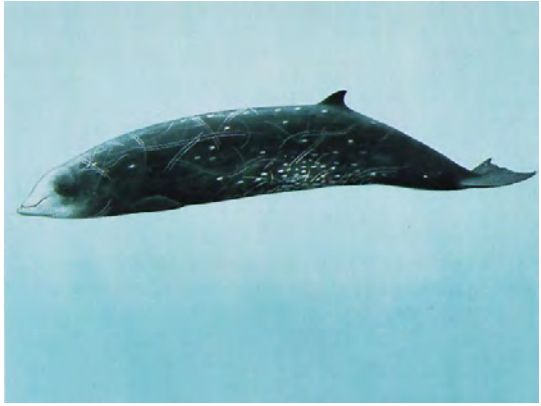
*Marine Mammals*

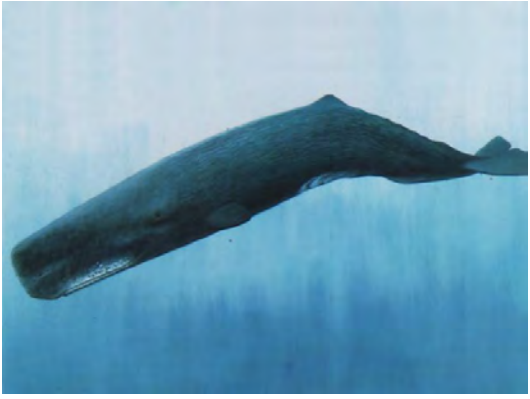
<p><b>Common name:</b> Bryde's Whale  <b>Chamorro name:</b> bayena  <b>Scientific name:</b> <i>Balaenoptera edeni</i></p>	
<p><b>Historic and current status:</b> Protected under the Marine Mammal Protection Act (1972); listed in Appendix 1 of CITES; population information not available.</p>	
<p><b>Threats:</b> Seismic operations; collision with large vessels; entanglement in fishing gear; defense operations; pollution, including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea, leading to bio-accumulation of toxic substances in body tissues; over-fishing of prey species, particularly commercial species such as anchovy.</p>	
<p><b>Habitat(s):</b> Temperate to tropical waters, both oceanic and inshore, bounded by latitudes 40°N and S, or the 20° isotherm.</p>	
<p><b>Goal:</b> To determine the importance of Guam's waters to the conservation of marine mammals.</p>	
<p><b>Objectives:</b> To survey annually Guam's waters to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.</p>	
<p><b>Action plan:</b> To conduct quarterly aerial surveys around Guam's waters to determine the abundance and distribution of the marine mammal species found around Guam's waters.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Australia Department of Environment and Heritage. 2005. <a href="http://www.deh.gov.au/coasts/species/cetaceans/">http://www.deh.gov.au/coasts/species/cetaceans/</a> accessed on 25 July, 2005.</li> <li>2. Eldredge, L. 2003b. The marine reptiles and mammals of Guam. <i>Micronesica</i> 35-36:653-660.</li> <li>3. Rice, D. W. 1998. Marine mammals of the world: systematics and distribution. Society for Marine Mammalogy, Special Publication 4.</li> </ol>	


<p><b>Common name:</b> Sei Whale  <b>Chamorro name:</b> bayena  <b>Scientific name:</b> <i>Balaenoptera borealis</i></p>	
<p><b>Historic and current status:</b> Protected under the Marine Mammal Protection Act (1972); listed in Appendix 1 of CITES; population information not available.</p>	
<p><b>Threats:</b> Seismic operations; collision with large vessels; entanglement in fishing gear; pollution, including increasing amounts of plastic debris at sea, oil spills, and dumping of industrial wastes into waterways and the sea, leading to bio-accumulation of toxic substances in body tissues, though less serious for species rarely feeding in low latitudes; over-harvest for scientific studies.</p>	
<p><b>Habitat(s):</b> Oceanic, undertaking long migrations between warm water breeding grounds and colder water feeding grounds, between 40°N and S.</p>	
<p><b>Goal:</b> To determine the importance of Guam’s waters to the conservation of marine mammals.</p>	
<p><b>Objectives:</b> To survey annually Guam’s waters to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.</p>	
<p><b>Action plan:</b> To conduct quarterly aerial surveys around Guam’s waters to determine the abundance and distribution of the marine mammal species found around Guam’s waters.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Australia Department of Environment and Heritage. 2005. <a href="http://www.deh.gov.au/coasts/species/cetaceans/">http://www.deh.gov.au/coasts/species/cetaceans/</a> accessed on 25 July, 2005.</li> <li>2. Eldredge, L. 2003b. The marine reptiles and mammals of Guam. <i>Micronesica</i> 35-36: 653-660.</li> <li>3. Rice, D. W. 1998. Marine mammals of the world: systematics and distribution. Society for Marine Mammalogy, Special Publication 4.</li> </ol>	

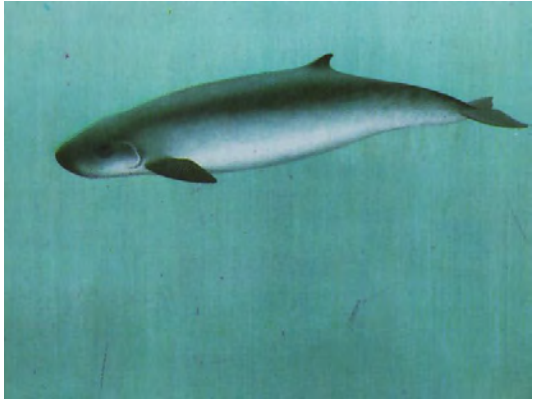
<p><b>Common name:</b> Humpback Whale  <b>Chamorro name:</b> bayena  <b>Scientific name:</b> <i>Megaptera novaeangliae</i></p>	
<p><b>Historic and current status:</b> Protected under the Marine Mammal Protection Act (1972); listed in Appendix 1 of CITES; population information not available.</p>	
<p><b>Threats:</b> Harassment from whale watching and research vessels/aircraft, pleasure craft, swimmers and divers; coastal seismic operations; defense operations; collision with large vessels; entanglement in fishing gear/shark nets; pollution, including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea, leading to bio-accumulation of toxic substances in body tissues, though less serious for species rarely feeding in low latitudes.</p>	
<p><b>Habitat(s):</b> Antarctic pelagic, in summer; temperate–subtropical/tropical coastal in winter.</p>	
<p><b>Goal:</b> To determine the importance of Guam’s waters to the conservation of marine mammals.</p>	
<p><b>Objectives:</b> To survey annually Guam’s waters to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.</p>	
<p><b>Action plan:</b> To conduct quarterly aerial surveys around Guam’s waters to determine the abundance and distribution of the marine mammal species found around Guam’s waters.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Australia Department of Environment and Heritage. 2005. <a href="http://www.deh.gov.au/coasts/species/cetaceans/">http://www.deh.gov.au/coasts/species/cetaceans/</a> accessed on 25 July, 2005.</li> <li>2. Eldredge, L. 2003b. The marine reptiles and mammals of Guam. <i>Micronesica</i> 35-36: 653-660.</li> <li>3. Rice, D. W. 1998. <i>Marine mammals of the world: systematics and distribution</i>. Society for Marine Mammalogy, Special Publication 4.</li> </ol>	

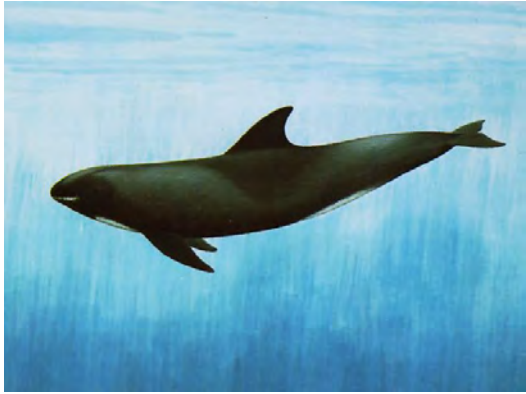



<p><b>Common name:</b> Cuvier's Beaked Whale  <b>Chamorro name:</b> bayena  <b>Scientific name:</b> <i>Ziphius cavirostris</i></p>	
<p><b>Historic and current status:</b> Protected under the Marine Mammal Protection Act (1972); listed in Appendix II of CITES; population information not available.</p>	
<p><b>Threats:</b> Possible entanglement in drift nets and other nets set, lost or discarded in international waters; competition from expanding commercial fisheries, especially on pelagic squids; pollution leading to accumulation of toxic substances in body tissues.</p>	
<p><b>Habitat(s):</b> Tropical (ca 22–32°C) to sub-polar (ca 1–8°C) deep oceanic waters.</p>	
<p><b>Goal:</b> To determine the importance of Guam's waters to the conservation of marine mammals.</p>	
<p><b>Objectives:</b> To survey annually Guam's waters to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.</p>	
<p><b>Action plan:</b> To conduct quarterly aerial surveys around Guam's waters to determine the abundance and distribution of the marine mammal species found around Guam's waters.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Australia Department of Environment and Heritage. 2005. <a href="http://www.deh.gov.au/coasts/species/cetaceans/">http://www.deh.gov.au/coasts/species/cetaceans/</a> accessed on 25 July, 2005.</li> <li>2. Eldredge, L. 2003b. The marine reptiles and mammals of Guam. <i>Micronesica</i> 35-36: 653-660.</li> <li>3. Rice, D. W. 1998. Marine mammals of the world: systematics and distribution. Society for Marine Mammalogy, Special Publication 4.</li> </ol>	

<p><b>Common name:</b> Sperm Whale  <b>Chamorro name:</b> bayena  <b>Scientific name:</b> <i>Physeter macrocephalus</i></p>	
<p><b>Historic and current status:</b> Protected under the Marine Mammal Protection Act (1972); listed in Appendix I of CITES; population information not available.</p>	
<p><b>Threats:</b> Not Available</p>	
<p><b>Habitat(s):</b> Pelagic, offshore, in deep water; population centers found in temperate/tropical waters where breeding/nursing schools, and groups of young males, occur; concentrations found where seabed rises steeply from great depth (e.g. on 'steep-to' coasts and near oceanic islands, probably associated with concentrations of major food—deep-sea cephalopods—in areas of upwelling). Only adult males, usually solitary or in small loose groups, found in cold waters (i.e. north or south of ca 45°S).</p>	
<p><b>Goal:</b> To determine the importance of Guam’s waters to the conservation of marine mammals.</p>	
<p><b>Objectives:</b> To survey annually Guam’s waters to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.</p>	
<p><b>Action plan:</b> To conduct quarterly aerial surveys around Guam’s waters to determine the abundance and distribution of the marine mammal species found around Guam’s waters.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Australia Department of Environment and Heritage. 2005. <a href="http://www.deh.gov.au/coasts/species/cetaceans/">http://www.deh.gov.au/coasts/species/cetaceans/</a> accessed on 25 July, 2005.</li> <li>2. Eldredge, L. 2003b. The marine reptiles and mammals of Guam. <i>Micronesica</i> 35-36: 653-660.</li> <li>3. Rice, D. W. 1998. Marine mammals of the world: systematics and distribution. Society for Marine Mammalogy, Special Publication 4.</li> </ol>	


<p><b>Common name:</b> Dwarf Sperm Whale  <b>Chamorro name:</b> bayena  <b>Scientific name:</b> <i>Kogia sima</i></p>	
<p><b>Historic and current status:</b> Protected under the Marine Mammal Protection Act (1972); not listed in either Appendix I or II of CITES; population information not available.</p>	
<p><b>Threats:</b> Seismic operations; collision with large vessels; entanglement in fishing gear; defense operations, pollution, including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea, leading to bio-accumulation of toxic substances in body tissues.</p>	
<p><b>Habitat(s):</b> Oceanic, apart from colder waters, but more coastal than pygmy sperm whale.</p>	
<p><b>Goal:</b> To determine the importance of Guam’s waters to the conservation of marine mammals.</p>	
<p><b>Objectives:</b> To survey annually Guam’s waters to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.</p>	
<p><b>Action plan:</b> To conduct quarterly aerial surveys around Guam’s waters to determine the abundance and distribution of the marine mammal species found around Guam’s waters.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Australia Department of Environment and Heritage. 2005. <a href="http://www.deh.gov.au/coasts/species/cetaceans/">http://www.deh.gov.au/coasts/species/cetaceans/</a> accessed on 25 July, 2005.</li> <li>2. Eldredge, L. 2003b. The marine reptiles and mammals of Guam. <i>Micronesica</i> 35-36: 653-660.</li> <li>3. Rice, D. W. 1998. Marine mammals of the world: systematics and distribution. Society for Marine Mammalogy, Special Publication 4.</li> </ol>	

<p><b>Common name:</b> Pygmy Sperm Whale  <b>Chamorro name:</b> bayena  <b>Scientific name:</b> <i>Kogia breviceps</i></p>	
<p><b>Historic and current status:</b> Protected under the Marine Mammal Protection Act (1972); not listed in either Appendix I or II of CITES; population information not available.</p>	
<p><b>Threats:</b> Seismic operations; collision with large vessels; entanglement in fishing gear; pollution, including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea, leading to bio-accumulation of toxic substances in body tissues.</p>	
<p><b>Habitat(s):</b> Oceanic, apart from colder waters.</p>	
<p><b>Goal:</b> To determine the importance of Guam's waters to the conservation of marine mammals.</p>	
<p><b>Objectives:</b> To survey annually Guam's waters to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.</p>	
<p><b>Action plan:</b> To conduct quarterly aerial surveys around Guam's waters to determine the abundance and distribution of the marine mammal species found around Guam's waters.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Australia Department of Environment and Heritage. 2005. <a href="http://www.deh.gov.au/coasts/species/cetaceans/">http://www.deh.gov.au/coasts/species/cetaceans/</a> accessed on 25 July, 2005.</li> <li>2. Eldredge, L. 2003b. The marine reptiles and mammals of Guam. <i>Micronesica</i> 35-36: 653-660.</li> <li>3. Rice, D. W. 1998. Marine mammals of the world: systematics and distribution. Society for Marine Mammalogy, Special Publication 4.</li> </ol>	

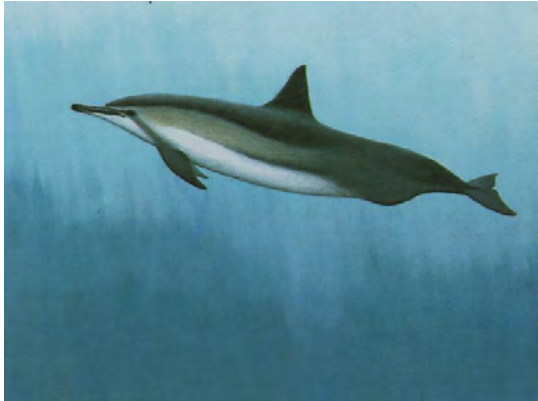
<p><b>Common name:</b> Melonheaded Whale  <b>Chamorro name:</b> bayena  <b>Scientific name:</b> <i>Peponocephala electra</i></p>	
<p><b>Historic and current status:</b> Protected under the Marine Mammal Protection Act (1972); listed in Appendix II of CITES; population information not available.</p>	
<p><b>Threats:</b> Possible illegal and incidental catches in gill-nets and small numbers taken in the purse-seine nets of the eastern tropical Pacific; captured in low numbers in small cetacean fisheries in several places, including Japan, Indonesia and Sri Lanka; entanglement in drift-nets and in lost or discarded netting; pollution (including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea) leading to bio-accumulation of toxic substances in body tissues.</p>	
<p><b>Habitat(s):</b> Pelagic and oceanic. Primarily tropical and subtropical but can be found in temperate waters. Inhabits warm waters (usually &gt;25°C), mainly equatorial. Generally, in upwelling areas.</p>	
<p><b>Goal:</b> To determine the importance of Guam's waters to the conservation of marine mammals.</p>	
<p><b>Objectives:</b> To survey annually Guam's waters to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.</p>	
<p><b>Action plan:</b> To conduct quarterly aerial surveys around Guam's waters to determine the abundance and distribution of the marine mammal species found around Guam's waters.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Australia Department of Environment and Heritage. 2005. <a href="http://www.deh.gov.au/coasts/species/cetaceans/">http://www.deh.gov.au/coasts/species/cetaceans/</a> accessed on 25 July, 2005.</li> <li>2. Eldredge, L. 2003b. The marine reptiles and mammals of Guam. <i>Micronesica</i> 35-36: 653-660.</li> <li>3. Rice, D. W. 1998. Marine mammals of the world: systematics and distribution. Society for Marine Mammalogy, Special Publication 4.</li> </ol>	


<p><b>Common name:</b> Killer Whale  <b>Chamorro name:</b> bayena  <b>Scientific name:</b> <i>Orcinus orca</i></p>	
<p><b>Historic and current status:</b> Protected under the Marine Mammal Protection Act (1972); listed in Appendix II of CITES; population information not available.</p>	
<p><b>Threats:</b> Is long-lived and a top predator, making it highly susceptible to accumulating high levels of heavy metals and organochlorines; reduction of food resources by overfishing of prey species; entanglement in drift-nets and in lost or discarded netting.</p>	
<p><b>Habitat(s):</b> Oceanic, pelagic and neritic, in warm and cold waters; may be more common in cold, deep waters; often seen near seal colonies.</p>	
<p><b>Goal:</b> To determine the importance of Guam's waters to the conservation of marine mammals.</p>	
<p><b>Objectives:</b> To survey annually Guam's waters to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.</p>	
<p><b>Action plan:</b> To conduct quarterly aerial surveys around Guam's waters to determine the abundance and distribution of the marine mammal species found around Guam's waters.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Australia Department of Environment and Heritage. 2005. <a href="http://www.deh.gov.au/coasts/species/cetaceans/">http://www.deh.gov.au/coasts/species/cetaceans/</a> accessed on 25 July, 2005.</li> <li>2. Eldredge, L. 2003b. The marine reptiles and mammals of Guam. <i>Micronesica</i> 35-36: 653-660.</li> <li>3. Rice, D. W. 1998. Marine mammals of the world: systematics and distribution. Society for Marine Mammalogy, Special Publication 4.</li> </ol>	


<p><b>Common name:</b> Shortfinned Pilot Whale  <b>Chamorro name:</b> bayena  <b>Scientific name:</b> <i>Globicephala macrorhynchus</i></p>	
<p><b>Historic and current status:</b> Protected under the Marine Mammal Protection Act (1972); listed in Appendix II of CITES; population information not available.</p>	
<p><b>Threats:</b> Entanglement in drift nets and other nets set, lost or discarded in international waters; competition from expanding commercial fisheries; pollution leading to accumulation of toxic substances in body tissues.</p>	
<p><b>Habitat(s):</b> Tropical (ca 22–32°C) to temperate (ca 10–22°C) oceanic waters, approaching coastal seas.</p>	
<p><b>Goal:</b> To determine the importance of Guam’s waters to the conservation of marine mammals.</p>	
<p><b>Objectives:</b> To survey annually Guam’s waters to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.</p>	
<p><b>Action plan:</b> To conduct quarterly aerial surveys around Guam’s waters to determine the abundance and distribution of the marine mammal species found around Guam’s waters.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Australia Department of Environment and Heritage. 2005. <a href="http://www.deh.gov.au/coasts/species/cetaceans/">http://www.deh.gov.au/coasts/species/cetaceans/</a> accessed on 25 July, 2005.</li> <li>2. Eldredge, L. 2003b. The marine reptiles and mammals of Guam. <i>Micronesica</i> 35-36: 653-660.</li> <li>3. Rice, D. W. 1998. Marine mammals of the world: systematics and distribution. Society for Marine Mammalogy, Special Publication 4.</li> </ol>	

<p><b>Common name:</b> Risso's Dolphin  <b>Chamorro name:</b> toninos  <b>Scientific name:</b> <i>Grampus griseus</i></p>	
<p><b>Historic and current status:</b> Protected under the Marine Mammal Protection Act (1972); listed in Appendix II of CITES; population information not available.</p>	
<p><b>Threats:</b> Possible illegal and incidental catches; captured in small numbers in directed fisheries in several parts of the world, including Indonesia and Solomon Islands; entanglement in drift-nets and in lost or discarded netting; pollution (including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea) leading to bio-accumulation of toxic substances in body tissues.</p>	
<p><b>Habitat(s):</b> Tropical, subtropical, temperate, and subantarctic waters; has been sighted both inshore and well offshore, although generally considered pelagic and oceanic; sea temperatures 15°–30°C; frequently seen over continental slope.</p>	
<p><b>Goal:</b> To determine the importance of Guam's waters to the conservation of marine mammals.</p>	
<p><b>Objectives:</b> To survey annually Guam's waters to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.</p>	
<p><b>Action plan:</b> To conduct quarterly aerial surveys around Guam's waters to determine the abundance and distribution of the marine mammal species found around Guam's waters.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Australia Department of Environment and Heritage. 2005. <a href="http://www.deh.gov.au/coasts/species/cetaceans/">http://www.deh.gov.au/coasts/species/cetaceans/</a> accessed on 25 July, 2005.</li> <li>2. Eldredge, L. 2003b. The marine reptiles and mammals of Guam. <i>Micronesica</i> 35-36: 653-660.</li> <li>3. Rice, D. W. 1998. Marine mammals of the world: systematics and distribution. Society for Marine Mammalogy, Special Publication 4.</li> </ol>	





<p><b>Common name:</b> Spinner Dolphin  <b>Chamorro name:</b> toninos  <b>Scientific name:</b> <i>Stenella longirostris</i></p>	
<p><b>Historic and current status:</b> Protected under the Marine Mammal Protection Act (1972); listed in Appendix II of CITES; population information not available.</p>	
<p><b>Threats:</b> Incidental catch in gill-net fishery and shrimp trawls; purse-seine netting in the eastern tropical Pacific; captured in small numbers in directed fishery in Solomon Islands; entanglement in drift-nets and in lost or discarded netting; pollution (including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea) leading to bio-accumulation of toxic substances in body tissues.</p>	
<p><b>Habitat(s):</b> Primarily pelagic but can be neritic in some regions; tropical, subtropical and occasionally temperate waters; associates with tuna, pantropical spotted dolphin and sea birds, under certain oceanographic conditions (i.e. well-defined, shallow, 100 m deep pelagic habitats in restricted areas).</p>	
<p><b>Goal:</b> To determine the importance of Guam's waters to the conservation of marine mammals.</p>	
<p><b>Objectives:</b> To survey annually Guam's waters to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.</p>	
<p><b>Action plan:</b> To conduct quarterly aerial surveys around Guam's waters to determine the abundance and distribution of the marine mammal species found around Guam's waters.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Australia Department of Environment and Heritage. 2005. <a href="http://www.deh.gov.au/coasts/species/cetaceans/">http://www.deh.gov.au/coasts/species/cetaceans/</a> accessed on 25 July, 2005.</li> <li>2. Eldredge, L. 2003b. The marine reptiles and mammals of Guam. <i>Micronesica</i> 35-36: 653-660.</li> <li>3. Rice, D. W. 1998. Marine mammals of the world: systematics and distribution. Society for Marine Mammalogy, Special Publication 4.</li> </ol>	


<p><b>Common name:</b> Striped Dolphin  <b>Chamorro name:</b> toninos  <b>Scientific name:</b> <i>Stenella coeruleoalba</i></p>	
<p><b>Historic and current status:</b> Protected under the Marine Mammal Protection Act (1972); listed in Appendix II of CITES; population information not available.</p>	
<p><b>Threats:</b> Incidental catch; direct and indirect catch in Sri Lanka and the Solomon Islands; large numbers taken by the Japanese drive fishery; entanglement in drift-nets and in lost or discarded netting; pollution (including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea) leading to bio-accumulation of toxic substances in body tissues.</p>	
<p><b>Habitat(s):</b> Pelagic. Deep water and outer edge of continental slope. Tropical, subtropical and warm temperate waters. Possible vagrants recorded in colder waters.</p>	
<p><b>Goal:</b> To determine the importance of Guam's waters to the conservation of marine mammals.</p>	
<p><b>Objectives:</b> To survey annually Guam's waters to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.</p>	
<p><b>Action plan:</b> To conduct quarterly aerial surveys around Guam's waters to determine the abundance and distribution of the marine mammal species found around Guam's waters.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Australia Department of Environment and Heritage. 2005. <a href="http://www.deh.gov.au/coasts/species/cetaceans/">http://www.deh.gov.au/coasts/species/cetaceans/</a> accessed on 25 July, 2005.</li> <li>2. Eldredge, L. 2003b. The marine reptiles and mammals of Guam. <i>Micronesica</i> 35-36: 653-660.</li> <li>3. Rice, D. W. 1998. Marine mammals of the world: systematics and distribution. Society for Marine Mammalogy, Special Publication 4.</li> </ol>	

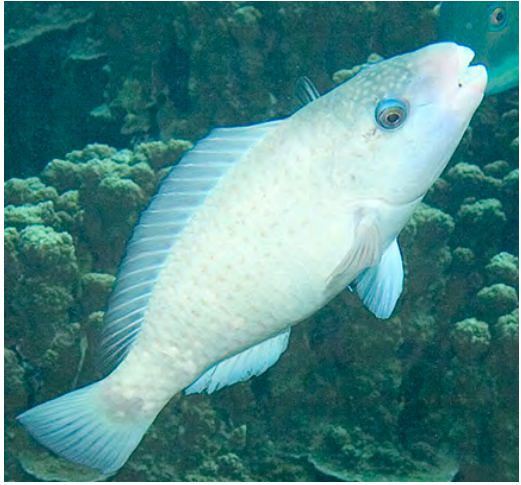
<p><b>Common name:</b> Dugong  <b>Chamorro name:</b> None  <b>Scientific name:</b> <i>Dugong dugon</i></p>	
<p><b>Historic and current status:</b> Protected under the Marine Mammal Protection Act (1972); population information not available.</p>	
<p><b>Threats:</b> Habitat loss; direct take; collisions with small vessels in shallow water.</p>	
<p><b>Habitat(s):</b> Shallow, tropical waters throughout the Indo-Pacific region; feed primarily in seagrass beds. Most of the world's population of dugongs is now found in northern Australian waters between Shark Bay in Western Australia and Moreton Bay in Queensland.</p>	
<p><b>Goal:</b> To determine the importance of Guam's waters to the conservation of marine mammals.</p>	
<p><b>Objectives:</b> To survey annually Guam's waters to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.</p>	
<p><b>Action plan:</b> To conduct quarterly aerial surveys around Guam's waters to determine the abundance and distribution of the marine mammal species found around Guam's waters.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Australia Department of Environment and Heritage. 2005. <a href="http://www.deh.gov.au/coasts/species/cetaceans/">http://www.deh.gov.au/coasts/species/cetaceans/</a> accessed on 25 July, 2005.</li> <li>2. Eldredge, L. 2003b. The marine reptiles and mammals of Guam. <i>Micronesica</i> 35-36: 653-660.</li> <li>3. Rice, D. W. 1998. Marine mammals of the world: systematics and distribution. Society for Marine Mammalogy, Special Publication 4.</li> </ol>	


*Marine Fishes*

<p><b>Common name:</b> Humphead Wrasse or Napoleon Wrasse  <b>Chamorro name:</b> tanguisson<sup>1</sup>  <b>Scientific name:</b> <i>Cheilinus undulatus</i></p>	
<p><b>Historic and current status:</b> Heavily fished by SCUBA equipped spear anglers. Adults are rarely seen. Juveniles are more frequently seen, especially in the marine preserves.</p>	
<p><b>Threats:</b> Human take of adults and juveniles, habitat degradation</p>	
<p><b>Habitat(s):</b> Adults inhabit outer reef slopes and channel slopes. Juveniles occur in coral-rich areas of lagoon reefs, particularly among thickets of staghorn <i>Acropora</i> thickets<sup>2</sup>. Juveniles are found in Cocos Lagoon, Tumon Bay Marine Preserve, and Piti Bomb Holes Preserve (GDAWR unpublished data, M. Tupper UOGML pers. com.)</p>	
<p><b>Goal:</b> Sustain population to facilitate de-listing from CITES and to prevent listing on Endangered Species List.</p>	
<p><b>Objectives:</b> Assess current population structure and size, protect habitat, manage take through outreach and education.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To collect baseline population size, demography (age and sex), genetic, and distribution information for Guam's stocks. <u>Protect habitat:</u> To provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. <u>Reduce take through outreach and education:</u> To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting slow growth rate, include in fisheries management plans.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Kerr, A. M. 1990. Chamorro fish names. <i>Micronesica</i>. 23: 93-118.</li> <li>2. Myers, R. F. 1999. <i>Micronesian reef fishes: A practical guide to the identification of the Inshore Marine Fishes of the Tropical Central and Western Pacific</i>, 3<sup>rd</sup> edition. Coral Graphics: Barrigada, Guam.</li> </ol>	


<p><b>Common name:</b> Bumphead Parrotfish  <b>Chamorro name:</b> atuhong<sup>1</sup>  <b>Scientific name:</b> <i>Bolbometopon muricatum</i></p>	 <p style="text-align: right; font-size: small;">Image © G. McNeil</p>
<p><b>Historic and current status:</b> Stocks have steadily declined in Guam. Sightings are rare.</p>	
<p><b>Threats:</b> This species feeds substantially on live coral, requires healthy reef habitat for survival, and is threatened by the loss of this habitat. Due to its habit of sleeping in schools, it is also vulnerable to commercial spearfishing.</p>	
<p><b>Habitat(s):</b> Clear outer lagoon and seaward reefs at depths of 1 to at least 30m. In unfished areas, it may enter outer reef flats at low tide.<sup>2</sup></p>	
<p><b>Goal:</b> To recover population to historic levels.</p>	
<p><b>Objectives:</b> Assess current population structure and size, protect habitat, and manage take through outreach and education.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To collect baseline population size, demography (age and sex), genetic, and distribution information for Guam's stocks. <u>Protect habitat:</u> Provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. <u>Reduce take through outreach and education:</u> To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting slow growth rate, include in fisheries management plans.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Kerr, A. M. 1990. Chamorro fish names. <i>Micronesica</i> 23: 93-118.</li> <li>2. Myers, R. F. 1999. <i>Micronesian reef fishes: A practical guide to the identification of the Inshore Marine Fishes of the Tropical Central and Western Pacific</i>, 3<sup>rd</sup> edition. Coral Graphics: Barrigada, Guam.</li> </ol>	


<p><b>Common name:</b> Surgeonfish  <b>Chamorro name:</b> hugupau, tataga, guasa', hangon, guagnas, hiyuk, kichu<sup>1</sup>  <b>Scientific name:</b> Acanthuridae</p>	
<p><b>Historic and current status:</b> Popular food fish, this family is heavily fished using a number of techniques including gill nets and spearfishing.</p>	
<p><b>Threats:</b> Overfishing, loss of habitat</p>	
<p><b>Habitat(s):</b> Varied, adults generally in lagoons and seaward reefs. Juveniles often in protected, turbid, inshore waters.<sup>2</sup></p>	
<p><b>Goal:</b> To manage populations for sustainable fishing.</p>	
<p><b>Objectives:</b> Assess current population structure and size, protect habitat, and manage take through outreach and education.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To collect baseline population size, demography (age and sex), genetic, and distribution information for Guam's stocks. <u>Protect habitat:</u> To provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. <u>Reduce take through outreach and education:</u> To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting slow growth rate, include in fisheries management plans.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Kerr, A. M. 1990. Chamorro fish names. <i>Micronesica</i> 23: 93-118.</li> <li>2. Myers, R. F. 1999. <i>Micronesian reef fishes: A practical guide to the identification of the Inshore Marine Fishes of the Tropical Central and Western Pacific</i>, 3<sup>rd</sup> edition. Coral Graphics: Barrigada, Guam.</li> </ol>	


<p><b>Common name:</b> Parrotfish  <b>Chamorro name:</b> laggua, palaksi<sup>1</sup>  <b>Scientific name:</b> Scaridae</p>	
<p><b>Historic and current status:</b> Popular food fish, this family is heavily fished using a number of techniques including gill nets, spearfishing.</p>	
<p><b>Threats:</b> Overfishing, loss of habitat</p>	
<p><b>Habitat(s):</b> Varied, adults generally in lagoons and seaward reefs although some occur exclusively in reef flat and shallow lagoon areas dominated by seagrass or dense algae beds. Juveniles often in protected, inshore waters including reef flats and lagoons, but may also be found on seaward reefs.<sup>2</sup></p>	
<p><b>Goal:</b> To manage populations for sustainable fishing.</p>	
<p><b>Objectives:</b> Assess current population structure and size, protect habitat, and manage take through outreach and education.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To collect baseline population size, demography (age and sex), genetic, and distribution information for Guam's stocks. <u>Protect habitat:</u> provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. <u>Reduce take through outreach and education:</u> To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting slow growth rate, include in fisheries management plans.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Kerr, A. M. 1990. Chamorro fish names. <i>Micronesica</i> 23: 93-118.</li> <li>2. Myers, R. F. 1999. <i>Micronesian reef fishes: A practical guide to the identification of the Inshore Marine Fishes of the Tropical Central and Western Pacific</i>, 3<sup>rd</sup> edition. Coral Graphics: Barrigada, Guam.</li> </ol>	


<p><b>Common name:</b> Emperors  <b>Chamorro name:</b> mafute, lililuk<sup>1</sup>  <b>Scientific name:</b> Lethrinidae</p>	
<p><b>Historic and current status:</b> Popular food fish, this family is heavily fished using a number of techniques including gill nets, spearfishing, hook and line.</p>	
<p><b>Threats:</b> Overfishing, loss of habitat</p>	
<p><b>Habitat(s):</b> Varied, adults generally in lagoons and seaward reefs although some occur as well as reef flat and shallow lagoon areas, including seagrass, mangroves, and shallow sandy areas. Juveniles often in protected, inshore waters including reef flats and lagoons, but may also be found on seaward reefs.<sup>2</sup></p>	
<p><b>Goal:</b> To manage populations for sustainable fishing.</p>	
<p><b>Objectives:</b> Assess current population structure and size, protect habitat, manage take through outreach and education.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To collect baseline population size, demography (age and sex), genetic, and distribution information for Guam's stocks. <u>Protect habitat:</u> To provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. <u>Reduce take through outreach and education:</u> To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting slow growth rate, include in fisheries management plans.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Kerr, A. M. 1990. Chamorro fish names. <i>Micronesica</i> 23: 93-118.</li> <li>2. Myers, R. F. 1999. <i>Micronesian reef fishes: A practical guide to the identification of the Inshore Marine Fishes of the Tropical Central and Western Pacific</i>, 3<sup>rd</sup> edition. Coral Graphics: Barrigada, Guam.</li> </ol>	





<p><b>Common name:</b> Groupers  <b>Chamorro name:</b> gadao, gadao pentu, gadao maluslus, gadao matingon, gadao mama'te, gadao alutong finu<sup>1</sup>  <b>Scientific name:</b> Serranidae</p>	
<p><b>Historic and current status:</b> Popular food fish, this family is heavily fished using a number of techniques including gill nets, spearfishing, hook and line.</p>	
<p><b>Threats:</b> Overfishing, loss of habitat</p>	
<p><b>Habitat(s):</b> Varied, adults generally in lagoons and seaward reefs although some occur as well as reef flat and shallow lagoon areas, including seagrass, mangroves, and shallow sandy areas. Juveniles often in protected, inshore waters including reef flats and lagoons, but may also be found on seaward reefs.<sup>2</sup></p>	
<p><b>Goal:</b> To manage populations for sustainable fishing.</p>	
<p><b>Objectives:</b> Assess current population structure and size, protect habitat, manage take through outreach and education.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To collect baseline population size, demography (age and sex), genetic, and distribution information for Guam's stocks. <u>Protect habitat:</u> To provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. <u>Reduce take through outreach and education:</u> To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting slow growth rate, include in fisheries management plans.</p>	
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<p><b>Common name:</b> Rabbitfish  <b>Chamorro names:</b> sesjun, manahak, manahak ha ‘tang, manahac lesu, hiting fade<sup>1</sup>  <b>Scientific name:</b> Siganidae</p>	
<p><b>Historic and current status:</b> Popular food fish, this family is heavily fished using a number of techniques including talaya, hook and line, gill net, and spear</p>	
<p><b>Threats:</b> Overfishing, loss of habitat</p>	
<p><b>Habitat(s):</b> Reef flats, lagoons and bays, and fore reefs.<sup>2</sup></p>	
<p><b>Goal:</b> To manage populations for sustainable fishing.</p>	
<p><b>Objectives:</b> Assess current population structure and size, protect habitat, manage take through outreach and education.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To collect baseline population size, demography (age and sex), genetic, and distribution information for Guam’s stocks. <u>Protect habitat:</u> To provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. <u>Reduce take through outreach and education:</u> To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting slow growth rate, include in fisheries management plans.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Kerr, A. M. 1990. Chamorro fish names. <i>Micronesica</i> 23: 93-118.</li> <li>2. Myers, R. F. 1999. <i>Micronesian reef fishes: A practical guide to the identification of the Inshore Marine Fishes of the Tropical Central and Western Pacific</i>, 3<sup>rd</sup> edition. Coral Graphics: Barrigada, Guam.</li> </ol>	


<p><b>Common name:</b> Snappers  <b>Chamorro names:</b> tagafi, fafaet, funai, kakaka, bua, matanhagon, lagu<sup>1</sup>  <b>Scientific name:</b> Lutjanidae</p>	
<p><b>Historic and current status:</b> Popular food fish taken with hook and line, spear, and gillnet. Some species are shunned due to chronic incidence of ciguatera toxin.</p>	
<p><b>Threats:</b> Overfishing, loss of habitat</p>	
<p><b>Habitat(s):</b> Varied, adults generally in lagoons and seaward reefs although some occur as well as reef flat and shallow lagoon areas, including seagrass, mangroves, and shallow sandy areas. Some species are the principal fisheries species taken from deep reefs (&gt;500 ft.). Juveniles often in protected, inshore waters including reef flats and lagoons. Some species are frequently found in brackish or freshwater habitats.<sup>2</sup></p>	
<p><b>Goal:</b> To manage populations for sustainable fishing.</p>	
<p><b>Objectives:</b> Assess current population structure and size, protect habitat, manage take through outreach and education.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To collect baseline population size, demography (age and sex), genetic, and distribution information for Guam's stocks. <u>Protect habitat:</u> To provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. <u>Reduce take through outreach and education:</u> To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting slow growth rate, include in fisheries management plans.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Kerr, A. M. 1990. Chamorro fish names. <i>Micronesica</i> 23: 93-118.</li> <li>2. Myers, R. F. 1999. <i>Micronesian reef fishes: A practical guide to the identification of the Inshore Marine Fishes of the Tropical Central and Western Pacific</i>, 3<sup>rd</sup> edition. Coral Graphics: Barrigada, Guam.</li> </ol>	

<p><b>Common name:</b> Goatfish  <b>Chamorro name:</b> sakmoneti, ti'ao, sakmoneten acho', sakmoneten amariyu, sakmoneten lasu lahi, sakmoneten le'ao<sup>1</sup>  <b>Scientific name:</b> Mullidae</p>	
<p><b>Historic and current status:</b> Popular food fish. Juveniles recruit in large schools, and form a culturally important fishery. Juveniles are taken with tekin (gill net), and talaya (throw net), while adults are more frequently taken with hook and line or spear. In terms of total weight, the fourth most important family of inshore fishes taken during 2003.</p>	
<p><b>Threats:</b> Overfishing, loss of habitat</p>	
<p><b>Habitat(s):</b> Juveniles are found in reef flats and bays, usually over sandy substrate. Adults may be found on reef flats, as well as seaward reefs, up to 300 feet deep.<sup>2</sup></p>	
<p><b>Goal:</b> To manage populations for sustainable fishing.</p>	
<p><b>Objectives:</b> Assess current population structure and size, protect habitat, manage take through outreach and education.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To collect baseline population size, demography (age and sex), genetic, and distribution information for Guam's stocks. <u>Protect habitat:</u> To provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. <u>Reduce take through outreach and education:</u> To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting slow growth rate, include in fisheries management plans.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Kerr, A. M. 1990. Chamorro fish names. <i>Micronesica</i> 23: 93-118.</li> <li>2. Myers, R. F. 1999. <i>Micronesian reef fishes: A practical guide to the identification of the Inshore Marine Fishes of the Tropical Central and Western Pacific</i>, 3<sup>rd</sup> edition. Coral Graphics: Barrigada, Guam.</li> </ol>	

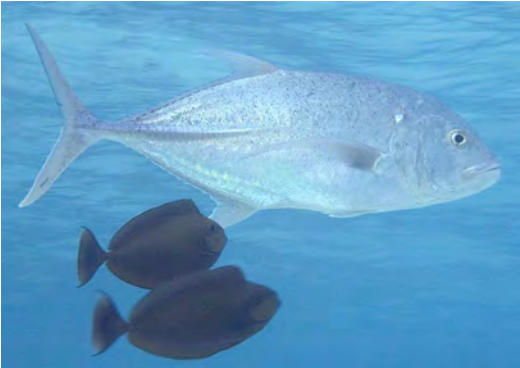
<p><b>Common name:</b> Butterflyfish  <b>Chamorro name:</b> ababang, ababang lonnat, ababang rayao, ababang pintado<sup>1</sup>  <b>Scientific name:</b> Chaetodontidae</p>	
<p><b>Historic and current status:</b> Not traditionally taken as a food fish by Chamorro population. Sometimes taken for food by people from other islands. Butterflyfish are some of the most popular species taken for the home aquarium trade, although many species do poorly in captivity.</p>	
<p><b>Threats:</b> Overfishing by the aquarium trade, loss of habitat</p>	
<p><b>Habitat(s):</b> Many species are closely associated with coral reefs. Most are found on reef flats or seaward reef slopes. Some species are obligate coral feeders, and as such, are indicators of a reef's health. Some species are found on deep reefs (&gt; 200 feet).<sup>2</sup></p>	
<p><b>Goal:</b> To manage and maintain current population status.</p>	
<p><b>Objectives:</b> Assess current population structure and size, protect habitat, manage take through outreach and education.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To collect baseline population size, demography (age and sex), genetic, and distribution information for Guam's stocks. <u>Protect habitat:</u> To provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. <u>Reduce take through outreach and education:</u> To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting slow growth rate, include in fisheries management plans.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Kerr, A. M. 1990. Chamorro fish names. <i>Micronesica</i> 23: 93-118.</li> <li>2. Myers, R. F. 1999. <i>Micronesian reef fishes: A practical guide to the identification of the Inshore Marine Fishes of the Tropical Central and Western Pacific</i>, 3<sup>rd</sup> edition. Coral Graphics: Barrigada, Guam.</li> </ol>	

<p><b>Common name:</b> Angelfish  <b>Chamorro name:</b> ababang<sup>1</sup>  <b>Scientific name:</b> Pomacanthidae</p>	
<p><b>Historic and current status:</b> Not traditionally taken as a food fish by Chamorro population. Sometimes taken for food by people from other islands. Angelfish are some of the most popular species taken for the home aquarium trade, although many species do poorly in captivity.</p>	
<p><b>Threats:</b> Overfishing by the aquarium trade, loss of habitat</p>	
<p><b>Habitat(s):</b> This family inhabits reef flats, clear lagoons, seaward reef slopes, and channels. Some species are found on deep reefs.<sup>2</sup></p>	
<p><b>Goal:</b> To manage and maintain current population status.</p>	
<p><b>Objectives:</b> Assess current population structure and size, protect habitat, manage take through outreach and education.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To collect baseline population size, demography (age and sex), genetic, and distribution information for Guam's stocks. <u>Protect habitat:</u> to provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. <u>Reduce take through outreach and education:</u> To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting slow growth rate, include in fisheries management plans.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Kerr, A. M. 1990. Chamorro fish names. <i>Micronesica</i> 23: 93-118.</li> <li>2. Myers, R. F. 1999. <i>Micronesian reef fishes: A practical guide to the identification of the Inshore Marine Fishes of the Tropical Central and Western Pacific</i>, 3<sup>rd</sup> edition. Coral Graphics: Barrigada, Guam.</li> </ol>	

<p><b>Common name:</b> Hawkfish  <b>Chamorro name:</b> aluda<sup>1</sup>  <b>Scientific name:</b> Cirrhitidae</p>	
<p><b>Historic and current status:</b> The stocky hawkfish (<i>Cirrhitus pinnulatus</i>) is often fished for food. Other species are taken incidentally by hook and line, but for the most part this is not a targeted family. Some species are very popular in the home aquarium trade and are at risk of over collection.</p>	
<p><b>Threats:</b> Overfishing (<i>C. pinnulatus</i>), aquarium collection, loss of habitat. Collection of these species for the aquarium trade often leads to the destruction of the corals they inhabit.</p>	
<p><b>Habitat(s):</b> Hawkfish are closely associated with coral reefs. Members of this family inhabit lagoons, reef fronts, submarine terraces, and seaward reefs up to at least 100m. Some species within this family are found exclusively with certain coral species such as antler coral (<i>Pocillopora eydouxi</i>) and <i>Acropora</i> species.<sup>2</sup></p>	
<p><b>Goal:</b> To manage and maintain current population status.</p>	
<p><b>Objectives:</b> Assess current population structure and size, protect habitat, manage take through outreach and education.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To collect baseline population size, demography (age and sex), genetic, and distribution information for Guam’s stocks. <u>Protect habitat:</u> To provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. <u>Reduce take through outreach and education:</u> To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting slow growth rate, include in fisheries management plans.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Kerr, A. M. 1990. Chamorro fish names. <i>Micronesica</i> 23: 93-118.</li> <li>2. Myers, R. F. 1999. Micronesian reef fishes: A practical guide to the identification of the Inshore Marine Fishes of the Tropical Central and Western Pacific, 3<sup>rd</sup> edition. Coral Graphics: Barrigada, Guam.</li> </ol>	

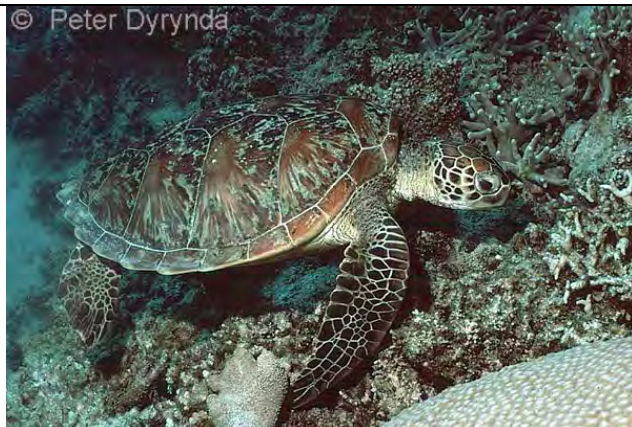
<p><b>Common name:</b> Wrasses  <b>Chamorro name:</b> palaksi, a'aga, lalacha' mamate<sup>1</sup>  <b>Scientific name:</b> Labridae</p>	
<p><b>Historic and current status:</b> Wrasses are popular food fish on Guam. They are frequently taken on hook and line, with tekis (gill nets), and with spear. Wrasses are carnivores, feeding on reef invertebrates and smaller fishes.</p>	
<p><b>Threats:</b> Overfishing, loss of habitat</p>	
<p><b>Habitat(s):</b> Wrasses are found in almost all coral reef habitats, from seagrass beds to sandy reef flats, to seaward reef slopes and deep reefs (&gt; 500 feet). In some habitats, wrasses are among the most abundant species found.</p>	
<p><b>Goal:</b> To manage populations for sustainable fishing.</p>	
<p><b>Objectives:</b> Assess current population structure and size, protect habitat, manage take through outreach and education.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To collect baseline population size, demography (age and sex), genetic, and distribution information for Guam's stocks. <u>Protect habitat:</u> To provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. <u>Reduce take through outreach and education:</u> To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting slow growth rate, include in fisheries management plans.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Kerr, A. M. 1990. Chamorro fish names. <i>Micronesica</i> 23: 93-118.</li> <li>2. Myers, R. F. 1999. <i>Micronesian reef fishes: A practical guide to the identification of the Inshore Marine Fishes of the Tropical Central and Western Pacific</i>, 3<sup>rd</sup> edition. Coral Graphics: Barrigada, Guam.</li> </ol>	



<p><b>Common name:</b> Jacks and Trevallies  <b>Chamorro name:</b> i'e, tarakitu, mamulan<sup>1</sup>  <b>Scientific name:</b> Carangidae</p>	
<p><b>Historic and current status:</b> Popular food fish. Juveniles recruit in large schools and form a culturally important fishery. Juveniles are taken with hook and line and talaya (throw net), while adults are more frequently taken with hook and line or spear. In terms of total weight, the second most important family of inshore fishes taken during 2003.</p>	
<p><b>Threats:</b> Overfishing, loss of habitat</p>	
<p><b>Habitat(s):</b> Juveniles are found on reef flats or around floating objects such as buoys and floating debris. Adults are found on reef flats and seaward reefs to a depth of at least 300 feet.<sup>2</sup></p>	
<p><b>Goal:</b> To manage populations for sustainable fishing.</p>	
<p><b>Objectives:</b> Assess current population structure and size, protect habitat, manage take through outreach and education.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To collect baseline population size, demography (age and sex), genetic, and distribution information for Guam's stocks. <u>Protect habitat:</u> To provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. <u>Reduce take through outreach and education:</u> To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting slow growth rate, include in fisheries management plans.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Kerr, A. M. 1990. Chamorro fish names. <i>Micronesica</i> 23: 93-118.</li> <li>2. Myers, R. F. 1999. <i>Micronesian reef fishes: A practical guide to the identification of the Inshore Marine Fishes of the Tropical Central and Western Pacific</i>, 3<sup>rd</sup> edition. Coral Graphics: Barrigada, Guam.</li> </ol>	

*Marine Reptiles*

**Common name:** Green Sea Turtle  
**Chamorro name:** haggan  
**Scientific name:** *Chelonia mydas*



**Historic and current status:** The green sea turtle is the most common sea turtle species found in the waters of Guam<sup>1</sup>. It is listed both federally and locally as endangered. Sightings are recorded throughout the year, but groups of individuals are often seen in Manell Channel and Cocos Lagoon, particularly during December to February and May to June<sup>2</sup>. Nesting occurs year-round but may vary by season. Currently identified important nesting sites on Guam include the Northwestern coastline from Falcona Beach to EOD Beach and Cocos Island. Uplisted to federally endangered under the Central West Pacific distinct population segment (DPS) on April 6, 2016.

**Threats:** Predation on eggs and hatchlings by introduced species, human take of eggs and adults (mainly for food), loss of marine and nesting habitat, taken as by-catch, oil spills, development, light pollution, marine debris, and climate change.

**Habitat(s):** Adult green sea turtles feed primarily on sea grass and algae. They can be seen throughout the island, in all marine habitats.

**Goal:** Restore population to a sustainable level and remove from Guam and US Endangered Species Lists.

**Objectives:** Assess population structure and size, assess, monitor, and protect habitat, and reduce illegal take through outreach and education.

**Action plan:** Conduct a comprehensive review of literature and data on sea turtles on Guam: Review and obtain data and literature on sea turtle nesting activities to determine nesting sites and trends on Guam. Define nesting monitoring research questions and standardize nesting beach monitoring activities: GDAWR will coordinate and work with partners to define research questions and develop a standardized monitoring schedule pertaining to nesting activities. Assess population structure and size: Obtain information on population size, demography (age and sex), genetics, movement, distribution, and health status of sea turtles in and about Guam; survey Guam's beaches for sea turtle nesting activity throughout the nesting period; conduct mark recapture in-water surveys of foraging population; and conduct nest excavations to obtain information on clutch size, hatchling success, and emergence rate. Protect habitat: To provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions; include sea turtle nesting and foraging habitat under the highest level of protection in the Guam Seashore Reserve Plan; include sea turtle nesting and foraging habitat on Environmental Sensitivity Index (ESI) maps. Reduce illegal take through outreach and education: To continue the volunteer program to monitor nesting activity, create educational materials, and

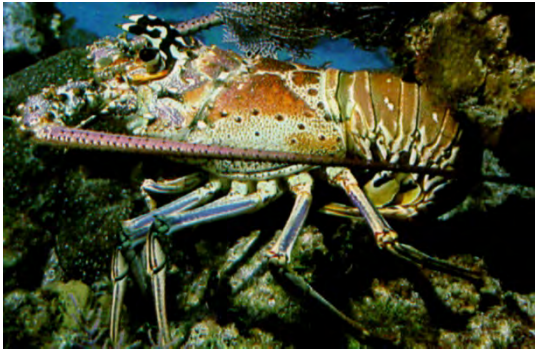
conduct presentations for school and community groups. Developing partnerships: DAWR will initiate discussion with partners (USFWS, AAFB-USAF, and Navy and stakeholders) to develop sea turtle cooperative agreements for the management and monitoring of sea turtles.

**Reference:**

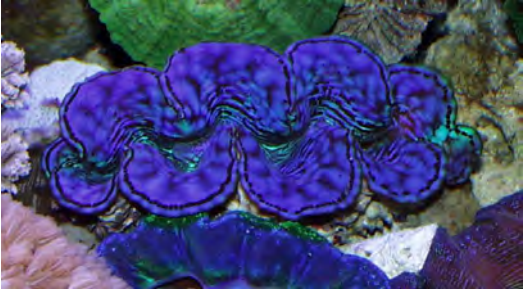
1. Kolinski, S. P. 2005. Sea Turtle Abundance at Isolated Reefs of the Mariana Archipelago. *Micronesica* 37(2): 287-296.
2. NMFS-USFWS [National Marine Fisheries Service- U.S. Fish and Wildlife Service]. 1998a. Recovery plan for U.S. Pacific populations of the green turtle (*Chelonia mydas*). National Marine Fisheries Service, Silver Spring, MD.
3. U.S. Fish and Wildlife Service. 2015b. 81 Final Rule 20057. Final Rule to List Eleven Distinct Population Segments of Green Sea Turtles, *Chelonia mydas*, as Endangered or Threatened and Revision of Current Listings Under the Endangered Species Act.

<p><b>Common name:</b> Hawksbill turtle  <b>Chamorro name:</b> haggan karai  <b>Scientific name:</b> <i>Eretmochelys imbricata</i></p>	
<p><b>Historic and current status:</b> Hawksbill turtles are less common in the waters of Guam than green sea turtles and nest on the island in much smaller numbers. They are listed both federally and locally as endangered. The first hawksbill turtle nest was not reported on Guam until November 1991.<sup>2</sup></p>	
<p><b>Threats:</b> Predation on eggs and hatchlings by introduced species, human take of eggs and adults (for food and shells), loss of habitat, taken as by-catch, oil spills, development, light pollution, and marine debris<sup>1</sup>, and climate change.</p>	
<p><b>Habitat(s):</b> Hawksbill turtles feed primarily on sponges. They can be seen in all nearshore habitat types<sup>1</sup>. Apra Harbor is an important foraging area.</p>	
<p><b>Goal:</b> Restore population to a sustainable level and remove from Guam and US Endangered Species Lists.</p>	
<p><b>Objectives:</b> Assess population structure and size, assess, monitor, and protect habitat, reduce illegal take through outreach and education.</p>	
<p><b>Action plan:</b> <u>Conduct a comprehensive review of literature and data on sea turtles on Guam:</u> Review and obtain data and literature on sea turtle nesting activities on Guam. <u>Define nesting monitoring research questions and standardize nesting beach monitoring activities:</u> GDAWR will coordinate and work with partners to define research questions and develop a standardized monitoring schedule pertaining to nesting activities. <u>Assess current population structure and size:</u> Obtain information on population size, demography (age and sex), genetics, movement, distribution, and health status of sea turtles in and about Guam; survey Guam's beaches for sea turtle nesting activity throughout the nesting period; conduct mark recapture in-water surveys of foraging population; conduct nest excavations to obtain information on clutch size, hatchling success, and emergence rate. <u>Protect habitat:</u> To provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions; include sea turtle nesting and foraging habitat under the highest level of protection in the Guam Seashore Reserve Plan; include sea turtle nesting and foraging habitat on Environmental Sensitivity Index (ESI) maps. <u>Reduce illegal take through outreach and education:</u> To continue the volunteer program to monitor nesting activity, create educational materials, and conduct presentations for school and community groups. <u>Developing partnerships:</u> DAWR will initiate discussion with partners (USFWS, AAFB-USAF, and Navy and others) to develop sea turtle cooperative agreements for the management and monitoring of sea turtles.</p>	
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>1. Kolinski, S. P. 2005. Sea Turtle Abundance at Isolated Reefs of the Mariana Archipelago. <i>Micronesica</i> 37(2): 287-296</li> <li>2. NMFS-USFWS. 1998b. Recovery plan for U.S. Pacific populations of the hawksbill turtle (<i>Eretmochelys imbricata</i>). National Marine Fisheries Service, Silver Spring, MD.</li> </ol>	

*Marine Arthropods*

<p><b>Common name:</b> Spiny Lobster  <b>Chamorro name:</b> mahonggang  <b>Scientific name:</b> <i>Paniluris</i> sp.</p>	
<p><b>Historic and current status:</b> This species is harvested for food. In 2003, it was the top ranked crustacean harvested with over 2,200 kg (4,800 lbs.) collected<sup>1</sup>.</p>	
<p><b>Threats:</b> Overfishing, loss of habitat.</p>	
<p><b>Habitat(s):</b> Surf zone, reef front, may feed in reef flats.</p>	
<p><b>Goal:</b> : To manage populations for sustainable fishing.</p>	
<p><b>Objectives:</b> Assess current population structure and size, protect habitat, and manage take through outreach and education.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To collect baseline population size, demography (age and sex), genetic, and distribution information for Guam's stocks. <u>Protect habitat:</u> To provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. <u>Reduce take through outreach and education:</u> To develop educational materials highlighting slow growth rate, include in fisheries management plans.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Gutierrez, J. T. 2003. Fisheries participation, effort, and harvest surveys. Government of Guam, Department of Agriculture, Division of Aquatic and Wildlife Resources, Annual Report.</li> </ol>	

*Marine Bivalves*

<p><b>Common name:</b> Giant Clam  <b>Chamorro name:</b> hima  <b>Scientific name:</b> <i>Tridacna derasa</i>  <i>Tridacna maxima</i>  <i>Tridacna squamosa</i>  <i>Hippopus hippopus</i></p>	
<p><b>Historic and current status:</b> Giant clams have been collected for their meat as well as their shells. The shells are carved into traditional jewelry. Tridacna clams are listed on CITES Appendix II. International trade in the meat or shells is prohibited. Tridacna are regulated under Guam law. Only clams with a shell width greater than 7 inches can be harvested.</p>	
<p><b>Threats:</b> Overfishing, loss of habitat</p>	
<p><b>Habitat(s):</b> Reef flats and seaward reefs to a depth of at least 60 feet.</p>	
<p><b>Goal:</b> Sustain population to de-listing from CITES and to prevent listing on Endangered Species List.</p>	
<p><b>Objectives:</b> To manage and increase population to allow sustainable fishing</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To collect baseline population size, demography (age and sex), genetic, and distribution information for Guam's stocks. <u>Protect habitat:</u> To provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. <u>Reduce take through outreach and education:</u> To develop educational materials highlighting slow growth rate, include in fisheries management plans.</p>	
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>1. Flores Jr., T. 1995. Giant Clam Transplantation. pp. 57-59. <i>In</i> Guam Department of Agriculture, Division of Aquatic and Wildlife Resources, Annual Report Fiscal year 1990, 124 pp.</li> <li>2. Flores Jr., T. 1996. Giant Clam Transplantation. pp. 77-79. <i>In</i> Guam Department of Agriculture, Division of Aquatic and Wildlife Resources, Annual Report Fiscal year 1996, 136 pp.</li> <li>3. Paulay, G. 2003b. The Bivalvia (Mollusca) of Guam. <i>Micronesica</i> 35-36: 218-243.</li> <li>4. Myers, R. F. 1990. Giant Clam Transplantation. pp.89-91. <i>In</i> Department of Agriculture, Division of Aquatic and Wildlife Resources, Annual Report Fiscal year 1990, 176pp.</li> </ol>	

*Marine Gastropods*

**Common name:** Triton’s Trumpet  
**Chamorro name:** None  
**Scientific name:** *Charonia tritonis*



**Historic and current status:** The Triton’s Trumpet (*Charonia tritonis*) is a large snail, with an attractive shell highly prized by shell collectors. In areas of dense human population, these animals are quite rare<sup>1</sup>. In some areas, these snails are collected as a food item, and the shells may be used as horns by some island people, but more frequently, they are taken for decorative purposes (C. Jones, pers. comm. 2005). Triton’s trumpet feed on echinoderms, and indeed is one of the few natural predators of the Crown of Thorns sea star<sup>1</sup>. Triton’s Trumpet has recently been listed in CITES Appendix II as a species of concern, thus international trade in this species is restricted.

**Threats:** Overfishing, loss of habitat

**Habitat(s):** Areas of rich coral growth

**Goal:** Sustain population and to prevent listing on Endangered Species List.


**Objectives:** To manage and increase population to allow sustainable fishing

**Action plan:** Assess current population structure and size: To collect baseline population size, demography (age and sex), genetic, and distribution information for Guam’s stocks. Protect habitat: To provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. Reduce take through outreach and education: To develop educational materials highlighting slow growth rate, include in fisheries management plans.


**Reference:**


1. Smith, B. D. 2003. Prosobranch gastropods of Guam. *Micronesica* 35-36: 244-270.


*Anthozoans (Corals)*


<p><b>Common name:</b> Hard Coral  <b>Chamorro name:</b> cho'cho'  <b>Scientific name:</b> Scleractinia</p>	
<p><b>Historic and current status:</b> Many of Guam's reefs have declined in health over the past 40 years. The average live coral cover on the fore reef slopes was approximately 50% in the 1960s<sup>3</sup>, but by the 1990s had dwindled to less than 25% live coral cover with only a few having over 50% live cover<sup>2</sup>. Still, in the past, Guam's reefs have recovered after drastic declines. A more distressing indicator of the health of Guam's coral reefs is the marked decrease in rates of coral recruitment. In 1979, 0.53 coral recruits were observed per Plexiglas fouling panel<sup>1</sup>. The use of similar materials and experimental design in 1989 and 1992 resulted in just 0.004 and 0.009 coral recruits per Plexiglas fouling plates, respectively<sup>2</sup>.</p>	
<p><b>Threats:</b> Land-based sources of pollution (sedimentation, pollution), recreational misuse, climate change, and disease.</p>	
<p><b>Habitat(s):</b> Highly variable, mangrove swamps, estuaries, and reef flats to up to 100m deep.</p>	
<p><b>Goal:</b> To maintain or expand Guam's hard coral resources.</p>	
<p><b>Objectives:</b> Take actions to limit impacts to coral resources and conduct assessments and monitoring of hard coral resources in Guam's waters.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> conduct <i>in situ</i> surveys of Guam's coral resources including percent cover, species composition, rugosity, disease. <u>Protect habitat:</u> restore vegetation within watersheds draining into coastal bays with significant coral resources, create, and monitor water quality. Provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. <u>Reduce take through outreach and education:</u> To educate residents on the need for re-vegetation, raise public awareness on the impacts of wildland arson, and educate recreational users.</p>	
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>1. Birkeland, C. 1997b. Status of coral reefs in the Marianas. pp. 91-100. In: Dollar, R., and C. Birkeland. (eds.) Status of coral reefs in the Pacific. Hawaii: Sea Grant College Program, School of Ocean and Earth Science and Technology, University of Hawaii.</li> <li>2. Birkeland, C., D. Rowley, and R. H. Randall. 1982. Coral recruitment patterns at Guam. pp. 2: 339-344. In: Proceedings of the Fourth International Coral Reef Symposium, Manila.</li> <li>3. Randall, R. H. 1971. Tanguisson-Tumon, Guam coral reefs before, during and after the crown-of-thorns starfish (<i>Acanthaster</i>) predation. M.S. Thesis for the University of Guam, Department of Biology.</li> </ol>	




<p><b>Common name:</b> None  <b>Chamorro name:</b> cho'cho'  <b>Scientific name:</b> <i>Acropora retusa</i></p>	
<p><b>Historic and current status:</b> Likely distributed in the western Indian Ocean, the east coast of India, and from Vietnam east to the Pitcairn Islands<sup>1</sup>. Currently, <i>Acropora retusa</i>, is known to occur in Guam, American Samoa, and the Pacific Remote Island Areas, excluding CNMI. On 2012, Wallace <i>et al.</i> identified a sample found in Guam's waters<sup>2</sup>. This species was listed as threatened under the U.S. Endangered Species Act in 2014.</p>	
<p><b>Threats:</b> Ocean warming, disease, ocean acidification, sedimentation plumes, land-based source pollution, recreational misuse (anchoring, stepping on corals, etc.).</p>	
<p><b>Habitat(s):</b> Shallow reef slopes and back-reef areas, such as upper reef slopes, reef flats, and shallow lagoons, and its depth range are 0-5 meters.</p>	
<p><b>Goal:</b> 1. To determine locations and abundance in Guam. 2. To develop and implement adaptive management actions to prevent further decline of species.</p>	
<p><b>Objectives:</b> Take actions to limit impacts to coral resources and conduct assessments and monitoring of hard coral resources in Guam's waters.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> conduct <i>in situ</i> surveys of Guam's coral resources including percent cover, species composition, rugosity, disease. <u>Protect habitat:</u> restore vegetation within watersheds draining into coastal bays with significant coral resources, create, and monitor water quality. Provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. <u>Reduce take through outreach and education:</u> To educate residents on need for re-vegetation, raise public awareness on the impacts of wildland arson, and educate recreational users.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. NOAA Fisheries Pacific Islands Region. 2015. Listed Corals In The Indo-Pacific. <a href="http://www.fpir.noaa.gov">www.fpir.noaa.gov</a></li> <li>2. Wallace, C.C. Done, B. J., and Muir, P.R. 2012. Revision and catalog of worldwide staghorn corals <i>Acropora</i> and <i>Isopora</i> (Scleractinia: Acroporidae) in the Museum of Tropical Queensland. <i>Memoires of the Queensland Museum/Nature</i> 57: 1-255.</li> <li>3. NOAA 2014. 79 FR 53851. Final listing determination on proposal to list 66 reef- building coral species and to reclassify Elkhorn and Staghorn corals.</li> </ol>	

<p><b>Common name:</b> None  <b>Chamorro name:</b> cho'cho'  <b>Scientific name:</b> <i>Acropora globiceps</i></p>	
<p><b>Historic and current status:</b> Likely distributed from the oceanic west Pacific to the central Pacific as far as east as the Pitcairn Islands. <i>A. globiceps</i> is considered to occur in Guam, CNMI, American Samoa, and the Pacific Remote Island Areas. The species was identified in 1999 and again in 2014 in Guam's waters<sup>1</sup>. This species was listed as threatened under the U.S. Endangered Species Act in 2014.</p>	
<p><b>Threats:</b> Ocean warming, disease, ocean acidification, sedimentation plumes, land-based source pollution, recreational misuse (anchoring, stepping on corals, etc.).</p>	
<p><b>Habitat(s):</b> Upper reef slopes, reef flats, and adjacent habitats in depths ranging from 0 to 8 meters.</p>	
<p><b>Goal:</b> 1. To determine locations and abundance in Guam. 2. To develop and implement adaptive management actions to prevent further decline of species.</p>	
<p><b>Objectives:</b> Take actions to limit impacts to coral resources and conduct assessments and monitoring of hard coral resources in Guam's waters.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> conduct <i>in situ</i> surveys of Guam's coral resources including percent cover, species composition, rugosity, disease. <u>Protect habitat:</u> restore vegetation within watersheds draining into coastal bays with significant coral resources, create, and monitor water quality. Provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. <u>Reduce take through outreach and education:</u> To educate residents on need for re-vegetation, raise public awareness on the impacts of wildland arson, and educate recreational users.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. NOAA Fisheries Pacific Islands Region. 2015. Listed Corals In The Indo-Pacific. <a href="http://www.fpir.noaa.gov">www.fpir.noaa.gov</a></li> <li>2. NOAA 2014. 79 FR 53851. Final listing determination on proposal to list 66 reef- building coral species and to reclassify Elkhorn and Staghorn corals.</li> </ol>	

<p><b>Common name:</b> None  <b>Chamorro name:</b> cho'cho'  <b>Scientific name:</b> <i>Seriatopora aculeata</i></p>	
<p><b>Historic and current status:</b> Likely distributed mostly within the Coral Triangle area (the Philippines to Timor Leste and east to the Solomon Islands), as well as adjacent areas in the western Pacific from the Mariana Islands down to New Caledonia. <i>S. aculeata</i> was reported in 1983 and again in 2014 in Guam<sup>1</sup>. This species was listed as threatened under the U.S. Endangered Species Act in 2014.</p>	
<p><b>Threats:</b> Ocean warming, disease, ocean acidification, sedimentation plumes, land-based source pollution, recreational misuse (anchoring, stepping on corals, etc.).</p>	
<p><b>Habitat(s):</b> Occurs in broad range of habitats on the reef slope and back-reef, including but not limited to upper reef slopes, mid-slope terraces, lower reef slopes, reef flats, and lagoons in a depth range of 3 to 40 meters.</p>	
<p><b>Goal:</b> 1. To determine locations and abundance in Guam. 2. To develop and implement adaptive management actions to prevent further decline of species.</p>	
<p><b>Objectives:</b> Take actions to limit impacts to coral resources and conduct assessments and monitoring of hard coral resources in Guam's waters.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> conduct <i>in situ</i> surveys of Guam's coral resources including percent cover, species composition, rugosity, disease. <u>Protect habitat:</u> restore vegetation within watersheds draining into coastal bays with significant coral resources, create, and monitor water quality. Provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. <u>Reduce take through outreach and education:</u> To educate residents on need for re-vegetation, raise public awareness on the impacts of wildland arson, and educate recreational users.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. NOAA Fisheries Pacific Islands Region. 2015. Listed Corals In The Indo-Pacific. <a href="http://www.fpir.noaa.gov">www.fpir.noaa.gov</a></li> <li>2. NOAA 2014. 79 FR 53851. Final listing determination on proposal to list 66 reef- building coral species and to reclassify Elkhorn and Staghorn corals.</li> </ol>	

<p><b>Common name:</b> Soft Coral  <b>Chamorro name:</b> None  <b>Scientific name:</b> Subclass Octocorallia</p>	 <p>An underwater photograph showing a dense field of soft coral reefs. The corals are various shades of pink, orange, and purple, with a feathery, branching appearance. The water is clear and blue. A small white logo with the text 'B. Enrique GCMF' is visible in the bottom right corner of the image.</p>
<p><b>Historic and current status:</b> Populations expanded in some areas in the last thirty years, but seem to be declining at present. These corals serve as important habitat for a number of marine invertebrates.</p>	
<p><b>Threats:</b> Land-based sources of pollution (sedimentation, chemicals), climate change, destruction by shell collectors, and disease.</p>	
<p><b>Habitat(s):</b> Habitats vary greatly from reef flats to over 100m (330 ft.). Many are filter feeders and prefer areas with strong currents.</p>	
<p><b>Goal:</b> To maintain or expand Guam’s soft coral resources.</p>	
<p><b>Objectives:</b> Take actions to limit impacts to coral resources and conduct assessments and monitoring of soft coral resources in Guam’s waters.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> conduct in situ surveys of Guam’s coral resources including percent cover, species composition, and disease. <u>Protect habitat:</u> restore vegetation within watersheds draining into coastal bays with significant coral resources, create, and monitor water quality. Provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. <u>Reduce take through outreach and education:</u> educate local residents on need for re-vegetation, raise public awareness of the impacts of wildland arson, and educate recreational users</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Colin, P. L., and C. Arneson. 1995. Tropical Pacific Invertebrates. Coral Reef Press, Beverly Hills, California.</li> </ol>	

*Marine Plants*

<p><b>Common name:</b> Sea Grasses  <b>Chamorro name:</b> lo'u  <b>Scientific name:</b> <i>Halodule uninervis</i>,  <i>Enhalus acoroides</i>, <i>Halophila minor</i></p>	
<p><b>Historic and current status:</b> Seagrass beds are widespread throughout Guam's reef flats. While past estimates are unavailable, it is believed that seagrass resources have declined due to modifications of Guam's reef flat environments such as dredging and sedimentation. More recently, trampling by divers has become a serious issue in the seagrass beds in Piti Bay. According to the most recent satellite image analysis conducted by NOAA, seagrass covers approximately 3 km<sup>2</sup> of the nearshore reef environment.<sup>1</sup></p>	
<p><b>Threats:</b> Sedimentation, habitat alteration, recreational impacts.</p>	
<p><b>Habitat(s):</b> Shallow reef flats of nearshore reefs.</p>	
<p><b>Goal:</b> To maintain or expand Guam's seagrass resources.</p>	
<p><b>Objectives:</b> Conduct assessment of seagrass density and extent in Guam's nearshore waters.</p>	
<p><b>Action plan:</b> <u>Assess current population structure and size:</u> To conduct on the ground surveys of Guam's seagrass resources including species composition, density, and extent. <u>Protect habitat:</u> restore vegetation within watersheds draining into coastal bays with significant seagrass resources, create walkways through significant seagrass resources. <u>Reduce take through outreach and education:</u> To educate local residents on need for re-vegetation, raise public awareness of the impacts of wildland arson, educate recreational users about seagrass bed's importance to fisheries.</p>	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. NOAA National Centers for Coastal Ocean Science (NCCOS). 2005. Atlas of the shallow-water benthic habitats of American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands. NOAA Technical Memorandum NOS NCCOS 8, Biogeography Team. Silver Spring, MD.</li> </ol>	

## **CHAPTER 4: Conservation Actions (Element 4)**

Conservation actions addressed in this chapter were decided upon the feasibility and effectiveness of minimizing and/or eliminating the threats that affects wildlife and habitats. As mentioned in Chapter 3, threats to Guam's SOGCN and habitats were evaluated based on how severe the threat is to the species, timing of the threat, and irreversibility of the threat. This assessment was done for almost all of the listed SOGCN, which benefits the recovery of habitats as well. Conservation actions addressed in Chapter 4 are ecosystem based, where multiple, specific species will benefit. For example, an action addressing effective legal habitat protection (reduces habitat loss due to unwarranted activities jeopardizing the recovery and protection of habitats for wildlife) may benefit multiple SOGCN and their habitats (ecosystem-based). Whereas, identified in most of the SOGCN accounts and Table 18: SOGCN summary table, actions identified are more species specific but are concurrently linked to the generalized Conservation Actions found in Chapter 4. Taking the ecosystem-based approach also eliminates redundancy of threats for each species or habitat and address threats more holistically. Conservation actions identified in the SOGCN accounts address the urgency of species-specific remediation.

Guam is continuously inundated by invasive species, habitat loss and a high demand for land development thus conservation actions identified addressed in this chapter are of high priority. Majority of these actions are weighed-in to counter attack the threats and challenges Guam's biological resources face today. These actions are the same as identified in 2005, with the exception that the ecological consequences of climate change were added. New or increasing threats identified in the 2015 SWAP include new or increasing instances of coral disease (i.e. orange band, black band, or white band disease) plant disease (i.e. anthracnose) throughout the island, uncontrollable spread of invasive species impacting plants (i.e. Lobate lac scale), climate change triggered coral bleaching events, and excessive land encroachment in Conservation Areas and Guam National Wildlife Refuge Overlays (i.e. military expansion).

Remarkable progress has been made in conservation and in implementing the strategies and actions called upon in the SWAP over the past ten years. Effective eradication of rodents and continuous control measures to reduce monitor lizards in Coco's Island occurred soon after the 2005 CWCS was approved. As result, 26 ko'ko birds were released and about 63 nests were found to date. The Department also noticed an increase in population for the Micronesian starlings and island-wide dispersal of breeding seabirds throughout Coco's Island. The removal of rodents and reducing monitor lizard population in Cocos Island also addressed Green sea turtle nests predation issues. Green sea turtle nest monitoring at Hinapsen Beach, Inarajan, Ipan Beach, Seaplane shore, Acho Bay and Hila'an Beach triggered adaptive management of threats to sea turtle nests in these areas. Feral pigs and monitor lizard tracks were observed by Haggan Watch volunteers, which prompted the use and installation of a 4-inch by 4-inch mesh wire (clutch protection device, CPD) to be installed above the clutch before estimated hatching date. CPD prevents monitor lizards and feral pigs from accessing the clutch.

The Ko'ko's for Cocos project addressed several actions identified in this chapter.

- Developed a Safe Harbor Agreement with Government of Guam Department of Parks and Recreation and Cocos Island Resort.

- Identified Limited Factors (rodents, monitor lizards, invasive vines) and assessed population of each.
- Partnered with U.S.D.A Wildlife Services for rodent eradication and Guam Forestry for invasive vine removal and forest rehabilitation.
- Released koko in Cocos Island in November 16, 2010 with 16 captive bred rails, and a second release on August 20, 2013 with 10 birds.

Specific conservation actions are indicated separately in each of the species accounts mentioned in Chapter 3 and summarized in Table 18. Terrestrial conservation actions are illustrated in Figure 18 [this chapter]. The actions addressed in Table 18 are species-specific and are to be addressed before any further actions are implemented. For instance, the Department's goal is to reintroduce native forest birds in Guam's habitats. To achieve this goal, addressing BTS and ungulate removal in habitats suitable for reintroduction holds the highest priority over other actions such as reforestation (reforestation is labeled a high priority task). Priorities identified is not necessarily set to stone, rather they are identified to serve as a place holder for what actions are to be addressed beforehand as it fits in current circumstances. Prioritizing actions will need further investigation using Best Management Practices offered by the Association of Fish and Wildlife Agencies (AFWA) before the next revision of the GWAP. In the meantime, to address any of the conservation actions, the ultimate priority on Guam for conservation to happen is to obtain legal protection for suitable habitat, as many of lands available will no longer be used for conservation, rather for development with the economic challenges the island faces today. For instance, in 2015, nearly 20 acres of the Cotal Conservation Area were cleared for a wind turbine project as an experiment to see how much wind is needed to produce renewable energy to power 30-40 houses. In light of this project occurring within a Conservation Area, strengthening legal protection on these lands is crucial (and most challenging) to accomplish.



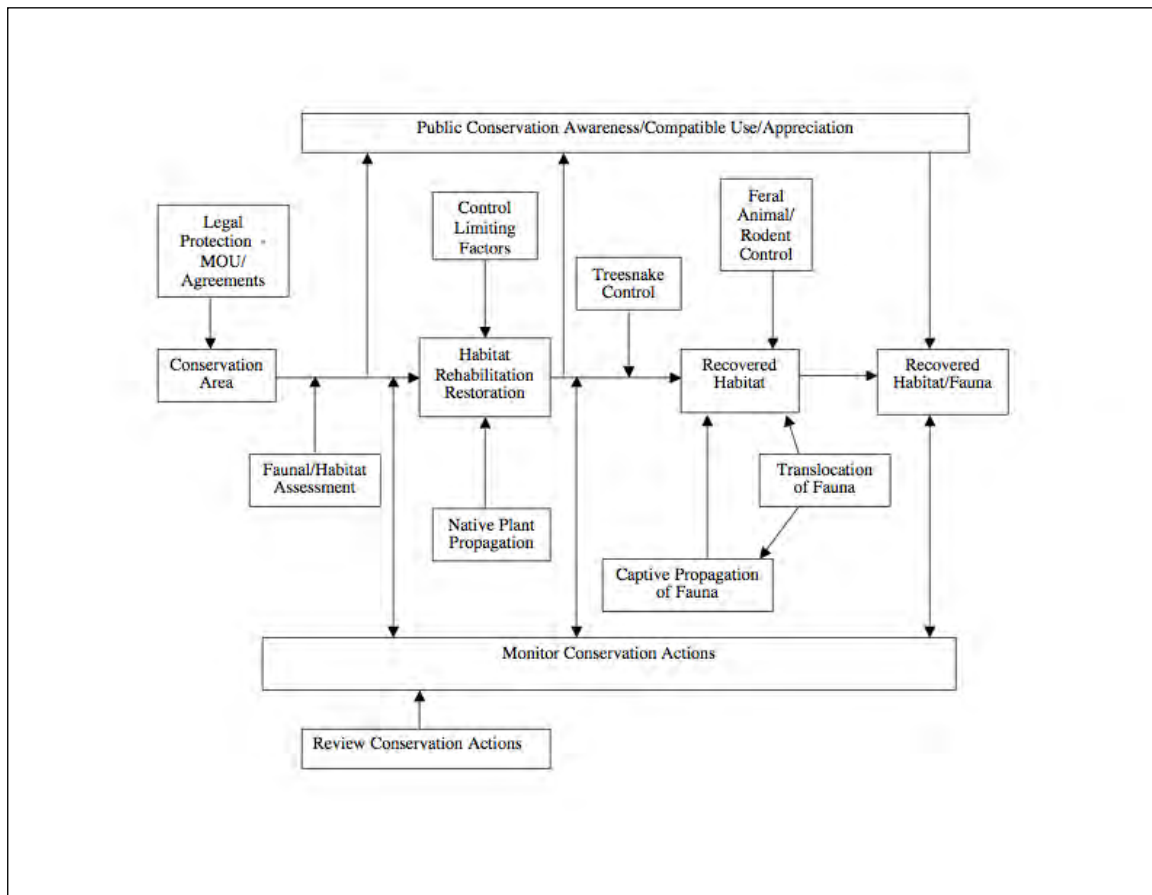


Figure 18. Diagram illustrating conservation actions for terrestrial plants and animals.

## Terrestrial

### *Legal Protection for Habitats and Wildlife*

Guam has several local laws providing protection for native flora and fauna. The Department has the authority to enforce and submit changes for adjudication the laws that govern Game, Forestry, and Conservation (5 GCA, Chapter 63, PL-6-85). In addition to ensuring the authority to enforce these laws, Guam code also provides a list of species that are to be protected (5 GCA, §63121 and §63101-63117). The Endangered Species Act, 5 GCA, §63208 allows for the adjudication of an endangered species list for Guam. The responsibility to promulgate the Endangered Species list falls to the Department who then provides the list to the Attorney General of Guam and the Legislature for adjudication.

In an effort to provide maximum legal protection for the habitats for preserving and enhancing the recovery and/or restoration of wildlife to Guam, the following objectives will be implemented:

- To develop cooperative agreements with USFWS, AAFB-USAF, and Navy to include federal and Guam Conservation Lands as part of the Guam Wildlife Refuge Overlay. Develop cooperative agreements for management, research and protection of endangered species and species of greatest conservation need.

- To develop Safe Harbor Agreements with private landowners in other areas adjacent to Conservation Land where wildlife may benefit.
- To determine boundary lines for all the Conservation Lands, and to further pursue the possibility of incorporating previously proposed conservation areas.
- To develop Memorandum of Understanding with the CNMI to facilitate the conservation restoration measures of shared (historically) fauna and plants.
- To develop regulations to ensure that island sustainable development strategies and planning give prominence to climate change issues.
- To explore other Government of Guam lands for the use of species recovery.
- To research regulations protecting excess lands to prevent loss and/or destruction to these lands from development.

*Habitat Assessment and Rehabilitation*

Guam is approximately 48% forested but there are few large areas of uniform vegetation (Donnegan 2002, and Fosberg & Mueller-Dombois 1998). The need to assess the state of habitats throughout the island is vital to the rehabilitation of these areas before any reintroductions of native fauna can be done. This assessment will be done in conjunction with predator and ungulate control. The following objectives will be pursued to assess the current state of the habitat, develop and implement plans to take appropriation actions to improve the habitat, or else maintain habitat as native forestland:

- To develop plans to improve habitats in conservation areas, to include reforestation, fire prevention, and control of invasive plants. Assist the Forestry and Soil Resources Division in developing forest recovery plans to include reforestation programs for Guam's Conservation Lands to include the control and removal of invasive, noxious plant species, replanting of native species, and protection of these areas with firebreaks.
- To determine the status of species listed as a SOGCN.
- To formulate a list of SOGCN flora for propagation and outplanting.
- To improve man-made habitat at Masso reservoir for the Mariana common moorhen, and other wetland species.
- To protect native trees and plants from human destruction.
- To develop regulations controlling the harvest of medicinal plants and wood within the Conservation Lands.
- To research weather trends (prolonged drought/rain) and determine the impacts to species-specific SOGCN.

*Captive Breeding and Translocation*

Captive breeding and translocation are and will always be an essential management tool for natural resource managers who work with small populations. Currently, GDAWR captive propagates two species of birds, the Guam rail and Micronesian kingfisher. The GDAWR facility can house and support 144 rails, and 16 kingfishers. The Department envisions the creation a new larger facility that would support conservation efforts on Guam and throughout Micronesia. Guam has the infrastructure that would support such a facility and could be the “hub” of Micronesia for captive propagation.

Most of Guam’s SOGCN would benefit from a large facility which would have facilities for mammals, birds, reptiles, gastropods and other invertebrates that need captive propagation. The progeny from captive breeding efforts would be released back into the wild. In addition to the benefits for Guam’s SOGCN, the new facility could serve the region as a refuge and breeding center for all terrestrial species in peril throughout Micronesia.

The beginning and/or continuation of captive breeding (propagation) and translocation efforts of regional endemics and indigenous species for Guam and Micronesia will be addressed by the following objectives:

- Maintain and expand captive propagation facility to further serve the needs of Guam and Micronesia’s SOGCN.
- Determine the need to captive breed other SOGCN. Implement captive propagation of endemic species of animals and plants for release into the wild continue captive breeding of Guam rails and Micronesian kingfishers.
- Protection of plants in the wild from insect infestation and other maladies.
- To determine the feasibility of translocation of shared SOGCN from the CNMI.
- To provide an adequate number of SOGCN plants for planting in Conservation Areas. Collect seeds and seedlings from the wild for transplantation to Conservation Areas.
- Establish cooperative agreements with CNMI-DFW to help manage Rota’s bird populations.

*Control of Limiting Factors*

Snake barriers (Aguon et al. 1999 and 2002, Campbell 1999, Perry et al. 1998, and Rodda et al. 1999a) and perimeter trapping have been demonstrated to be effective in removing snakes in areas larger than 1-hectare (Engeman and Linnell 1998, Engeman et. al. 1998). A combination of both techniques may be employed considering the uneven substrate characteristic of much of Guam’s northern limestone forest. As birds settle into territories and begin to breed, electrical barriers then can be used to protect their nests.

Guam DAWR, US Department of Agriculture, Wildlife Services, US Geological Survey, Biological Research Division, and several other government and private investigators made advances in the use of traps and barriers to control brown treesnakes. Area-wide snake control, using both removal and exclusion methodologies was tested at Area 50 Northwest Field and demonstrated the possibility for successfully reintroducing Guam rails and other native forest birds in the near future. Such reintroduction efforts utilized methods originally developed for introduction of rails on Rota. Feral cat control remains a major obstacle to the establishment of a small population of rails. Given the significant advances in brown treesnake control, it is appropriate to continue activities toward the recovery of the Guam rail and establishment of a population in the wild on Guam.

Methods for eradicating snakes from remote locations in the wild need to be applied to protect swiftlet colony sites, such as Mahlac Cave, from snake predation. Currently, snake traps using a live mouse as an attractant, are used to reduce snake abundance around island swiftlet caves. This method is labor intensive, especially when applied at remote sites. More cost-effective techniques need to be developed.

The endemic Guam Micronesian kingfisher can also benefit from large scale snake control. Application of barriers and area-wide snake removal will assist in efforts to repatriate kingfishers back into the wild. Releases of other indigenous birds no longer found on Guam but still found in the Marianas Islands may follow as large areas are controlled for snakes.

The following objectives will be pursued to control limiting factors affecting SOGCN:

- To survey abundance of non-native predators in Conservation Areas and highly sensitive habitats for future SOGCN reintroduction.
- To control brown treesnake abundance in Conservation Areas and selected sites for release of SOGCN species. Guam DAWR, USDA-WS, NWRC, and USGS-BRD will determine what appropriate snake control measures may be used for each of the areas. In addition, predator control measures will include the control of dogs, cats, monitor lizards and rodents.
- To test the feasibility of implementing hunting management program for reducing abundance of ungulates in the conservation areas and suitable habitats available for SOGCN recovery.
- To evaluate, assess, and amend current bio-security plans to combat the impacts of invasive species and to prevent the introduction of new invasive species.
- To research effective methods to control and eradicate LFA, CRB, and Asian cycad scale in SOGCN listed habitats in Guam.

*Reintroduction and Restoration of SOGCN to Designated Habitats*

The reintroduction and restoration of SOGCN to designated habitats is the ultimate goal of all the management and conservation efforts put forth in the GWAP. The following objectives will be implemented for particular species and for all SOGCN:

- To inventory conservation areas for caves and identify other potential cave sites for brown treesnake control and translocation of *A. vanikorensis bartchi* and *E. semicaudata rotensis*.
- To determine the genetic similarity and suitability of CNMI and Hawaiian populations of Island swiftlets for translocation and reintroduction purposes and to perform reintroductions on Guam if possible.
- To examine and determine the status of SOGCN in conservation areas and other areas they may occur.

To reintroduce native fauna and flora identified as SOGCN into conservation lands, GNWR Overlay and other suitable areas (i.e., Safe Harbors).

**Aquatic**

Early aquatic management efforts by GDAWR were influenced by the USFWS and equivalent temperate zone state fish and wildlife agencies, focusing on individual species or groups of species that were important fishery resources. In the 1970s, GDAWR management decisions reflected the views and values of the times and GDAWR was responsible for a number of introductions of non-native freshwater organisms for aquaculture and sport fishing. However, beginning in the mid-1980s, due in part to an estimated 70% decline in catch per unit effort of inshore coral reef fish over a 15-year period, the aquatics section began to shift its focus. In the mid-1990s, GDAWR resurrected the freshwater program, shifting from a focus on aquaculture and sport fish introductions to monitoring representative watersheds. During this time, GDAWR also took its first step in ecosystem-based management of marine fisheries resources by creating the territories five marine preserves.

*Freshwater*

Most aquatic organisms on Guam use rheotaxis to find their way upstream. If these organisms are able to bypass or ascend obstructions like dams, they would reach an area of little or no current (reservoir) and are unable to continue their upstream migration. The organisms end up in the reservoir, where they are much more susceptible to predation, and are less likely to find suitable areas for feeding or spawning.

Some organisms are able to pass the reservoir, and breed. Young are passively carried downstream to the ocean for the marine portion of their life history. If the young are prevented from reaching the marine environment within a critical first few days of birth, they do not survive. Young born above a dam can become caught in the reservoir formed behind the dam and perish. Studies by GDAWR indicate the diversity of native organisms is much lower in the three rivers feeding into the reservoir than in three controlled rivers located outside the Fena watershed, as well as the control river leading from the Fena dam.

To address these issues and the threats previously mentioned, the following objectives will be pursued:

- To determine the impacts of dams and other manmade structures that may have an impact on freshwater aquatic organisms.
- To conduct a biological inventory of freshwater organisms for Guam.
- To research the extent and impact invasive species have on native freshwater species.
- To develop and implement a program for protecting native freshwater aquatic organisms and their habitats.
- To assess and rehabilitate freshwater habitats suitable for reintroduction of SOGCN species.
- To determine risk and vulnerability assessments on freshwater habitats and native species.
- To research the natural occurring freshwater wetlands determining total area of the habitat and impacts to drought and increase rains for breeding moorhens and freshwater invertebrates.

### *Coral Reef Fisheries and Habitat*

Guam is located near the center of biodiversity for coral reefs, with over 5000 species of marine organisms recorded on Guam's reefs. Hundreds of these are important fishery resources, while hundreds more are components of essential fish habitat. Faced with such complexity, GDAWR began to implement ecosystem-based management actions. One of these actions was the creation of Guam's five marine preserves in May 1997. The law creating the preserves called for setting aside areas restricting take of all marine organisms and protection for their associated habitat. That same year Governor Carl T.C. Gutierrez signed Executive Order 97-10, adopting the Guam Coral Reef Initiative and creating the Guam Coral Reef Initiative Coordinating Committee (GCRICC), of which GDAWR is a member.

As part of the GCRICC, GDAWR helped to identify the top five priority threats impacting Guam's coral reefs: land-based sources of pollution, overfishing, lack of public awareness, recreational misuse and overuse, and climate change/coral/beaching/disease. The GCRICC then selected local navigators to guide the development of 3-year Local Action Strategies (LAS) for each of these priority threats. These LAS are described in greater detail in Appendix 7.

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The following objectives will be implemented:

- To continue the implementation of local action strategies (LAS), to include the determination of land-based sources of pollution, implement coral reef fisheries management actions, foster education and outreach programs, recreational use, climate change, and coral bleaching and disease.
- To maintain established Marine Preserves.
- To assess the effectiveness of Marine Preserves.
- To implement management actions to protect and improve the status of marine SOGCN within Guam's jurisdiction.
- To develop fishing licenses and fees for commercial and non-commercial use.
- To explore adaptive management programs addressing threats and conservation for seagrass and mangrove habitats.
- To research climate change impacts and trends on coral reef fisheries and habitat.

### *Sea Turtles*

Three species of sea turtles visit Guam's waters: Green sea turtles (*Chelonia mydas*), hawksbill sea turtles (*Eretmochelys imbricata*), and leatherback sea turtles (*Dermochelys coriacea*). Little is known about the habits and life histories of sea turtles in Micronesia. Only two of these species, the green and hawksbill sea turtles, use the beaches of Guam as nesting grounds, although hawksbill sea turtle nests are found only rarely. The green turtle nesting population is small and may be critically depleted, but much more monitoring is necessary to determine true population levels. No peak nesting time has been determined, and year-round nesting may occur. Threats include anthropogenic factors such as loss of nesting habitat and foraging grounds, human take and bycatch, especially from nets and long-lining. In addition, sea turtles face threats from predation, particularly from invasive species, and the effects of climate change

Guam DAWR is taking steps to fill in this knowledge gap by studying both resident and nesting sea turtles in Guam's waters. Currently the focus is on green and hawksbill sea turtles as they are more frequently observed in Guam's waters and use the beaches for nesting. The objectives for protecting these species are in line with the U.S. Recovery Plan for U.S. Pacific Populations of Green and Hawksbill Turtles:

- To reduce poaching by establishing a regular presence on nesting beaches.
- To maintain the Haggan Watch volunteer program to supplement staff surveys and provide a larger presence throughout Guam. This program will also be used to facilitate community involvement in sea turtle conservation.

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- To increase public knowledge on the importance of sea turtle conservation in an effort to reduce human take.
- To evaluate nest success and implement appropriate nest protection measures and to protect and manage nesting habitat.
- To continue biosecurity measures at historical nesting sites to prevent predation by feral cats, dogs, and pigs, monitor lizards and rodents.
- To monitor and reduce incidental mortality in the commercial and recreational fisheries and to effectively respond to sea turtle strandings.
- To develop and strengthen cooperative agreements with the USFWS, AAFB-USAF, and Navy to establish/continue nesting turtle monitoring, protect nesting and foraging habitat, and track migrating turtles.
- To increase partnerships and mentorships with the University of Guam by working with students to produce research on the sea turtles of Guam.

### *Marine Mammals*

The marine mammals that visit Guam's waters have not been studied. Information is limited to sightings and for some of the dolphin species rough estimates of pod size and movements are known. The objectives for these species are:

- Educate public (including commercial and non-commercial fishermen) about marine mammals and steps they can take to help protect these species.
- Develop a volunteer reporting program for fishermen and tourist vessels for marine mammal sightings.
- Develop agreements with DoD to monitor marine mammals in areas scheduled for military exercises (as identified in the Mariana Islands Technical and Training Exercises EIS).
- Seek technical assistance from federal partners to gain information about marine mammals in Guam's waters.

### **Public Awareness and Education**

#### *Development of a Public Conservation Awareness Program*

The need to foster an informed population about conservation and the importance of natural resources to the island is critical to the success of any long-term conservation efforts. Guam DAWR and its partners in the GWAP have identified a lack of public awareness as a priority threat to many of our conservation actions.

Guam has experienced success in creating public awareness for coral reef issues through Education and Outreach Local Action Strategies (EO LAS) developed by the Guam Coral Reef Initiative Coordinating Committee. For instance, the Guam Visitors Bureau (GVB) and the tourism industry are now working with the natural resources agencies to market Guam's coral reefs, and in particular, the marine preserves, to the



1 million visitors that come to our island yearly. This new awareness of the economic value of our coral reef resources is beginning to create a sense of stewardship in the industry, absent during the economic boom of the 1980s and recession of the 1990s. The goal of the education and outreach local action strategy (EO LAS) is to increase awareness of the need for the protection of Guam's coral reefs through improved efforts in the community, in the classroom, and with policy makers. Other venues for introducing conservation awareness and outreach are the Island Pride Campaign and publications such as *Man, Land and Sea*. The Island Pride Campaign is a program that combines educational and environmental activities with fun events to teach children to love the island's resources and instill a sense of stewardship. The quarterly publication of *Man, Land and Sea* which is published through BSP is another outlet for public/private education and awareness campaigns.

Under GDAWR, significant outreach and education projects were developed and implemented from 2012 to 2016. First, a marine preserve campaign for Piti Bomb Holes Preserve, named "Piti Pride Tepungan Wide" with an extension of the campaign to Tumon Bay Marine Preserve was well received. Second, a ridge to reef conservation program called, "Help Save Guam's Reefs" remains as an on-going effort island-wide.

With financial and technical support from Rare, an international, non-profit conservation organization, the GDAWR Aquatic Education Resource Information and Education Officer received training in communication in conservation. Key training components consisted of campaign design, social marketing strategies, and socio-economic result analysis. One of the five marine preserves and its community was selected for the campaign based on drafts of GDAWR Limits of Acceptable Change report and the Conservation Action Plan (CAP) for Piti Bomb Holes Preserve. Using Knowledge, Attitude, and Practice/Perception (KAP) surveys and analysis, the campaign, "Piti Pride Tepungan Wide" was created with a campaign mascot named "Piti Pete", an orange spine unicorn fish, *Naso lituratus*. The campaign identified target audiences of fishers and resource users to lead the community using this marine preserve towards improving their activities in the water to reduce negative impacts to fish habitat. Piti Pride was successful at implementing a Pride Line number, sometimes referred to as a hotline number, to increase communication from the public to GDAWR resource managers. In addition, new partnerships in Aquatic Education were created with local and federal resource management agencies, as well as private marine sport businesses and other local government agencies, not only to increase awareness of the benefits of marine preserves but also to train their employees, colleagues, and customers to be more diligent in its protection. Some outreach activities included collaborating with multiple enforcement entities to improve communication and monitoring support of the marine preserves; increasing education of marine preserve benefits to tour guides and tourism related businesses and local agencies by offering trainings to demonstrate how to teach others to reduce damage to fish habitat; and presenting "Piti Pride" to educators and the general public at schools, events, and other outreach activities.

After analysis of the results and impacts of the "Piti Pride" campaign, Tumon Bay Marine Preserve was selected as the next conservation campaign site to continue the efforts from the Pride Line, 688-DAWR. Local residents met with GDAWR and the Guam Visitors Bureau (GVB) to engage the community in Tumon to improve

conditions by collaborating with outreach activities, such as beach goers and vendors awareness. To enhance sustainable tourism, GVB has offered to add marine conservation in their Guam Community College Tour Guide Certification Course, to replace and/fix conservation signs, and to support community awareness of marine preserve guidelines. As another “Piti Pride” campaign partner, the University of Guam Sea Grant has offered some financial support to continue the marine preserve campaigns. Part of the support includes trainings, producing a new logo and signs for the Tumon Bay Marine Preserve campaign. A difference from the “Piti Pride” campaign, the local community will be carrying out their outreach activities themselves to ensure sustainability of conservation efforts.

Second, in the past, GDAWR had created a “Help Save Guam’s Reefs” slogan that was used on collateral materials such as pencils, pens, pins, tote bags, and caps but a formal program had not been developed. Under a U.S.F.W. Sport Fish Restoration Grant project to develop a ridge to reef concept, a poster was created and distributed to Guam Department of Education schools, presentations, and public and outreach events. Next, to elaborate on the details of the poster a brochure was designed to enhance educators’ use of the poster. The brochure explains about the positive and negative practices of land use that affect fisheries and coral reef habitat. In addition, pocket folders were created to hold handouts related to watershed conservation, fisheries management, and any other aquatic education topics and distributed at teacher workshops, watershed events, and fisheries presentations that teach about land use effects on fisheries. Ideally, the pocket folders were produced for educators that have participated at a workshop in which they learn about ridge to reef conservation and receive a class set for their students so they can then use the folders with their lessons on conservation. For example, in August 2015 and March 2016, the Resource Information and Education Officer presented “Effects of Deforestation on Fisheries” at an UOG Educator’s Symposium and GDOE Librarian’s Week. At the end of the symposium, teachers who submitted a relevant lesson plan on conservation received a class set of “Help Save Guam’s Reefs” folders so they can use for their classes. In this way, more students are exposed to the “Help Save Guam’s Reefs” concept on the folder versus the old way of distribution by randomly handing out multiple items without a formal presentation. In addition, one of the lesson plans from the teachers was selected for another “Help Save Guam’s Reefs” poster for the Piti-Asan Watershed at Masso Reservoir. A Masso Nature Park Trail Guide was produced to complement the poster as well. In the future, GDAWR could do an entire series of watershed posters on Guam to capture different conservation areas on Guam.

To improve on these programs, GDAWR would need to formally create a presenter’s guide on what to present about marine preserves and the ridge to reef concept in order to deliver consistent messages among multiple presenters. Messages should be selected from existing conservation plans and current issues then formalized so that presenters can meet conservation objectives. Most presenters use an ad hoc method of delivery, such as “play it by ear” or “talk story” not really meeting any objectives other than exposure to marine species. Incorporation of marine species facts can be easily added to any presentation, but the core messages should be clear. Marine preserves, fisheries, and watershed management awareness is important to Guam’s environment and should continue in an organized program such as “Piti Pride” and “Help Save Guam’s Reefs”.

To increase the awareness of the general public and private industry the following objectives will be implemented:

- To explore and evaluate social marketing methods to engage public participation and involvement for preserving Guam's wildlife and habitats.
- To develop, implement and utilize existing programs to increase public awareness of natural resources and issues pertaining to them.
- To develop outreach campaigns, educate the public and private industry of the value of preserving Guam's wildlife and habitats.
- To develop a plan to address public awareness and education of conservation issues- create products that target audiences with appropriate messages, formalize presentations, increase public service announcements, and enhance messages by including a call to action and facilitate public involvement in conservation efforts.
- To explore an internship program to implement conservation awareness programs.

*Recreation Activities within the Conservation Areas*

The local Conservation Areas that have been established have limited accessibility for the general public. Hunters, hikers, and off-road enthusiast are the main users of these areas. The Anao Conservation Area is a wonderful example of what a limestone forest should resemble. However, many individuals do not know about this Conservation Area because there are no signs indicating how to get there. The area is mainly used by the hunting community and must be accessed through private lands. By creating more opportunities for the public to get out and experience these areas firsthand, we can educate and instill a sense of stewardship of our natural resources. Providing greater accessibility through the creation of trails into and campsites on conservation lands we can ensure that future generations experience and appreciate the wonders of Guam's natural resources.

The GNWR's visitor center at Ritidian Point provides the opportunity for the public to experience nature and culture. This is the direction we should take with the conservation lands established by the Government of Guam. To assist in creating recreational activities with local conservation areas we will implement the following objectives:

- To allow public hunting access to game species in Conservation Areas.
- To develop signage identifying Guam's Conservation Areas; highlighting key habitat types, important fauna, geologic formations, and other key aspects of the Conservation Area.
- To allow compatible public activities in Conservation Areas.

**Law Enforcement of Natural Resource Laws and Regulations**

As stated previously, the Department Law Enforcement Section has the authority to enforce laws and regulations pertaining to the natural resources of Guam (Table 1). The ability of the Department’s Law Enforcement officers to interdict individuals breaking laws and regulations has been hindered due to several factors. These factors include shortfalls in manpower and equipment, and public education about the rules and regulations governing natural resources on Guam. By far the biggest obstacle for enforcement is public education. The public must be properly educated as the laws and the reason for the laws that protect natural resources. To aid in the protection and enforcement of natural resource laws and regulations we will implement the following objectives:

- To protect Guam’s endangered species and SOGCN from illegal harvesting or incidental take by enforcing Guam’s natural resource regulations and developing regulations for SOGCN not protected under current regulations.
- To protect Guam’s Marine Preserves and Conservation lands.
- By educating the public of Guam’s natural resource regulations.
- By creating and maintaining a volunteer conservation officer program to aid with monitoring activities in Conservation and other public lands.
- By maintaining and promoting Conservation officer law enforcement skills.
- Hire and train additional Conservation officers to protect Guam’s biological resources.

**Climate Change**

The Pacific Islands are among the countries most vulnerable to climate change globally. Coastal communities are particularly vulnerable to even small changes in climatic variables, especially rainfall pattern, tropical storm patterns, and to sea level rise. Vulnerability results from high population densities and growth rates, and scarce natural resources, which is exacerbated by poorly developed and maintained infrastructure. Behavioral impacts to SOGCN species such as coral reef fish have become noticeable due to the chemical changes in the seawater prey fish swimming towards predator fish instead of swimming away (Dixson, et. al. 2010). It is crucial to formally study these observable changes in behavior in addition to monitoring critical habitats and how they are impacted by changes in climate. Monitoring and adapting to climatic variables are needed to respond and minimize the threats to natural resources. To aid the efforts in protecting and minimizing the climatic variables on the natural resources we will implement the following objectives:

- To participate in the Guam Climate Change Task Force (GCCTF) and the Guam Climate Change Advisory Committee (GCCAC), established under Governor Calvo’s E.O. 2015-08.

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- To assist in a Guam Vulnerability Assessment to Climate Change Plan (funded under TAP-Guam-2016-2, Grant No D16AP00023)
- To take the lead in coordinating a section of the Guam Vulnerability Assessment plan that addresses vulnerability and risk with regard to critical habitat for endangered and threatened species.
- To identify funding for utilizing the dynamically downscaled model of climate impacts on Guam (REF) with Software Assisted Habitat Modeling (SAHM) for VisTrails<sup>1</sup> in order to visualize impacts of climate change on critical habitats for threatened and endangered species.
- To improve the technical capacity of DAWR with regard to tools, specifically, geographic information systems and remote sensing in order to improve decision making, monitoring, and visualization of changes in critical habitats.
- To participate in working group to establish adaptive management goals and actions to help minimize threats and address impacts for climate change to SOGCN and habitats. DAWR have participated in discussions with the Coral Initiative Task Force about climate change impacts occurring on Guam's coral reefs and marine life.
- To develop and implement policies to address protection for coral reef communities and other at-risk habitats on Guam.

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<sup>1</sup> VisTrails is an open-source management and scientific workflow system designed to integrate the best of both scientific workflow and scientific visualization systems. Developers can extend the functionality of the VisTrails system by creating custom modules for bundled VisTrails packages. The Invasive Species Science Branch of the U.S. Geological Survey (USGS) Fort Collins Science Center (FORT) and the U.S. Department Software for Assisted Habitat Modeling (SAHM) for VisTrails Offered by the Invasive Species Science Branch of the U.S. Geological Survey–Fort Collins Science Center and the North Central Climate Science Center of the U.S. Department of the Interior of the Interior's North Central Climate Science Center have teamed up to develop and implement such a module—the Software for Assisted Habitat Modeling (SAHM). SAHM expedites habitat modeling and helps maintain a record of the various input data, the steps before and after processing, and the modeling options incorporated in the construction of an ecological response model.

Table 18. SOGCN Summary Table.

Common name <i>Scientific name</i>	Local listing	Federal listing	Habitat(s)	Threats	Status	Knowledge base	Action
<b>TERRESTRIAL Mammals</b> Mariana fruit bat <i>Pteropus m. mariannus</i>	E	E	Limestone and ravine forest	<ul style="list-style-type: none"> <li>• Brown treesnake (BTS) predation</li> <li>• Human exploitation</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• &lt; 50 individuals in AAFB bat colony</li> <li>• Status off base is unknown</li> </ul>	Good	<ul style="list-style-type: none"> <li>• BTS and ungulate control at colony</li> <li>• Implement recovery plan</li> <li>• Island wide surveys</li> </ul>
Pacific sheath-tailed bat <i>Emballonura semicaudata rotensis</i>	E	E	Cave dwellers, Forested areas	<ul style="list-style-type: none"> <li>• Human exploitation</li> <li>• Habitat loss</li> <li>• BTS predation</li> </ul>	<ul style="list-style-type: none"> <li>• Extirpated from the wild on Guam</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Area-wide BTS control</li> <li>• Habitat preparation</li> <li>• Increase knowledge base</li> </ul>
<b>Forest Birds</b> Mariana crow <i>Corvus kubaryi</i>	E	E	Limestone forest	<ul style="list-style-type: none"> <li>• BTS and other invasive predators</li> <li>• Small population</li> <li>• Loss of habitat</li> <li>• Human exploitation</li> </ul>	<ul style="list-style-type: none"> <li>• Extirpated in Guam</li> <li>• Rota population declining</li> </ul>	Good	<ul style="list-style-type: none"> <li>• Predator control</li> <li>• Supplement population</li> <li>• Monitor population</li> <li>• Investigate cause of declining population</li> </ul>
Guam rail <i>Gallirallus owstonii</i>	E	E	Limestone forest, scrub forest, and savanna complex	<ul style="list-style-type: none"> <li>• BTS, feral cats, and rats predation</li> <li>• Competition with introduced game species</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Captive population</li> <li>• Extirpated from the wild on Guam</li> <li>• ~ 600 rails reintroduced to Rota since 1989</li> </ul>	Good	<ul style="list-style-type: none"> <li>• Predator control at release sites</li> <li>• Reintroduce to Guam</li> <li>• Habitat preparation</li> </ul>

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Common name <i>Scientific name</i>	Local listing	Federal listing	Habitat(s)	Threats	Status	Knowledge base	Action
Guam Micronesian kingfisher <i>Todiramphus cinnamominus cinnamominus</i>	E	E	Limestone forest	<ul style="list-style-type: none"> <li>• BTS, feral cat, monitor lizard, and rat predation</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Extirpated in the wild.</li> <li>• ~70 individuals in mainland zoos.</li> <li>• Three males and one female at GDAWR facility.</li> </ul>	Good	<ul style="list-style-type: none"> <li>• Continue captive breeding efforts</li> <li>• Continue support with Micronesian Kingfisher Species Survival Plan (MK SSP)</li> <li>• Reforestation</li> <li>• Area-wide predator control</li> </ul>
Island swiftlet <i>Aerodramus vanikorensis bartschi</i>	E	E	Cave dwelling; forages over savanna complex and ravine forest	<ul style="list-style-type: none"> <li>• BTS predation</li> <li>• Pesticides</li> </ul>	<ul style="list-style-type: none"> <li>• ~500-600 birds in a single colony in southern Guam.</li> <li>• Possibly two smaller populations in southern (1) and northern (1) Guam.</li> </ul>	Good	<ul style="list-style-type: none"> <li>• BTS control</li> <li>• Reintroduce to northern Guam</li> <li>• Continue monitoring existing pop. and caves</li> <li>• Investigate impacts to climate change</li> <li>• Investigate breeding rates and success</li> </ul>
Mariana fruit-dove <i>Ptilinopus roseicapilla</i>	E		Limestone forest	<ul style="list-style-type: none"> <li>• BTS, feral cat, monitor lizard, and rat predation</li> <li>• Habitat loss</li> <li>• Human exploitation</li> </ul>	<ul style="list-style-type: none"> <li>• Extirpated in Guam</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Habitat preparation</li> <li>• Reintroduce to Guam</li> <li>• Research Nat'l history and biology of the sp.</li> </ul>
White-throated ground dove <i>Gallicolumba xanthonura</i>	E		Limestone forest	<ul style="list-style-type: none"> <li>• BTS, feral cat, and rat predation</li> <li>• Habitat loss</li> <li>• Human exploitation</li> </ul>	<ul style="list-style-type: none"> <li>• Extirpated in Guam</li> <li>• Recent visitor from Rota since 2004 (J. Quitugua, field notes)</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• BTS control</li> <li>• Investigate origin of individuals observed</li> <li>• Improve knowledge base via research studies</li> </ul>

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Common name <i>Scientific name</i>	Local listing	Federal listing	Habitat(s)	Threats	Status	Knowledge base	Action
Micronesian starling <i>Aplonis opaca guami</i>	E		Historically found in all habitats.	<ul style="list-style-type: none"> <li>• BTS, feral cats, and rat predation.</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Two small populations in Northern Guam and Cocos Island</li> <li>• Small migration to central Guam (Dededo to Agana).</li> </ul>	Good	<ul style="list-style-type: none"> <li>• BTS control</li> <li>• Monitor population status</li> <li>• Investigate current home range, food source, and nesting</li> <li>• Develop sâli SSP plan</li> </ul>
Micronesian honeyeater <i>Myzomela rubratta saffordi</i>	E		Found inhabiting all habitat types	<ul style="list-style-type: none"> <li>• BTS, feral cats, and rat predation.</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Extirpated on Guam</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• BTS control</li> <li>• Improve knowledge base via research studies</li> <li>• Habitat preparation</li> </ul>
<b>Wetland Birds</b> Mariana common moorhen <i>Gallinula chloropus guami</i>	E	E	Freshwater habitat types (lake, pond, and springs)	<ul style="list-style-type: none"> <li>• BTS, feral cat predation</li> <li>• Habitat loss</li> <li>• Climate change</li> <li>• Competition</li> </ul>	<ul style="list-style-type: none"> <li>• About 100 adult birds observed</li> <li>• Habitat preference model project in progress</li> </ul>	Good	<ul style="list-style-type: none"> <li>• Survey and monitor population</li> <li>• Predator control</li> <li>• Protect habitat</li> <li>• Investigate impact to climate change</li> </ul>
Nightingale reed-warbler <i>Acrocephalus luscinius luscinius</i>	E	E	Areas in or near brackish water or marsh habitats	<ul style="list-style-type: none"> <li>• BTS predation</li> <li>• Habitat loss</li> <li>• Human exploitation</li> <li>• Wild fires</li> </ul>	<ul style="list-style-type: none"> <li>• Extirpated on Guam</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• BTS control</li> <li>• Habitat preparation</li> <li>• Reintroduce to Guam</li> <li>• Improve knowledge base via research studies</li> </ul>
<b>Seabirds</b> Brown booby <i>Sula leucogaster</i>	E		Roost and nest on high cliff walls	<ul style="list-style-type: none"> <li>• BTS predation</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown, frequent visitor to Guam</li> </ul>	Good	<ul style="list-style-type: none"> <li>• BTS control</li> <li>• Determine distribution and abundance</li> <li>• Identify and prepare roost and nest sites</li> </ul>



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Common name <i>Scientific name</i>	Local listing	Federal listing	Habitat(s)	Threats	Status	Knowledge base	Action
White-tailed tropicbird <i>Phaethon lepturus</i>	E		Roost and nest on high cliff walls and tall trees	<ul style="list-style-type: none"> <li>• BTS predation</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown, frequent visitor to Guam</li> </ul>	Good	<ul style="list-style-type: none"> <li>• BTS control</li> <li>• Determine distribution and abundance</li> <li>• Identify and prepare roost and nest sites</li> </ul>
Pacific reef heron <i>Egretta sacra</i>	E		Roost and nest on islets on or near ground	<ul style="list-style-type: none"> <li>• BTS predation</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown, frequent visitor to Guam</li> </ul>	Good	<ul style="list-style-type: none"> <li>• BTS control</li> <li>• Determine distribution and abundance</li> <li>• Identify and prepare roost and nest sites</li> </ul>
Migratory Shore Birds			Mud flats, tidal flats, and open fields	<ul style="list-style-type: none"> <li>• Predators</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Determine the abundance and distribution</li> <li>• Reduce or prevent habitat loss and monitor important sites for contaminants and spills</li> <li>• Implement appropriate predation control</li> </ul>
<b>Reptiles</b> Micronesian gecko <i>Perochirus ateles</i>	E		Historically found in Limestone forest and beach strand	<ul style="list-style-type: none"> <li>• BTS, feral cats, and introduced gecko (<i>Gehrya oceanica</i>) predation</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Determine abundance and distribution</li> <li>• Implement appropriate predation control</li> </ul>
Snake-eye skink <i>Cryptoblepharus peocilopleurus</i>	E		Coastal strand, loose sand soil	<ul style="list-style-type: none"> <li>• BTS, feral cats, and introduced gecko (<i>Gehrya oceanica</i>) predation</li> <li>• Competition</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Determine abundance and distribution</li> <li>• BTS and cat control in habitat</li> </ul>

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Common name <i>Scientific name</i>	Local listing	Federal listing	Habitat(s)	Threats	Status	Knowledge base	Action
Azure-tailed skink <i>Emoia cyanura</i>	E		Forest edge, loose ground cover	<ul style="list-style-type: none"> <li>• BTS, feral cats, and introduced gecko (<i>Gehrya oceanica</i>) predation</li> <li>• Competition</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Determine abundance and distribution</li> <li>• BTS and cat control in habitat</li> </ul>
Slevin's skink <i>Emoia slevini</i>	E		Forest floors, old fields, low tree trunks	<ul style="list-style-type: none"> <li>• BTS, feral cats, and introduced gecko (<i>Gehrya oceanica</i>) predation</li> <li>• Competition</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Determine abundance and distribution</li> <li>• BTS and cat control in habitat</li> </ul>
Moth Skink <i>Lipinia noctua</i>	E		Forested areas, large tree trunk	<ul style="list-style-type: none"> <li>• BTS, feral cats, and introduced gecko (<i>Gehrya oceanica</i>) predation</li> <li>• Competition</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Determine abundance and distribution</li> <li>• BTS and cat control in habitat</li> </ul>
<b>Gastropods</b> Mariana Islands fragile tree snail <i>Samoana fragilis</i>	E		Limestone and ravine forest	<ul style="list-style-type: none"> <li>• Habitat loss and modification</li> <li>• Predation by alien snail and flatworm</li> <li>• Wild grassland fires</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Good	<ul style="list-style-type: none"> <li>• Survey population</li> <li>• Predator control</li> <li>• Reforestation</li> <li>• Supplement smaller populations</li> </ul>
Pacific tree snail <i>Partula radiolata</i>	T	*P	Limestone forest	<ul style="list-style-type: none"> <li>• Habitat loss and modification</li> <li>• Predation by alien snail and flatworm</li> <li>• Wild grassland fires</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Good	<ul style="list-style-type: none"> <li>• Survey population</li> <li>• Predator control</li> <li>• Reforestation</li> <li>• Supplement smaller populations</li> </ul>
Mariana Islands tree snail <i>Partula gibba</i>	T	*P	Limestone and ravine forest	<ul style="list-style-type: none"> <li>• Habitat loss and modification</li> <li>• Predation by alien snail and flatworm</li> <li>• Wild grassland fires</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Good	<ul style="list-style-type: none"> <li>• Survey population</li> <li>• Predator control</li> <li>• Reforestation</li> <li>• Supplement smaller populations</li> </ul>

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Common name <i>Scientific name</i>	Local listing	Federal listing	Habitat(s)	Threats	Status	Knowledge base	Action
<b>Insects</b> <b>Family</b> <i>Nymphalidae</i> Forest flicker <i>Hypolimnas</i> <i>octocula</i> <i>mariannensis</i>			Limestone forest	<ul style="list-style-type: none"> <li>• Habitat loss for the host plant, <i>Procris pedunculata</i></li> <li>• Predation of caterpillar by an ichneumonid wasp</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Identify and map localities with <i>Procris p.</i>, and reduce encroachment of invasive vines</li> <li>• Study seasonal activity for the butterfly</li> <li>• Cultivate caterpillars in a safe predator-free setting, to rear for release.</li> </ul>
Marianas rusty <i>Vagrans egistina</i>			Limestone forest	<ul style="list-style-type: none"> <li>• Habitat loss for the host plant <i>Maytenus thompsonii</i></li> <li>• Predation by parasitoid wasps and ants</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Identify and map localities with <i>Procris p.</i>, and reduce encroachment of invasive vines</li> <li>• Study seasonal activity for the butterfly</li> <li>• Cultivate caterpillars in a safe predator-free setting, to rear for release.</li> </ul>

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Common name <i>Scientific name</i>	Local listing	Federal listing	Habitat(s)	Threats	Status	Knowledge base	Action
<b>Plants</b> Tree fern <i>Cyathea lunulata</i>	E		Ravine forest edge, usually on muddy hill slopes	<ul style="list-style-type: none"> <li>• Habitat loss</li> <li>• Typhoons</li> <li>• Wild grass land fires</li> </ul>	<ul style="list-style-type: none"> <li>• Rare</li> </ul>	Good	<ul style="list-style-type: none"> <li>• Identify and map localities of species</li> <li>• Protect habitat</li> <li>• Collect and propagate seedlings</li> </ul>
Federico Nut <i>Cycas marianensis</i>			Limestone forest, ravine forest, coastal areas, and savanna summits	<ul style="list-style-type: none"> <li>• Asian cycad scale (<i>Aulacaspis yasumatsui</i>) infestation</li> <li>• Ungulate damage</li> <li>• Wild grass land fires</li> <li>• Typhoons</li> </ul>	<ul style="list-style-type: none"> <li>• Common throughout Guam, many effected by Asian cycad scale</li> </ul>	Good	<ul style="list-style-type: none"> <li>• Biological control for Asian cycad scale</li> <li>• Collect seeds and propagate</li> <li>• Ungulate control</li> </ul>
<b>No Common Name</b> <i>Heritiera longipetiolata</i>	E	E	Limestone forest	<ul style="list-style-type: none"> <li>• Herbivory and damage</li> <li>• Rare fruiting occurrence</li> <li>• Typhoons</li> </ul>	<ul style="list-style-type: none"> <li>• Rare</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Monitor for fruiting occurrence</li> <li>• Develop nursery for seedlings</li> <li>• Ungulate control in habitat</li> </ul>
<b>No Common Name</b> <i>Merilliodendron megacarpum</i>			Limestone forest	<ul style="list-style-type: none"> <li>• Herbivory</li> <li>• Typhoons</li> <li>• Development</li> </ul>	<ul style="list-style-type: none"> <li>• Rare</li> </ul>	Good	<ul style="list-style-type: none"> <li>• Ungulate control in habitat</li> <li>• Collect and propagate seedlings</li> </ul>
Fire tree <i>Serianthes nelsonii</i>	E	E	Limestone and ravine forest	<ul style="list-style-type: none"> <li>• Herbivory</li> <li>• Insect damage</li> <li>• Typhoons</li> <li>• Lack of propagation</li> </ul>	<ul style="list-style-type: none"> <li>• Rare</li> </ul>	Good	<ul style="list-style-type: none"> <li>• Ungulate control</li> <li>• Collect plant material for propagation and distribution</li> </ul>
<b>No Common Name</b> <i>Tabernaemontana rotensis</i>		E	Limestone forest	<ul style="list-style-type: none"> <li>• Typhoons</li> <li>• Development</li> <li>• Browsing of new seedlings</li> </ul>	<ul style="list-style-type: none"> <li>• Common but not abundant</li> </ul>	Good	<ul style="list-style-type: none"> <li>• Determine distribution and status</li> </ul>

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Common name <i>Scientific name</i>	Local listing	Federal listing	Habitat(s)	Threats	Status	Knowledge base	Action
<b>No Common Name</b> <i>Bulbophyllum guamense</i>		T	Limestone cliff lines	<ul style="list-style-type: none"> <li>• Habitat loss</li> <li>• Development</li> <li>• Typhoons</li> <li>• Wildland fires</li> <li>• Predation by slugs</li> </ul>	• Fewer than 250 individuals and declining.	Lacking	<ul style="list-style-type: none"> <li>• Determine distribution and status</li> <li>• Minimize fires</li> <li>• Control nonnative slugs</li> </ul>
<b>No Common Name</b> <i>Dendrobium guamense</i>		T	Epiphyte on trees in moist habitats	<ul style="list-style-type: none"> <li>• Habitat loss</li> <li>• Development</li> <li>• Typhoons</li> <li>• Wildland fires</li> <li>• Predation by slugs</li> </ul>	• Fewer than 250 individuals	Lacking	<ul style="list-style-type: none"> <li>• Determine distribution and status</li> <li>• Minimize fires</li> <li>• Control nonnative slugs</li> </ul>
<b>No Common Name</b> <i>Eugenii bryanii</i>		T	Windy exposed cliff lines	<ul style="list-style-type: none"> <li>• Habitat loss</li> <li>• Development</li> <li>• Typhoons</li> <li>• Nonnative plants and animals</li> <li>• Ungulate browsing</li> </ul>	• Fewer than 420 individuals	Lacking	<ul style="list-style-type: none"> <li>• Determine distribution and status</li> <li>• Minimize development near cliff lines</li> <li>• Control ungulates</li> </ul>
<b>No Common Name</b> <i>Hedyotis megalantha</i>		T	Savanna	<ul style="list-style-type: none"> <li>• Habitat loss</li> <li>• Development</li> <li>• Wildland fires</li> <li>• Nonnative plants and animals</li> <li>• Typhoon</li> <li>• Recreational vehicles</li> </ul>	• Fewer than 1,000 individuals in Southern Guam	Lacking	<ul style="list-style-type: none"> <li>• Determine distribution and status</li> <li>• Minimize fires</li> <li>• Manage recreational vehicle use where the spp. occurs</li> </ul>
<b>No Common Name</b> <i>Maesa walkeri</i>		T	Limestone, open edges	<ul style="list-style-type: none"> <li>• Habitat loss</li> <li>• Development</li> <li>• Wildland fires</li> <li>• Nonnative plants and animals</li> <li>• Typhoon</li> </ul>	• 2 known individuals on Guam	Lacking	<ul style="list-style-type: none"> <li>• Determine distribution and status</li> <li>• Ungulate control</li> <li>• Collect plant material for propagation and distribution</li> </ul>

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Common name <i>Scientific name</i>	Local listing	Federal listing	Habitat(s)	Threats	Status	Knowledge base	Action
<b>No Common Name</b> <i>Nerivilia jacksoniae</i>		T	Shandy places on sandy soil or humus	<ul style="list-style-type: none"> <li>• Habitat loss</li> <li>• Development</li> <li>• Nonnative plants and animals</li> <li>• Fires</li> <li>• Typhoon</li> <li>• Predation by nonnative slugs</li> </ul>	• Fewer than 200 individuals on Guam	Lacking	<ul style="list-style-type: none"> <li>• Determine distribution and status</li> <li>• Collect plant material for propagation and distribution</li> <li>• Manage land use where spp. occurs</li> </ul>
<b>No Common Name</b> <i>Phyllanthus saffordii</i>		T	Savanna	<ul style="list-style-type: none"> <li>• Habitat loss</li> <li>• Development</li> <li>• Wildland fires</li> <li>• Nonnative plants and animals</li> <li>• Typhoon</li> <li>• Recreational vehicles</li> </ul>	• Fewer than 1,400 individuals on Southern Guam	Lacking	<ul style="list-style-type: none"> <li>• Determine distribution and status</li> <li>• Minimize fires</li> <li>• Manage recreational vehicle use where the spp. occurs</li> </ul>
<b>No Common Name</b> <i>Psychotria malaspinae</i>		T	Limestone edges and understories	<ul style="list-style-type: none"> <li>• Habitat loss</li> <li>• Development</li> <li>• Nonnative plants and animals</li> <li>• Typhoon</li> </ul>	• 3 individuals known on Guam	Lacking	<ul style="list-style-type: none"> <li>• Determine distribution and status</li> <li>• Collect plant material for propagation and distribution</li> <li>• Manage land use where spp. occurs</li> </ul>
<b>No Common Name</b> <i>Solanum guamense</i>		T	Limestone cliffs and terraces near the sea	<ul style="list-style-type: none"> <li>• Habitat loss</li> <li>• Development</li> <li>• Nonnative plants and animals</li> <li>• Typhoon</li> <li>• Ungulate damage and browsing</li> </ul>	• 1 individual known on Guam	Lacking	<ul style="list-style-type: none"> <li>• Determine distribution and status</li> <li>• Collect plant material for propagation and distribution</li> <li>• Manage land use where spp. occurs</li> </ul>

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Common name <i>Scientific name</i>	Local listing	Federal listing	Habitat(s)	Threats	Status	Knowledge base	Action
<b>No Common Name</b> <i>Tinospora homosepala</i>		T	Forest ecosystem	<ul style="list-style-type: none"> <li>• Habitat loss</li> <li>• Development</li> <li>• Nonnative plants and animals</li> <li>• Typhoon</li> <li>• Potential loss of sexual reproduction</li> </ul>	<ul style="list-style-type: none"> <li>• 30 known male individuals on Guam, no female representatives known.</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Determine distribution and status</li> <li>• Collect plant material for propagation and distribution</li> <li>• Manage land use where spp. occurs</li> </ul>
<b>No Common Name</b> <i>Trachoma guamense</i>		T	Shady forest ecosystem	<ul style="list-style-type: none"> <li>• Habitat loss</li> <li>• Development</li> <li>• Nonnative plants and animals</li> <li>• Typhoon</li> <li>• Herbivory by slugs</li> <li>• Low genetic representation</li> </ul>	<ul style="list-style-type: none"> <li>• One individual known on Guam.</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Determine distribution and status</li> <li>• Collect plant material for propagation and distribution</li> <li>• Control invasive slugs where <i>T. guamense</i> occur</li> <li>• Manage land use where spp. occurs</li> </ul>
<b>AQUATIC Marine Mammals</b> Bryde's whale <i>Balaenoptera edeni</i>		E	Temperate to tropical waters, oceanic and inshore bounded by latitude 40° N and S or 20° isotherm	<ul style="list-style-type: none"> <li>• Seismic operations</li> <li>• Collision with vessels</li> <li>• Entanglement</li> <li>• Defense operations</li> <li>• Pollution</li> <li>• Loss of prey species</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Public outreach</li> <li>• Monitoring</li> </ul>

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Common name <i>Scientific name</i>	Local listing	Federal listing	Habitat(s)	Threats	Status	Knowledge base	Action
Sei whale <i>Balaenoptera borealis</i>		E	Oceanic, warm water breeding, cold water feeding grounds, between 40° N and S.	<ul style="list-style-type: none"> <li>• Seismic operations</li> <li>• Collision with vessels</li> <li>• Entanglement</li> <li>• Pollution</li> <li>• Rarity of low latitude feeding</li> <li>• Over-harvest for scientific studies</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Humpback whale <i>Megaptera novaeangliae</i>		E	Antartic pelagic, in summer: temperate to subtropical, in winter: tropical coastal	<ul style="list-style-type: none"> <li>• Human disturbance</li> <li>• Coastal seismic operations</li> <li>• Defense operations</li> <li>• Collision with vessels</li> <li>• Entanglement</li> <li>• Pollution</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Cuvier's beaked whale <i>Ziphius cavirostris</i>		E	Tropical to sub-polar deep oceanic waters	<ul style="list-style-type: none"> <li>• Entanglement</li> <li>• Competition for food source</li> <li>• Pollution</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Sperm whale <i>Physeter macrocephalus</i>		E	Pelagic, offshore, deep water, temperate-tropical	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Dwarf sperm whale <i>Koiga sima</i>		E	Oceanic, apart from colder waters, more coastal than pygmy whale	<ul style="list-style-type: none"> <li>• Seismic operations</li> <li>• Collision</li> <li>• Entanglement</li> <li>• Defense</li> <li>• Operation</li> <li>• Pollution</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Pygmy sperm whale <i>Koiga breviceps</i>		E	Oceanic, apart from colder waters	<ul style="list-style-type: none"> <li>• Seismic operations</li> <li>• Collision</li> <li>• Entanglement</li> <li>• Pollution</li> <li>• Toxicity</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Public outreach</li> <li>• Monitoring</li> </ul>



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Common name <i>Scientific name</i>	Local listing	Federal listing	Habitat(s)	Threats	Status	Knowledge base	Action
Melonheaded whale <i>Peponocphala electra</i>		E	Pelagic and oceanic, primarily tropical and subtropical, temperate (< 25°)	<ul style="list-style-type: none"> <li>• Illegal and incidental fishing</li> <li>• Capture</li> <li>• Entanglement</li> <li>• Pollution</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Killer whale <i>Orcinus orca</i>		E	Oceanic, pelagic, neritic, in warm and cold waters	<ul style="list-style-type: none"> <li>• Heavy metals and organo-chlorine accumulation</li> <li>• Reduction of food resources</li> <li>• Entanglement</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Shortfinned pilot whale <i>Globicephala macrorhynchus</i>		E	Tropical to temperate oceanic waters approach coastal seas	<ul style="list-style-type: none"> <li>• Entanglement</li> <li>• Lost and discarded</li> <li>• Competition</li> <li>• Pollution</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Risso's dolphin <i>Grampus griseus</i>			Tropical, subtropical, temperate, subantarctic waters	<ul style="list-style-type: none"> <li>• Incidental and illegal capture</li> <li>• Entanglement</li> <li>• Pollution</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Spinner dolphin <i>Stenella longirostris</i>			Primary pelagic, can be neritic in same regions, tropical, subtropical, and temperate waters	<ul style="list-style-type: none"> <li>• Incidental and illegal catching</li> <li>• Capture</li> <li>• Entanglement</li> <li>• Pollution</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Striped dolphins <i>Stenella coeruleoalba</i>			Pelagic, deep water, and outer continental slope.	<ul style="list-style-type: none"> <li>• Incidental catch</li> <li>• Direct and indirect catch</li> <li>• Entanglement</li> <li>• Pollution</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Dugong <i>Dugong dugon</i>		E	Shallow tropical waters throughout Indo-Pacific region	<ul style="list-style-type: none"> <li>• Habitat loss</li> <li>• Direct take</li> <li>• Collisions with small vessels</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Lacking	<ul style="list-style-type: none"> <li>• Public outreach</li> <li>• Monitoring</li> </ul>

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Common name <i>Scientific name</i>	Local listing	Federal listing	Habitat(s)	Threats	Status	Knowledge base	Action
<b>Freshwater Fishes</b> Stream goby <i>Stiphodon</i> sp.			Freshwater streams	<ul style="list-style-type: none"> <li>• Introduced fish and plants</li> <li>• Degradation of water quality</li> </ul>	<ul style="list-style-type: none"> <li>• Abundant</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Public outreach</li> <li>• Protect habitat</li> <li>• Monitoring</li> </ul>
Redbellied goby <i>Sicyopus</i> sp.			Freshwater streams	<ul style="list-style-type: none"> <li>• Introduced fish and plants</li> <li>• Degradation of water quality</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Public outreach</li> <li>• Protect habitat</li> <li>• Monitoring</li> </ul>
Marianas goby <i>Stenogobius</i> sp.			Rivers; soft sandy or muddy substrates	<ul style="list-style-type: none"> <li>• Loss of habitat</li> <li>• Degradation of water quality</li> </ul>	<ul style="list-style-type: none"> <li>• Common</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Public outreach</li> <li>• Protect habitat</li> <li>• Monitoring</li> </ul>
Flagtail <i>Kuhlia rupestris</i>			Rivers and streams	<ul style="list-style-type: none"> <li>• Introduced fish and plants</li> <li>• Degradation of water quality</li> </ul>	<ul style="list-style-type: none"> <li>• Common</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Public outreach</li> <li>• Protect habitat</li> <li>• Monitoring</li> </ul>
Giant marbled eel <i>Anguilla marmorata</i>			Rivers and streams	<ul style="list-style-type: none"> <li>• Over-fishing</li> <li>• Habitat modification</li> </ul>	<ul style="list-style-type: none"> <li>• Common</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Public outreach</li> <li>• Protect habitat</li> <li>• Monitoring</li> </ul>
<b>Freshwater Crustaceans</b> Atyid shrimp Atyidae			Rocky and hard substrates in rivers	<ul style="list-style-type: none"> <li>• Introduced predators</li> </ul>	<ul style="list-style-type: none"> <li>• Common</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Protect habitat</li> <li>• Monitoring</li> </ul>
Tahitian prawns <i>Macrobrachium</i> sp.			All freshwater habitats on Guam	<ul style="list-style-type: none"> <li>• Introduced predators</li> <li>• Habitat loss</li> <li>• Over-fishing</li> <li>• Destructive fishing method</li> </ul>	<ul style="list-style-type: none"> <li>• Common</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Public outreach</li> <li>• Protect habitat</li> <li>• Monitoring</li> </ul>
Freshwater crabs Varunid crabs			Rocky and hard substrates in rivers	<ul style="list-style-type: none"> <li>• Introduced predators</li> <li>• Loss of water quality</li> </ul>	<ul style="list-style-type: none"> <li>• Common</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Protect habitat</li> <li>• Monitoring</li> </ul>
<b>Freshwater Gastropods</b> Nerite snails Neritidae			Rocky and hard substrates in rivers	<ul style="list-style-type: none"> <li>• Introduced predators</li> </ul>	<ul style="list-style-type: none"> <li>• Common</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Protect habitat</li> <li>• Monitoring</li> </ul>

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Common name <i>Scientific name</i>	Local listing	Federal listing	Habitat(s)	Threats	Status	Knowledge base	Action
Thiarid snails Thiaridae			Soft substrates in rivers and lakes	<ul style="list-style-type: none"> <li>• Introduced predators</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Common</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Protect habitat</li> <li>• Monitoring</li> </ul>
<b>Freshwater Plants</b> Water ferns <i>Ceratopteris thalictroides</i>			Slow moving or stagnant water, ponds, lakes	<ul style="list-style-type: none"> <li>• Introduced predators</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Common</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Protect habitat</li> <li>• Monitoring</li> </ul>
Pond weed <i>Potamogeton mariannense</i>			Slow moving stretches of rivers with soft or muddy substrates	<ul style="list-style-type: none"> <li>• Introduced plants and animals</li> <li>• Substrate loss</li> </ul>	<ul style="list-style-type: none"> <li>• Uncommon</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Protect habitat</li> <li>• Monitoring</li> </ul>
<b>Marine Fishes</b> Humphead wrasse (Napolean wrasse) <i>Cheilinus undulates</i>			Coral-rich lagoons to outer reef slopes	<ul style="list-style-type: none"> <li>• Human take</li> <li>• Habitat degradation</li> </ul>	<ul style="list-style-type: none"> <li>• Heavily fished, adults rarely seen</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Marine Preserves</li> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Bumphead parrotfish <i>Bolometopon muricatum</i>			Outer lagoon and seaweed reefs	<ul style="list-style-type: none"> <li>• Over-fishing</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Rare</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Marine Preserves</li> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Surgeonfish <i>Acanthuridae</i>			Inshore to lagoons and seaweed reefs	<ul style="list-style-type: none"> <li>• Over-fishing</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Marine Preserves</li> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Parrotfish <i>Scaridae</i>			Lagoons and seaweed flats, some in reef flats (seagrass or dense algae beds)	<ul style="list-style-type: none"> <li>• Over-fishing</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Marine Preserves</li> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Emperors <i>Lethrinidae</i>			Lagoons and seaweed reefs	<ul style="list-style-type: none"> <li>• Over-fishing</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Marine Preserves</li> <li>• Public outreach</li> <li>• Monitoring</li> </ul>

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Common name <i>Scientific name</i>	Local listing	Federal listing	Habitat(s)	Threats	Status	Knowledge base	Action
Groupers <i>Serranidae</i>			Lagoons and seaweed reefs	<ul style="list-style-type: none"> <li>• Over-fishing</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Marine Preserves</li> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Rabbitfish <i>Siganidae</i>			Varies	<ul style="list-style-type: none"> <li>• Over-fishing</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Marine Preserves</li> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Snappers <i>Lutjanidae</i>			Varies	<ul style="list-style-type: none"> <li>• Over-fishing</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Marine Preserves</li> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Goatfish <i>Mullidae</i>			Reef flats; young in sandy substrate, adults in seaward reefs (300 ft. depth)	<ul style="list-style-type: none"> <li>• Over-fishing</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Marine Preserves</li> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Butterflyfish <i>Chaetodontidae</i>			Coral reefs	<ul style="list-style-type: none"> <li>• Capture for aquarium trade</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Marine Preserves</li> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Angelfish <i>Pomacanthidae</i>			Reef flats, clear lagoons, seaward reef slopes, channels	<ul style="list-style-type: none"> <li>• Capture for aquarium trade</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Marine Preserves</li> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Hawkfish <i>Cirrhitidae</i>			Closely associated to coral reefs	<ul style="list-style-type: none"> <li>• Over-fishing</li> <li>• Capture for aquarium trade</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Marine Preserves</li> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Wrasses <i>Labridae</i>			All coral reef habitats	<ul style="list-style-type: none"> <li>• Over-fishing</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Marine Preserves</li> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Jacks and Trevallies <i>Carangidae</i>			Reef flats; young usually around floating objects, adults in depths up to 300 ft.	<ul style="list-style-type: none"> <li>• Over-fishing</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Marine Preserves</li> <li>• Public outreach</li> <li>• Monitoring</li> </ul>

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Common name <i>Scientific name</i>	Local listing	Federal listing	Habitat(s)	Threats	Status	Knowledge base	Action
<b>Marine Mollusc</b> Giant clam <i>Tridacna derasa</i>			Reef flats and seaward reefs in depths up to 60 ft.	<ul style="list-style-type: none"> <li>• Over-fishing</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Marine Preserves</li> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
Giant clam <i>Tridacna maxima</i> <i>T. squamosa</i> <i>Hippopus hippopus</i>			Reef flats and seaward reefs in depths up to 60 ft.	<ul style="list-style-type: none"> <li>• Over-fishing</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Marine Preserves</li> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
<b>Marine Gastropod</b> Triton's trumpet <i>Charonia tritonis</i>			Rich coral growth areas	<ul style="list-style-type: none"> <li>• Over-fishing</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Limited	<ul style="list-style-type: none"> <li>• Marine Preserves</li> <li>• Public outreach</li> <li>• Monitoring</li> </ul>
<b>Marine Reptiles</b> Green sea turtle <i>Chelonia mydas</i>	T	T	All marine habitats	<ul style="list-style-type: none"> <li>• Predation</li> <li>• Human take</li> <li>• Habitat loss</li> <li>• Oil spills</li> <li>• Marine debris</li> </ul>	<ul style="list-style-type: none"> <li>• Common in Guam's marine habitat</li> </ul>	Good	<ul style="list-style-type: none"> <li>• Monitoring</li> <li>• Public outreach</li> <li>• Marine preserves</li> </ul>
Hawksbill turtle <i>Eretmochelys imbricata</i>	E	E	All nearshore habitat types	<ul style="list-style-type: none"> <li>• Predation</li> <li>• Human take</li> <li>• Habitat loss</li> <li>• Oil spills</li> <li>• Marine debris</li> </ul>	<ul style="list-style-type: none"> <li>• Rare</li> </ul>	Good	<ul style="list-style-type: none"> <li>• Monitoring</li> <li>• Public outreach</li> <li>• Marine preserves</li> </ul>
<b>Marine Arthropods</b> Spiny lobster <i>Paniluris</i> sp.			Surf zone, reef front, reef flats	<ul style="list-style-type: none"> <li>• Over-fishing</li> <li>• Habitat loss</li> </ul>	<ul style="list-style-type: none"> <li>• Unknown</li> </ul>	Good	<ul style="list-style-type: none"> <li>• Monitoring</li> <li>• Marine preserves</li> <li>• Public outreach</li> </ul>
<b>Marine Plants</b> Sea grasses <i>Halodule uninervis</i> , <i>Enhalus acoroides</i> , <i>Halophila minor</i>			Shallow reef flats of nearshore reefs	<ul style="list-style-type: none"> <li>• Sedimentation</li> <li>• Habitat alteration</li> <li>• Recreational impacts</li> </ul>	<ul style="list-style-type: none"> <li>• Declining</li> </ul>	Good	<ul style="list-style-type: none"> <li>• Monitoring</li> <li>• Marine preserves</li> <li>• Public outreach</li> </ul>
<b>Marine Anthozoans</b> Hard coral Subclass Scleractinia			Highly variable, mangrove swamps, estuaries,	<ul style="list-style-type: none"> <li>• Pollution</li> <li>• Sedimentation</li> <li>• Recreational misuse</li> <li>• Climate</li> </ul>	<ul style="list-style-type: none"> <li>• Declining in health</li> </ul>	Good	<ul style="list-style-type: none"> <li>• Monitoring</li> <li>• Marine preserves</li> <li>• Public outreach</li> </ul>

Common name <i>Scientific name</i>	Local listing	Federal listing	Habitat(s)	Threats	Status	Knowledge base	Action
			and reef flats up to 100m deep	change • Disease			
<i>Acropora retusa</i>		E	Shallow reef slopes, back reef areas in depths of 0-5 meters	<ul style="list-style-type: none"> <li>• Ocean warming</li> <li>• Disease</li> <li>• Ocean acidification</li> <li>• Sedimentation plumes</li> <li>• Land base pollution</li> <li>• Recreational misuse</li> </ul>	Declining	Lacking	<ul style="list-style-type: none"> <li>• Determine distribution and status</li> <li>• Monitoring</li> <li>• Restore vegetation within watersheds</li> <li>• Manage recreational users</li> <li>• Public outreach</li> </ul>
<i>Acropora globiceps</i>		E	Upper reef slopes, reef flats and adjacent areas in depths of 0-8 meters	<ul style="list-style-type: none"> <li>• Ocean warming</li> <li>• Disease</li> <li>• Ocean acidification</li> <li>• Sedimentation plumes</li> <li>• Land base pollution</li> <li>• Recreational misuse</li> </ul>	Declining	Lacking	<ul style="list-style-type: none"> <li>• Determine distribution and status</li> <li>• Monitoring</li> <li>• Restore vegetation within watersheds</li> <li>• Manage recreational users</li> <li>• Public outreach</li> </ul>
<i>Seriatopora aculeate</i>		E	Reef slope and back reef (upper reef slopes, midslope terraces, lower reef slopes, reef flats and lagoons) in depths of 3-40 meters	<ul style="list-style-type: none"> <li>• Ocean warming</li> <li>• Disease</li> <li>• Ocean acidification</li> <li>• Sedimentation plumes</li> <li>• Land base pollution</li> <li>• Recreational misuse</li> </ul>	Declining	Lacking	<ul style="list-style-type: none"> <li>• Determine distribution and status</li> <li>• Monitoring</li> <li>• Restore vegetation within watersheds</li> <li>• Manage recreational users</li> <li>• Public outreach</li> </ul>
Soft coral Subclass Octocorallia			Varies in depths up to 100m, prefers high current areas	<ul style="list-style-type: none"> <li>• Sedimentation</li> <li>• Chemicals</li> <li>• Climate change</li> <li>• Destruction</li> <li>• Disease</li> </ul>	• Declining	Good	<ul style="list-style-type: none"> <li>• Monitoring</li> <li>• Marine preserves</li> <li>• Public outreach</li> </ul>



**CHAPTER 5: Proposed Monitoring and  
Incorporation of New Information (Element 5)**



### **Monitoring and Evaluation**

Guam's WAP encompasses monitoring and evaluation in three areas: 1) surveys (species and habitat); 2) effectiveness of proposed strategies; and 3) ten-year revision of the SWAP. The approach to monitoring and evaluation is based on expanding existing efforts in order to be cost effective, in light of limited financial resources (Schoonmaker and Luscombe 2005). For new efforts, the approach will be to focus on relevant, realistic, and effective monitoring and evaluation that is cost-effective, sustainable, and has minimal impact to native ecosystems.

#### *Surveys of Species*

Except for several species of resident native birds, a majority of Guam's terrestrial (both vertebrate and invertebrate) resident species of animals is extirpated or extinct, or found only in captivity or in low numbers. For those species still extant on Guam, monitoring of these populations as conservation actions are implemented will be important to conservation evaluations.

To standardize observations, personnel will be trained in identification and survey methods to ensure that the data collected is as accurate as possible. Such training will include identification of calls for certain species, recording of number of animals observed, and use of standard bird survey techniques incorporated in Ramsey and Scott 1981.

Goals: To monitor the long-term population trends of SOGCN.

- Objective 1: Conduct colony and/or island-wide counts indicating population trends over a five-year period.
- Objective 2: Conduct colony and/or island-wide population surveys in relation to efforts to increase the quality and quantity of limestone and ravine forest habitats.

#### Mariana fruit bats and Sheath-tailed bats

- Colony Counts – Quarterly counts of all colonies. As new colonies are found they will be surveyed quarterly.
- Island-wide Survey - An island-wide survey, using randomly stratified fixed survey stations, will be established and conducted every 5 years.
- Continue efforts with Joint Region Marianas, GNWR, and NPS to work collaboratively in managing the recovery of fruitbats on Guam, especially in military installations, Ritidian refuge, and NPS lands.

#### Native Birds

- Direct Monitoring – A combination of radio telemetry and re-sighting banded birds will continue to be used for monitoring for extant bird populations, as well as, captive reared birds that are released into the wild. The population of Guam rails on Cocos Island is monitored

weekly. In the future, as captive flocks of Guam rails, Micronesian kingfishers are large enough for release into the wild on Guam, monitoring with these methods will be valuable in determining the survivorship of released birds. Survey plans to regularly monitor Micronesian starlings and Common moorhens need to be developed. Information from these surveys will guide future conservation actions for the protection of these two species.

- Playback Surveys – Previously, playback surveys were an important tool for monitoring the population of Marianas crows on Guam. These surveys involve playing tape-recorded calls at survey points a minimum of 300 meters apart for 2.5 minutes followed by a 2-minute silent period to record numbers, distance, and plumage condition. When crows are reintroduced to Guam playback surveys for them will be reinstated. Playback censuses are important in monitoring Guam rails released on Rota and Cocos island. Other re-introduced species of birds could be surveyed by this method as well.
- Roadside Counts – Annual May roadside counts along 23 survey routes around northern and southern Guam will continue to monitor the status of native and non-native bird species. Survey points are spaced 600 meters apart along roadways, and the number of birds heard and seen during a five-minute survey period at each station is recorded. This survey will expand to additional areas of Guam as populations of birds increase, and the frequency of counts may increase depending on need.
- Swiftlet Surveys – Island swiftlets will be surveyed by counting the number of birds within the cave and then counting the number of birds entering and exiting the cave during a 1 to 2 hour period before dark (dark is defined as one hour after sunset). The swiftlet population for a cave is then estimated by subtracting the number of departures, from the number of arrivals, and adding the estimated number of swiftlets in the cave prior to the count. All counts are conducted with at least one observer at each cave entrance for a particular colony. In some cases, two observers are utilized, two counting the number of swiftlets entering a cave and the third person counting the number of birds exiting. In addition to cave exit surveys, surveys should be performed to search for new caves being used by Island swiftlets.
- Shorebird Surveys – Survey for migratory shorebirds, August through May, along shorelines (Togcha, and Dungca’s Beach) and grassy fields to determine the abundance of specific shorebirds. Areas historically monitored will be surveyed initially to establish current baseline information and serve as a means of comparison. Other appropriate areas will be added. Information from Annual Marianas Audubon Christmas bird counts and other pertinent sources will be incorporated into the database on shorebird abundances in Guam.

- Develop and implement a Citizen Science group to get community involved in birding and teaching individuals on best management practices in sharing field observations.

Terrestrial Reptiles (skinks and geckos)

- Conduct annual surveys to determine the status of each reptile SOGCN. These surveys will be conducted in Conservation Areas to monitor the status of each area, and the effectiveness of conservation measures. Additionally, surveys will be conducted in areas known to historically harbor these lizards.

Invertebrates – Gastropods

- As the populations of remaining native snails are very small, visual surveys of native snails in areas historically known to contain them will be conducted to determine the current population numbers. Initial surveys will be conducted in the Hilaan, Tanguisson and Haputo areas and other areas where they might occur.
- Conduct annual surveys in key areas to determine the status of each species to determine the efficacy of conservation efforts.

Invertebrates – Native Butterflies

- Conduct annual assessments on the status and distribution of Guam's native butterflies needing immediate conservation attention.
- Conduct annual surveys of other native insect species needing close monitoring.

Sea Turtles

- Establish baseline data on nesting and in-water sea turtle populations on Guam.
- Determine the population levels and annual recruitment for the foraging population by establishing an in-water mark-recapture program.
- Continue and strengthen the Haggan Watch volunteer program which will be used to supplement staff surveys and provide a larger presence throughout Guam
- Monitor incident mortality in the commercial and recreational fisheries.
- To develop and strengthen cooperative agreements with the USFWS, AAFB-USAF, and Navy to establish/continue nesting turtle monitoring, protect nesting and foraging habitat, and track migrating turtles.
- Continue Haggan Huddle working group and expand functionality of the working group to manage sea turtle conservation efforts amongst partners.

*Predator and Invasive Species Surveys*

The introduction of species to Guam, whether intentional or accidental, has had a negative impact on native species and their environment. The introduced brown treesnake caused significant damage to Guam's native vertebrate fauna. The recovery of native fauna hinges on the control of the snake. However, efforts to eradicate the snake must be combined with habitat restoration, captive breeding or translocations, and even the removal of other predators such as cats, dogs, and rats. Monitoring the abundance of the brown treesnake is important in determining the efficacy of brown treesnake control measures. In addition, monitoring the presence and distribution of other invasive species must also be emphasized.

Goal: To determine population trends and control of introduced predator invasive species that limit the recovery of SOGCN on Guam.

Objective 1: Monitor monthly abundance of brown treesnakes and other predator species in Conservation Areas designated for restoration and where brown treesnake control is being implemented to determine the efficacy of treesnake control measures.

Objective 2: Identify the abundance and distribution of invasive species in Conservation Areas and remove these species.

- Implement area-wide multi-species predator control by trapping and/or barriers in conservation areas slated for release of SOGCN.
- Continue to support studies into improving predator control techniques.
- Assess predator control threshold for non-federally listed forest bird species and other SOGCN.
- Monitor the abundance of invasive species in Guam and determine feasible methods to be employed to reverse the threat for SOGCN.

In addition to brown treesnakes, Guam's role as a transportation hub of the Pacific has led to numerous introductions of anurans. Historically, Guam did not have any native species of amphibians and introduced populations quickly spread to cover much of the island. Introduced amphibian populations are a threat to native species through predation as well as an additional food source for brown treesnakes. At least thirteen species of frogs and toads have made their way to Guam and at least five species currently have breeding populations on Guam (*Bufo marinus*, *Polypedates megacephalus*, *Litoria falax*, *Rana guentheri*, *Eleutherodactylus planirostris*). Of particular concern to conservation is the Coqui frog (*Eleutherodactylus coqui*). Coqui frogs have been found on Guam at least four times in the past but have yet to establish themselves. Because Coqui frogs have direct metamorphosis from egg to frog and lay their eggs on vegetation, they are not restricted to aquatic breeding sites. They have been introduced and subsequently established in Hawaii and Florida. Live plants imported from areas with Coqui frogs pose a great risk to Guam's native species. In 2004, a public awareness campaign began and frog call surveys and inspections were

conducted with the specific goal of early detection of Coqui frog introduction. To date, Guam is free from Coqui and efforts to continue awareness and increase inspections for Coqui and other invasive species at Guam's port of entries is occurring.

### *Monitoring Habitats and Conservation Areas*

The GWAP will entail the management and monitoring of restorative actions within conservation areas on Guam. Many conservation areas on Guam, both on military and government of Guam lands, are in dire need of restoration as a result of ungulate damage (Wiles et al. 1999). Conservation actions proposed by existing plans to rehabilitate designated forest habitats are important to restoring these areas to a natural state, as well as to making them suitable to the native fauna.

Fire and ungulate damage are probably the most significant factors leading to the loss of native habitat. Some areas heavily impacted by ungulates have changed into monospecific plant communities. The species of plants are usually the one that tend not to be palatable to ungulates. For example, *O. marianensis* is a native species that easily develops monotypic stands because deer does not favor them. Much of southern areas of Guam are covered with *Miscanthus floridulus* because this grass species quickly flourishes in areas made available by repeated burning. The non-native palm, *Palma brava*, has replaced native ravine forests in some areas.

Goal: To monitor the progress of restoration efforts of habitats.

Objective 1: Development of a GIS map of historic and current distribution for Guam.

Objective 2: To illustrate the reduction of habitat degradation and loss as control measures for deer and feral pigs are implemented in conservation areas.

### Vegetation GIS Maps for Guam

- Establish and strengthen partnerships with US Forest Service, FSRD, and private forestry to provide support and assistance for a completed vegetation analysis for Guam. This research provides an assessment on habitat availability at a broad scale and will serve as a baseline for native forest restoration. Monitoring long-term trends in forest types on Guam to aid managers to propose effective management to recover habitat and SOGCN species.
- The map will be updated, as information is made available. The map will be used to identify important trends in habitat restoration on Guam.

Monitoring Native Forests

- Conduct plant surveys (transects and counts) to determine the status and efficacy of conservation efforts for habitat in key areas. Vegetation transects will be used to assess the condition of the conservation. The abundance and diversity of the types of plant species in the conservation areas will be documented.
- Determine the status of conservation areas to determine the abundance of various native species of plants.
- Historic information will be compiled to provide baseline information on habitats and be compared to current trends and conditions.
- Information on conservation areas (and high valued habitats, to be identified) will be used to specifically determine what actions will be taken to improve the habitat for fauna and flora goals. Many areas principally need a reduction in feral deer and pig populations.
- Develop and implement reforestation techniques in Guam conservation areas and national wildlife refuge overlay lands.

Monitoring Wetland Habitats

- A map of the historic and current distribution of Guam's wetlands will be compiled. These maps will show trends of the distribution of the wetlands in Guam. Mitigation wetland sites, ponding basins, and other man-made ponds will be included in the inventory.
- As these areas encompass a greater area on Guam, broad scale monitoring will be used to assess conditions of these habitats. Appropriate partnership will be developed as some of these areas are privately or federally owned.
- Evaluate the ability of habitat suitability models to predict species presences and enhance habitat for moorhens and other native freshwater organisms.
- Investigate impacts of prolonged weather conditions to breeding moorhens and invertebrates.

**Aquatic Monitoring and Evaluation**

Guam DAWR research priorities focus on the major threats to Guam's aquatic species: fishing, pollution, invasive species, development, recreation, and disease. Because freshwater and marine resources are intimately linked, impacts in the upper reaches of Guam's watersheds affect not only freshwater organisms, but are amplified throughout the watershed and impact marine organisms as well.

Partners such as the FSRD, GEPA, NPS, and scientists from the University of Guam are also seeking insight into the problems facing Guam's aquatic resources. Together these organizations are tackling issues such as soil erosion rates, re-vegetation of badland areas, sedimentation on near-shore reef communities, pollution levels in coastal waters, and settling and recruitment rates of corals.

### *Survey of Freshwater Habitats and Organisms*

Guam's native freshwater fauna are threatened by habitat loss due to sedimentation, eutrophication, and increased water flow caused by bank alteration and loss of riparian vegetation. Because of their amphidromous life histories, all of Guam's native fish species are vulnerable to stream blockage. Monitoring these species in their native habitat will allow GDAWR to monitor the existing stocks and to evaluate improvement due to management activities.

Goal: To monitor the long-term population trends of freshwater SOGCN.

### Assessing Impacts of Dams

- Conduct a long-term study of the effect a manmade dam (Fena) has on the native freshwater fauna of Guam, as almost all of Guam's native freshwater fauna is amphidromous, with a marine larval stage in their life history before they return to freshwater to spend their adult lives. Dams affect native fauna. A dam acts as a physical barrier to some native organisms. Organisms not able to pass upstream of the dam are limited to the reaches of rivers below the dam.
- Survey seven Guam rivers annually to monitor the effect a dam has on native fauna. The three rivers that feed into the Fena reservoir (Maagas, Almagosa, and Sadok) are classified experimental, and the river below Fena dam (Maulap) and three other rivers outside the Fena watershed (Ylig, Lonfit, and Manenggon) are the controls.
- In each river, a 200-meter section will be chosen, and divided into 20 10-meter segments. Within each segment, a quadrat will be randomly chosen and surveyed, for a total of 20 sample sites per river.
- Data collected at each quadrat will include species identification, number and size of individuals of each species observed, activity of observed animals, two most dominant substrate types, percentage of canopy cover over quadrat, area of quadrat, depth of water in quadrat, and average water velocity in quadrat, as well as observers, location, date and time.

### River Inventory

- Continue biological river inventory for Guam to obtain baseline biological data important for management of our freshwater resources. Of over 100 named rivers and streams, GDAWR has biological

information for about 12 rivers. GDAWR will be surveying rivers with no known biological information.

- Data collection includes visual surveys, as well as specimen collection using net and electrofishing. GDAWR now has biological information for 37 rivers, and eventually intends to collect information on all 100.

Freshwater river surveys

- The freshwater fishery resources will be monitored by surveying seven rivers in three watersheds each year for analysis and comparison between watersheds by using appropriate parametric or non-parametric tests. (See attached freshwater data collection sheet).

Reservoir Fisheries Monitoring

- Monitor the freshwater fishery in Fena Lake by conducting a stock assessment, using electrofishing and mark-recapture methodology, to determine species, species density, and other environmental parameters.
- The freshwater fishery resources in Masso reservoir will be monitored by conducting mark-recapture studies on a yearly basis to collect biological information of the freshwater fisheries resource.

Guam Environmental Monitoring and Assessment Program (EMAP) – Surface Waters

- Continue participation in the development of the Guam Environmental Protection Agency's EMAP protocols for surface waters of the Western Pacific eco-region. This program will monitor many parameters of river habitat health including general water chemistry, physical habitat parameters, periphyton community structure and abundance, biomass and chlorophyll, fish community structure and abundance, macro-invertebrate community structure and abundance, sediment chemistry, fish tissue chemistry, water column contaminants and rapid habitat and visual stream assessments. GDAWR staff will also assist GEPA with biological surveys.

*Marine Species Surveys*

There are a number of methods for assessing fish stocks in marine waters. Guam DAWR uses a variety of these methods to assess the impacts of fishing and effectiveness of the marine preserves as a fisheries management tool. These methods include creel surveys and in situ monitoring.



Goal: Management of Guam's Marine Fisheries Resources

Offshore Fisheries Participation, Effort, and Harvest Surveys

- To monitor the health of Guam's reef, bottom, and pelagic fishery resources by conducting 192 offshore surveys each year at the three largest boat launch facilities on island.
- To continue gathering limited biological data that will add to a long-term historical data base on Guam's fish species by conducting 192 offshore surveys over a one-year period at the three largest boat launch facilities on island.

Inshore Fisheries Participation, Effort, and Harvest Surveys

- To monitor the health of Guam's reef and bottom fishery resources by conducting 192 inshore surveys each year along the coastline of Guam.
- To continue gathering limited biological data that will add to a long-term historical database on Guam's fish species by conducting 192 offshore surveys over a one-year period along the coastline of Guam.
- To monitor the health of Guam's reef and bottom fishery resources by conducting 24 aerial surveys each year along the coastline of Guam.

Assessing Guam's Reef Fish Spawning Aggregations

- To continue creel survey data collection to look for probable spawning aggregation encounters documented in the surveys to determine the species caught, approximate site location, date, time, tide, and moon phase.
- Interview local fishermen and fishermen identified by the creel data analysis as having located an aggregation to locate the site on a map and provide any details about aggregations they have witnessed.
- Analyze and compile data and enter onto a GIS map, as new information is made available.

Visual Stock Assessment Surveys of Marine Preserves and Control Sites

- To evaluate the effect on sport fish populations caused by the creation of five marine preserves where fishing is restricted or prohibited by conducting fish counts and timed-swim counts on at least 25 permanent transects located in reef flat and lagoon habitats in Achang Reef Flat Marine Preserve, Piti Bomb Holes Marine Preserve, Tumon Bay Preserve, Asan Bay, Pago Bay, and Cocos Lagoon over a one-year period.

- To evaluate the effect on sport fish populations caused by the creation of five marine preserves where fishing is restricted or prohibited by conducting fish counts, timed-swim counts, and video-transects/quadrant on at least 25 permanent transects located at the 20', 30', 40', and 50' depth contours of the fore reef slopes in Achang Reef Flat Marine Preserve, Piti Bomb Holes Marine Preserve, Tumon Bay Preserve, Asan Bay, and the backside of Cocos Lagoon, over a one-year period.

*Marine Preserve Monitoring*

- In 1997, Guam established five marine preserves around the island amounting to 11.8% of Guam's shoreline. Guam DAWR will continue to sample the fish populations and reef communities in two of the preserve areas and control sites to determine the effectiveness of the preserve system. These studies focus on the fish species targeted for consumption and for indicator species such as butterflyfish.
- The Piti Bomb Holes Preserve and the Achang Reef Flat Preserve are the experimental sites for the stock assessment surveys. Cocos Lagoon and the Asan fore reef slope serve as the control sites for the Piti Bomb Holes Preserve, while Pago Bay reef flat and Cocos fore reef slope serve as the control sites for the Achang Reef Flat Preserve.
- As in prior years, sixty-six (66) permanent belt transects (50m x5m) will be surveyed on the reef flats and fore reef slopes of two preserve sites, Piti Bomb Holes Preserve and Achang Reef Flat Preserve, and three control sites, Asan Bay, Cocos Lagoon, and Pago Bay. Two sets of transects will be on the fore reef slope at the 20', 30', 40', and 50' depth contours. Eight transects are on the reef flat at each site representing distinct microhabitats (seagrass, coral/algal/rubble, and sandy bottom).
- Fish communities will be surveyed using two different visual survey techniques along each transect. Density will be assessed using a visual fish census along a strip transect. Two fish counters following the 50 m long permanent transect, each counting all target fish within 2.5 m of their side of the transect. All target fish within this 250-m<sup>2</sup> area will be scored on data sheets based on their species and size class. Three size classes will be used based on the fork length of the fish (<15 cm, 15 cm-30 cm, >30 cm). The strip transect method will be complemented by a timed visual survey in the same area. At each site, fish counters will record the species and size class of all fish encountered in the area during a 30-minute interval.
- Data will be analyzed statistically. A two-tailed paired t-test (Sokal and Rohlf, 1995) will be used to compare fish densities and diversity over time within each study site. The Shannon diversity index will be used to calculate an index number for species diversity and evenness at each site for both pre- and post-implementation data. A higher index

number indicates greater diversity. If the assumptions of analysis of variance (ANOVA) are not met, even after transformations, a nonparametric test will be conducted (Sokal and Rohlf, 1995).

Guam Environmental Monitoring and Assessment Program – Coastal Waters

- This program will assess the biological condition of Guam’s marine water using standardized methods. Reef fish, macroinvertebrates, macroalgae, and coral abundance will be recorded at 50 randomly selected sites throughout Guam’s waters. This program will be complemented by water quality monitoring and sediment analysis.

Marine Turtles In-Water and Nesting Beach Surveys

- Aerial Surveys: Conduct monthly aerial surveys of species needing close monitoring.
- To obtain data on nesting and in-water sea turtle populations on Guam.
- To determine foraging area population levels and annual recruitment, an in-water mark-recapture program should be established.
- To continue and strengthen Haggan Watch volunteer program, which will be used to supplement staff surveys and provide a larger presence throughout Guam. This program will also be used to facilitate community involvement in sea turtle conservation.
- To evaluate nest success and implement appropriate nest protection measures and to protect and manage nesting habitat.
- To monitor and reduce incidental mortality in the commercial and recreational fisheries and to respond to sea turtle strandings.
- To continue and strengthen cooperative agreements with the USFWS, AAFB-USAF, and Navy to establish/continue nesting turtle monitoring, protect nesting and foraging habitat, and track migrating turtles.

*Marine Habitat Monitoring and Evaluation*

Since, healthy fish populations require healthy reef habitat, GDAWR and its partners also monitor the coral reef habitat through a number of projects to determine the impact of land-based sources of pollution and other threats to healthy coral reef habitats.

Goal: To protect vital marine habitats and the aquatic life they contain.

Objective 1: To compile marine trend information to identify serious threats to Guam’s marine resources.

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Objective 2: To determine water quality indicators important to coral reefs to help manage Guam coral reefs, thereby benefiting the marine life.

Objective 3: Participate in Marianas Archipelago Reef Assessment and Monitoring Program (MARAMP) to improve the understanding of coral reef ecosystems, evaluate and reduce adverse impacts, enhance coral reef ecosystem-based fisheries management and conservation through cooperation with partners (federal and local agencies and non-governmental organizations), and provide scientific information needed to establish, strengthen, and manage MPAs (NOAA, Pacific Islands Fisheries Science Center, Coral Reef Ecosystem Division website <http://www.nmfs.hawaii.edu/crd>).

### Quantifying and Assessing the Effects of Sedimentation on Fish Abundance, Fish Diversity, and Benthic Habitats including corals

- To obtain a purchase order to obtain supplies and equipment needed for the project.
- To assess Piti Bomb Holes Preserve and Fouha Bay, areas with current and future erosion control projects, and two appropriate control sites for detailed monitoring.
- To conduct fish counts, timed-swim counts, and video-transects on 24 permanent transects located in the 20', 30', 40', and 50' depths of the fore reef slopes and reef flats of Piti Bomb Holes Preserve, Fouha Bay, and two control sites.
- To install and monitor thirty sediment traps on a monthly basis each year during the study at Piti Bomb Holes Preserve, Fouha Bay, and two control sites in order to quantify sediment load at impacted sites.

### Analyzing and Assessing Recreational Impacts on Coral Reef Habitat and Determining a Carrying Capacity within Marine Preserves

- Hire a Marine Preserves Biologist and fisheries technician.
- Investigate and assess the impacts of recreation activities within Tumon Bay and Piti Bomb Holes Marine Preserves on coral reef habitat by linking recreational activities to their effects on the abundance, diversity, and distribution of fishes, corals, macro-invertebrates, and marine plants as well as substrate cover, water clarity, temperature, dissolved oxygen, pH, and damage or pollution related to recreational activities and comparing the effects to appropriate control sites.

Guam Environmental Monitoring and Assessment Program – Coastal Waters

- Implement an Environmental Monitoring and Assessment Program (EMAP), to be conducted by GEPA and assisted by GDAWR staff. The EMAP program will assess the physical and chemical condition of Guam's Marine water using standardized methods and a suite of environmental indicators. This information will be used to rank the relative importance of various stressors on the affected resource types.

Marianas Archipelago Reef Assessment and Monitoring Program (MARAMP)

- Guam DAWR will continue participation in MARAMP cruise trips. The MARAMP is intended to be a long-term monitoring program with research cruises scheduled bi-annually. The cruise usually comprised of staff from the NOAA Coral Reef Ecosystem Investigation Program, GDAWR, NPS, and the University of Guam Marine Laboratory to conduct a variety of ecological and oceanographic assessments, including the following:
  - Benthic Habitat Mapping: multi-beam surveys, single beam QTC surveys, geodetic control, towed diver surveys, and TOAD towed camera surveys,
  - Fish, Turtle, and Marine Mammal Surveys: belt transects, stationary point counts, towed diver surveys, roving diver surveys, and hydroacoustic surveys,
  - Benthic Surveys (corals, other inverts, algae): belt transects, towed diver surveys, roving diver surveys, and TOAD towed camera surveys, and
  - Oceanography: closely spaced CTDs, drifters, subsurface temperature, ADCP transects, CREWS/SST buoys, current/wave moorings.

**Data Management and Archiving**

Faunal and Vegetation survey data will be archived with GDAWR. The information collected will be analyzed and reported in State Wildlife Grant reports, to include information on species abundance and distribution, and on habitat trends. Statistical analysis (either parametric or non-parametric) will be used to determine significant changes in abundances (Sokal and Rohlf 1995).

Wildlife Tracking and Reporting Actions for the Conservation of Species (TRACS) will be incorporated for sharing information of projects funded under SWG funds. TRACS is designed to effectively monitor trends for species and habitat conservation. But more importantly, serves as a vehicle to engage partners and stakeholders to contribute recommendations to improve and adapt management on projects.

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Goal: Management of compiled field notes and resource information.

Objective 1: To maintain collection of data and field notes

Objective 2: To publish reports in field journals and other manuscripts

- Collaborate with resource partners to share data.
- Promptly input information into TRACS and make information available for partners and stakeholders.
- Partner with technical and statistical experts to analyze data and publish scientific work happening on Guam.

### **Establishment of a Monitoring Group**

Mentioned in the 2005 Plan, in order to assist in the synthesis of the information gathered from monitoring of SOGCN and relevant habitats, establishing a Guam Monitoring Group is important. The group was not formed in the past 10 years after the 2005 Plan. Efforts will be focused to gather technical experts to review project's objectives, approach and results. This group will be composed of appropriate local and federal agencies including but not limited to the Department of Agriculture (GDAWR and FSRD), GCMP-Marine, NOAA, USDA-NRCS, USFWS Ecological Services, GNWR, USDA-Wildlife Services, DON, USGS-BRD, and UOG. In addition, NGO's, students pursuing their Master's Degree, and Researchers will be invited to participate. The Department will be assembling the Monitoring Group with an invitation letter to request their participation and involvement.

This group will be reviewing the progress of on-going projects by evaluating project methods and data collected to determine if the actions are effectively addressing the limiting factor. The group will be tasked to develop adaptive management measures to be implemented in the projects, which needs guidance to reach desired outcomes.

By establishing a monitoring group, new information will be shared amongst technical experts and obtained. The group will be tasked to evaluate the effectiveness of the methods used to address priority actions for species and habitats through the process of utilizing the result chain (adaptive management).

### **Effectiveness of Measures: Implementation of the Result Chain**

To effectively achieve the goals and objectives identified in GWAP, the Department will need to allocate Guam's conservation resources. Many partners (and stakeholders) perform conservation actions in different ecological boundaries that meet their mandates (or purposes). The Department will need to develop a project-specific result chain (AFWA, 2011) to illustrate how an action will produce outcomes to help achieve the GWAP (and partners') goals and objectives. For example, the Department had launched a bio-security campaign to promote awareness in boaters leaving the main island to check their cabins for rodents and BTS prior to visiting Cocos Island (free from rodents and BTS). The Department's partner, Guam Invasive Species Council Office may launch a campaign to inform boaters to inspect their boats for BTS and properly clean and remove algae from the underside of their boat before traveling to the CNMI to prevent transporting invasive species to CNMI. Although this action is implemented by different agencies and are countering similar threats (invasive species), the result chain may appear very similar.

In Chapter 3 the threats identified are broad, encompassing several approaches for conservation actions to occur (or be tested, based on who will be implementing a specific study). Figure 19 illustrates the process to be adopted by GDAWR and technical expert partners and implemented to measure the effectiveness of the actions to produce desired outcomes and contribute to goal achievement. The Department continues to use a Three Level Approach to measure effectiveness of conservation actions. The Levels are as follows:

- Level 1: Initial implementation of conservation action
- Level 2: Amending methods of the action and reassessing the results, and
- Level 3: Adaptive management to produce desired outcome

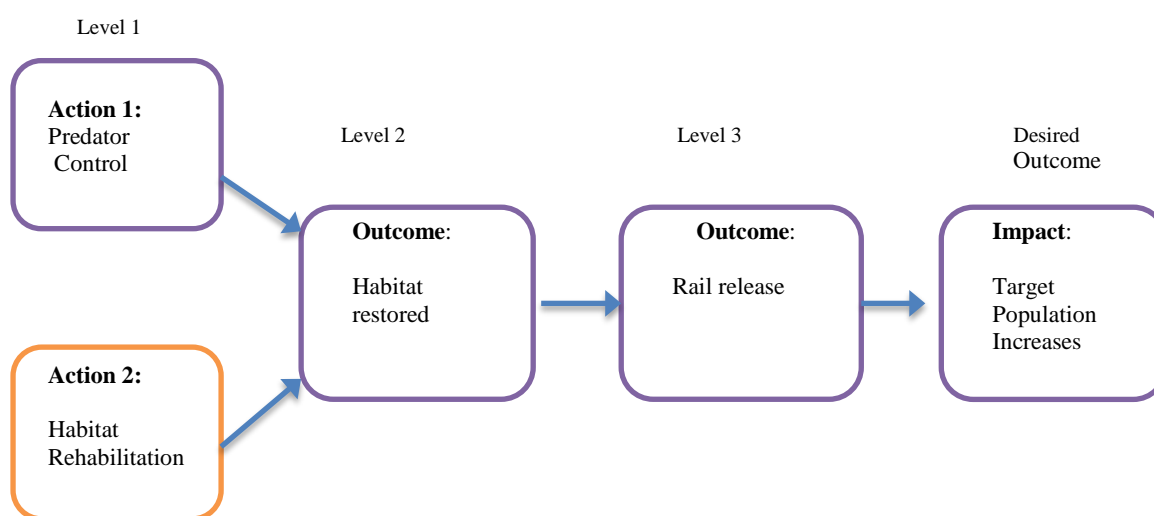


Figure 19. Result Chain Showing Linkage Between Actions and Impact.

# **CHAPTER 6: Periodic Review of Strategy (Element 6)**



### **Ten –Year Review of the Strategy**

Guam DAWR developed the first edition of its state wildlife action plan (formerly, Comprehensive Wildlife Action Plan) in 2005. Ten years later, that plan must be updated to facilitate the effective implementation of its conservation strategies and actions, and to continue receiving federal funds through the State Wildlife Grants (SWG) program, administered by U.S. Fish and Wildlife Services (USFWS). Periodic iterations of the plan, now called the State Wildlife Action Plan (SWAP), is a requirement for receipt of federal funding under the SWG program, and USFWS has developed guidance on requirements, process, deadlines, and content, including eight required elements. In addition, the Association of Fisheries and Wildlife Agencies (AFWA) has developed best management practices to provide guidance and examples that assist its member states in the consistently process of revising a SWAP (AFWA 2012). The best management practices and required documents have guided the SWAP revision.

As was the case in 2005, the critical status of the island’s native ecosystems and the importance of protecting and recovery of native species are acknowledged as the foundation of the plan. Identifying and protecting suitable habitats in Government of Guam owned lands and intact native communities is recognized as a high priority and a major focus for conservation efforts. The status of key native habitats is described in general and the needs of individual species are described by species or similar taxa. On an ecological level, Guam SWAP takes a habitat management approach and landscape view that takes into accounts the complex relationships among species and their habitats, and more importantly, the need for change and adaptability. The approach in 2015 is to build on and synthesize information from the 2005 CWCS, nurture and solidify conservation partnerships and cooperative efforts implemented thus far and incorporate new information from the past ten years. Furthermore, establishing successful partnerships and their efforts in Guam’s biological resources in the past ten years are highlighted with the goal of enhancing and expanding existing and creating new partnerships that increase support for and the effectiveness of Guam’s SWAP.

Guam DAWR leads the development and renewal of the Guam SWAP, in collaboration with Guam Forestry and Soil Resources Division, primarily in charge of protecting Guam’s terrestrial and marine resources. In 2014, DAWR staff began assembling and updating the GWAP. With staff turnovers, DAWR decided to seek additional assistance to complete the revision of the SWAP. Guam Coastal Zone Management Program, UOG’s Pacific Island Climate Science Center, and UOG’s Marine Lab, and National Oceanic Atmospheric Administration Guam’s Fisheries Office helped contributed in the development of the SWAP.

Much of the 2005 CWCS plan remained relevant and the foundation on which to continue conservation efforts, the structure and content of the document was retained as much as possible. The content of the 2005 CWCS was reviewed, evaluated and identified sections to be updated by DAWR staff and technical experts who used the plan for grant applications (UOG) or collaborative efforts for specific projects (FSRD, GCZMP) or federal agency partners charge to provide technical guidance to local resource agencies (NOAA, NPS, GNWR, and DOD). Special attention was paid in information gaps for SOGCN, candidates for SOGCN listing, new threats and challenges to native wildlife and their habitats, new or changing conservation

strategies or management approaches or priorities, consequences from climate change, and strengthening land laws set aside for conservation efforts. These topics were then taken to private and local partners and community via written requests, emails, discussions, meetings, and social media to obtain comments and concerns, for a 30-day review and comment period. Soon after the allotted time for public and partners review and comments, DAWR evaluated the comments and incorporated the information into the SWAP, as seem fit, to have a final version of the plan. Figure 20 demonstrates the approach taken between DAWR, partners, and stakeholders to form the Document.

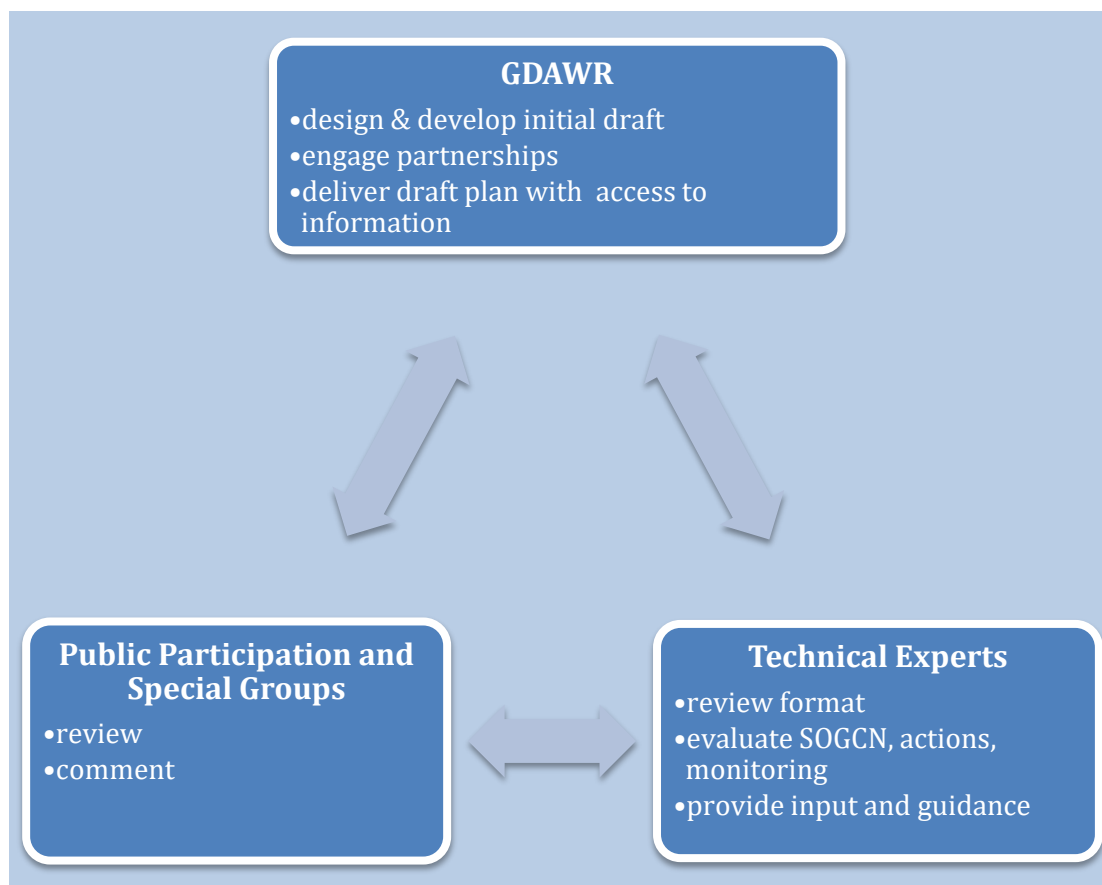


Figure 20. Interaction relationship between partners and public.

Since public participation was at the lowest, DAWR strategically used several methods to garner information from the public to increase participation. DAWR made their presence at several events, such as UOG’s Charter Day, Guam Nature Alliance’s watershed public events, with copies of the SWAP document to speak with participants at these events to get information and feedback. Topics discussed included SOGCN candidates, threats, conservation strategies and priorities, and habitats for conservation. Many of the feedback received shared common sentiments to see more native species in Guam’s forests and stopping military expansion, training, and Marine Corp’s relocation from Japan to Guam and CNMI.

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Other resource agency's both local and federal (stationed on Guam) including DOD environmental and Non-Governmental Organizations were presented with the SWAP document for review and input. Having busy and tight work schedules to spare time and effort for review and provide input, most of the feedback given related to the SOGCN list. Contrary to what is identified in the 2015 SWAP, DAWR decided to table the species that are culturally valued for food, until sufficient data is collected to decide whether these species are to be included in SOGCN, such as the coconut crab and sea cucumbers.

Guam's SWAP will be fully reviewed every 10 years with interim performance reports (reviews) every year of the program for projects funded by State Wildlife Grants. The interim performance reports will be used as a tool for the Department with their technical experts, to evaluate the success or failure of management objectives, adjust management actions accordingly, and review project proposals (need, objectives, and approach) addressed in the SWAP.

- The proposed management actions for Guam's SOGCN will be updated as new information is gathered from these reviews. The Department will coordinate, with technical experts, a complete assessment of the strategy in a needed basis. The findings will be compiled and shared using all available media for public review and comments that will be incorporated in the future revision of the plan.
- The Department and its partners will use the original eight elements and other criteria available at the time of revision. The effort will be in consultation with other stakeholders, both public and private. And clearly describing the process of the revision made.
- A review of the priority levels will be made to assure SOGCN needs (conservation actions) are being addressed. The Department, with technical experts, will adopt and re-design to meet Guam's biological needs The Nature Conservancy threat assessment tool to aid in the determination of the priority levels for SOGCN and conservation actions in the plan. Rankings will be established and clearly defined as a result the scoring will not be as biased and solely determined by species specific or group (i.e. hard corals).
- The Department will publish research papers with some of the data collected during SOGCN activities to assist with selection of future priority species. These publications will also serve to educate the public about historical, current, and trending species needs in order to gain more informed community feedback for future actions and research areas.
- The Department will hire a Wildlife Action Plan coordinator to engage conservation partners (local agencies, federal agencies, stakeholders and non-government groups) in the initiation an update of the Wildlife Action Plan and invite their participation. The coordinator will be tasked to summarize met and unmet goals and objective outcomes; and, compile new information on species, habitats, threats and actions for SOGCN. Make the determination to

include culturally sensitive resources such as medicinal plants and food supply into the SOGCN for sustainable harvest.

- The next revision shall start at least 2 years before the tenth year and be completed by the end of the tenth year. The countdown to revision shall commence on October 1, 2015 and the first full revision shall be completed and submitted for review and approval by October 1, 2025.

**Next steps**

Emphasis for the next 10 years will focus on improving needed skills and knowledge to design a standardized approach (process) for public outreach effectiveness, identifying and establishing specific threat and action priorities for addressing SOGCN and habitats. GDAWR will be identifying and meeting with technical experts knowledgeable with cultural valued species (for consumption) to be addressed in GWAP for sustainability. The approach to accomplish this task will be done cautiously because of the history and traditional perception of resources used by the local community. By the next review of the GWAP, efforts to meet with the fishers and hunting groups will be made to solicit for their information and concerns. Their input and participation will be key to drive culturally sensitive, yet highly valued, SOGCN such as the coconut crab and most land crabs and native breadfruit tree to be included in the next revision. Since the Festival of Arts of the Pacific (FESPAC) in 2016, Guam has seen a revival of traditional practices, such as cultural healing and carving. Many of the resources used for medicine and carving have become scarce due to ungulates, habitat loss and development. The Department will coordinate meetings with this special group of traditional practitioners to discuss the need to include culturally important resources to be included in the GWAP. Projects that occurred after the approval of the 2005's CWCS will continue. Conservation has begun with DAWR fisheries and UOG's Marine Lab to revive studies with our freshwater fauna and flora identified in Chapter 3 and make necessary improvements in the objectives and actions currently in place.

**CHAPTER 7: Coordination of the development, Implementation, Review, and Revision of the GWAP with Federal, State, and Local Agencies (Element 7)**

## **Coordination with Federal, State, and Local Partners**

GDAWR identified federal, state, and local stakeholders that may have had interest in providing input for the GWAP. Letters informing Government of Guam agencies, University of Guam (UOG), USAF, USN, and NGOs (The Nature Conservancy and Marianas Audubon Society) of the 10-year revision of GWAP were sent out in February 17, 2015. Each of the agencies was invited to provide their concerns, input, and assistance.

Various government, state and regional partners assisted in the revision of the GWAP, while the Fisheries and Wildlife Sections of GDAWR headed the revision of the GWAP. The USFWS Marianas Team in Guam provided input on SOGCN, monitoring and conservation actions. Information on common species of greatest concern was shared with the State of Hawaii's Department of Land and Natural Resources, CNMI Division of Land and Natural Resources. Most of the information pertains to migratory shorebirds' status and action plans, which are implemented in the plan. Input on various portions of the plan provided by: the University of Guam (UOG) on marine vertebrates, land snails, insects, and plants; the Colorado State University (CSU) on birds; and FSRD on terrestrial plants, as well as digital maps of conservation areas and information on the vegetation contained in them. The National Oceanic and Atmospheric Administration provided input for marine and aquatic sections as well as the overall revision of the strategy. The Government of Guam's Department of Land Management assisted with maps and identifying conservation and public lands.

The Department will be coordinating with partners to identify new projects and review of existing projects discussed in Chapter 4 (Review and Revision).

# **CHAPTER 8: Broad Public Participation (Element 8)**

## **Pre-GWAP Draft Public Meetings:**

The initial approach to invite public input on the GWAP was to hold public meetings at village mayors' offices. After zero community attendance at three village meetings, the Department decided to alter its methods of gaining public input by incorporating social media, public events, and classrooms. The public was engaged through the use of online social media such as Facebook, soliciting participation in the revision of Guam's GWAP by reviewing and providing input on the existing GCWCS. Copies were made available for review at the DAWR administration office. In addition, DAWR participated in public events such as the Annual International Coastal Clean-up, UOG's Charter Day, the Annual Lunar Festival, and several Earth month activities, by hosting a static display table showcasing the GWAP. Doing so, allowed the Department the opportunity to give notice of the GWAP revision, dates for a final version, and inform public about contents of the GWAP. During the events, one-on-one conversations were made discussing the contents of the GWAP to review and provide comments. Handouts were given to attendees at the events identifying means (point of contacts email and office numbers) to submit comments, ask questions, or get involved.

The Department was granted approval by individual teachers and professors to hold a class presentation about the GWAP. Instructors were reached via email with a letter requesting an opportunity to discuss the GWAP contents and the requirements for revising the GWAP. Presentations were held in science classes and student organizations at GCC, UOG, five public high schools (GW, JFK, SSHS, SHS, THS) and three private high schools (FD, AOLG, ND) to inform and solicit feedback from students. A total of 483 students from these educational institutions were provided a topic-specific presentation of portions of the GWAP, followed by question and answer session or brainstorm activities after each topic discussed, allowing students to be interactive and engaged in the process. The Department then summarized the information obtained from the school presentations. Comments expressing similar topics (i.e.: native bird reintroduction) were grouped together to avoid redundancy, at the same time, was addressed thoroughly in the document. Public meetings hosted by the Department, were announced via newspaper print for 10 working days as required by Guam Law, and printed ads posted on bulletin boards at various government agencies (Guam Power and Guam Waterworks cashiers, Department of Revenue and Taxation's Division of Motor Vehicle office, Guam Public Library, and Post Offices) to discuss more in detail the purpose of the GWAP and what should be addressed, based on the public's concerns. Meetings were scheduled for 6:00 PM at Mangilao, Yigo, and Talofofu Mayor's offices. Unfortunately, there were no public in attendance in any of the scheduled meetings held at the Mayor's offices.

The poor attendance at these meetings called for effective adaptive management measures in engaging with the public. The Department decided to deliver the GWAP document to people at common places, such as shopping malls and beach. Residences, whom the Department randomly selected, were asked short answer questions pertaining to the GWAP and about conservation efforts on Guam, in general. The Department accumulated over 100 responses from this experience compared to the no show during the meetings held at the Mayor's offices. As result, with much confidence, the Department reached a level of success at fulfilling public participation in the GWAP public comments. All comments received were reviewed



and summarized, and identical comments were grouped as one, and incorporated in the final revision of the plan.

Summary of comments/concerns expressed followed by the Department's response:

- The development of village-hotel partnerships to promote ecotourism and awareness in key habitats.

The Department agrees that the Mayor Council should work collaboratively with Guam Visitor's Bureau (GVB) and Department of Parks and Recreation (DPR) to establish a plan to promote ecotourism, especially in Conservation Areas identified in Chapter 2. The Department will be partners (not coordinators) to assist and provide technical guidance.

- The preservation of native forests in relation to game species and concerns about possible limitations of hunting activities in conservation areas.

The Department continues to manage the Anao, Bolanos, and Cotal Conservation Areas. These areas are GovGuam properties and accessible for public entry. Hunting for feral pig and deer is allowed in these areas, with a valid permit and deer tag(s). The Department announced, referencing Guam Code Annotated, that Conservation areas are not restricted areas, rather managed areas for conservation purposes. Addressed in Chapter 5, the Department will explore in the development of Game Management Areas, which will allow licensed hunters additional lands to pursue game in private lands and other Government of Guam lands (not to exclude NPS lands).

- The need to minimize urban development and military training on the island and to promote more eco-friendly development.

The Department continues to review and provide consultations based on its' authorities for development and military exercises and trainings. DPR's State Historic and Preservation Office, GEPA, GCZMP, and the Department works together in addressing concerns and mitigation to the proposed activities. Legal protection of habitats identified in Chapter 4, emphasize the need to strengthen regulations for Conservation Areas and Marine Preserve Areas established.

- The need for more introductions of native bird species and facilities to observe migratory birds during the migrating months.

For any introductions to occur, it is viable to remove and control non-native predators, as well reestablish native forests. The Department agrees it is a high priority to manage non-native predators before releasing native birds to their habitats. The Department provided a platform at Masso Reservoir to serve as a fishing platform and as an observation platform to allow public to view moorhens and migratory

birds in the area. Access to MPA's is made available for beach-goers and individuals interested in viewing migratory birds and sea birds on Guam. This concern is briefly described in Chapters 4 and 5, and SOGCN Accounts addressing Outreach and Awareness.

- The need to control the coconut rhinoceros beetle and other invasive species impacting the health of native trees and prevention measures for invasive species entry to the island.

The Department, under legislation, established the Guam Invasive Species Council (GISC). The council is tasked to develop a Guam Invasive Management Plan, which includes bio-security. Collaboration with the GISC and other partners, DAWR is committed to helping in any way to manage invasive species (non-native predators) for the purpose of reviving Guam's native species. The concern was incorporated in Chapters 2,3,4,5 and SOGCN accounts.

- Access to recreational areas and public access for fishermen.

The Department continues to partner with DPR, and private landowners to provide access to recreational and fishing areas. Numerous areas are land-locked and will require access through private lands for feasible entry to these areas. Access to Anao and Bolanos conservation areas is land locked between private and military lands. The Department is committed to be the liaison for recreational users in these properties and fishing grounds and install information for access by establishing trails and other accommodations. The concern was incorporated in Chapters 4.

- Coordinate internship programs during the summer for students to engage and be given the opportunity to work in conservation.

The Department will be exploring the process and requirements of having an internship program for students of interest. As this will become a new venture for the Department, of great concern is liability of the participants and the Department, itself. Establishing internship programs at the Department was not addressed in current Plan and will need some research with Government Operations and Policies.

- Improve communication with students and general public by having a functional and updated webpage easily to access on-line.

The Department is dedicated to improving its communication with the general public by providing an updated, functional, informative, user-friendly and easily accessible webpage by contracting a business specializing in social marketing and web-design. Before the web page is release, a pilot test will be offered to students representing each level of education on island to get feedback if improvements are necessary. This comment was briefly covered in Chapters 6, 7 and 8, emphasizing the need for an updated webpage for the Department.

- Managing harvest of all culturally valued food items and including these species in the SOGCN for sustainable harvest.

The Department decided to table this topic until information is gathered and analyzed. The need to investigate harvest rate and population size of the species collected as a food item is necessary before going to the community for input and discussion. The comment was addressed in Chapter 6 with the need to identify and engage tribal groups to incorporate their thoughts and belief in sustainable harvest, traditional harvest, and traditional healing practices.

- Polluted beaches and leptospirosis and other bacteria found in popular swimming holes in Guam's rivers.

The Department will collaborate with GEPA and GCZMP to mitigate the on-going occurrences of polluted waters on Guam, and Department of Public Health and Social Services, and DPR to raise public awareness of the health issues that may arise from polluted waters. The desired outcome for many of the actions discussed in Chapter 4 and SOGCN accounts (for example, ungulate control/eradication and reforestation) will mitigate polluted beach and leptospirosis and other bacteria found in popular recreational swimming areas.

The Department will look into improving their approach to the public to take part for revising the Plan in future years. By doing so, we hope there will be more public involvement for the next revision of the plan. Revitalizing our Department's website to allow access to review the GWAP by the chapters will be needed for the Department to meet Element 8. Allowing for access and having the document available, with rapport exchange communication with individuals interested in the GWAP and its contents will be beneficial. Comments and suggestions provided by the public will be incorporated into the next revision. The Department is committed to continue their presence in other events, such as those mentioned earlier in the chapter, to get more one-on-one time with deliverables for the public to get interest and involvement. One event that has grown quickly to the public's eye is the Conference of Island Sustainability, coordinated by UOG, which started several years after the implementation of the 2005 GCWCS. This annual event attracts hundreds of individuals and interest groups learning about issues and topics concerning sustainability. Participation in other conferences such as the Mariana's Terrestrial Workgroup, Coral Reef Initiative annual meetings, and Brown Treesnake working group annual meeting will be beneficial for revisions on the Plan.

### **Public Participation in the Implementation of the Plan**

There are numerous ways that the Department engages the public in conservation and educational efforts of the Plan. There are public outreach programs that share information with Guam's schoolchildren upon teacher or school request. Typical presentations include endangered/threatened species, invasive species, Guam watersheds, protecting corals, and marine preserves. Over 100 presentations are given each year to educate the island youth and encourage them to respect and conserve our island resources. Other youth programs include the annual Masso' Reservoir Youth Fishing Derby, started in 2013. This program teaches youth about freshwater habitats, species, and sustainable fishing practices. Annual Kid's Fishing Derby started since 1990, to educate participants in the conservation of fish (catch-release method) and hook and line fishing methods. The Department holds static and/or interactive educational booths at annual Earth Day and Charter Day events. The Department donates vegetable starts to school's who make requests for classroom or school-wide gardens. The Division of Forestry provides native plant species and information/support for landowners wishing to replant with indigenous trees. The Division of Forestry engages students, and community in the planting and care of trees leading up to and during annual Arbor Day events and numerous tree planting events held in Cotal Conservation Area, Geus-Manell, Pago Bay and Masso watershed areas. Addressing wildland fires during the dry-seasons on island, Forestry, together with many of their partners (DAWR included) worked collaboratively to promote the Munnga man sungi Guahan (Don't Burn Guam) campaign. The campaign opened opportunities for students and the community, specifically the southern residents, to get involved and be informed in many of Guam's restoration and conservation efforts.

The Department has initiated the Hunter's Education Program in hopes of turning it over to trained hunters to teach the classes to improve the rate of licensed hunters on Guam. The Department started an annual Pig Hunting Derby in 2012 that provides education and instruction on safe hunting practices while encouraging the public to assist in ungulate control, specifically the feral pigs that had a low harvest interest. The first derby had 10 hunters with 30 harvests. The event has grown to include over 100 hunters and average of 60 pigs harvested within the two-day event. The Pork in the Park is a free public event held the weekend following the Pig Hunting Derby to encourage more public awareness of the ability to safely prepare and enjoy feral pork. Local teams compete in their culinary concoctions to win prizes in various categories while the public is afforded the opportunity to taste the feral pork. The Department has paired with a local hotel for extra food preparation. The Department also has locally partnered with the USDA-WS, Water and Environmental Research Institute, school conservation groups, Farm-To-Table, UOG Soil and Water Conservation Group, GNWR, GCZMP, MPS, USGS-BRD, and many others to provide static and interactive environmental educational displays during the family event.

The Haggan Watch engages volunteer staff to supplement Department staff surveys. The volunteer program started in 2005. There have been over 400 members since the inception of the program with a minimum of 10 new members trained per year. The Haggan Watch volunteers assist in the monitoring, tagging, and clutch inventory of nesting sea turtles. The Haggan Huddle (HH) was developed in 2014 as a quarterly meeting of local sea turtle experts and managers, as well partners overseas. HH acts as a working group for sea turtle recovery management on Guam. The partners,

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present updates on any current sea turtle activity while discussing and assessing methodology and best management practices in order to achieve management goals and objectives for sea turtles. In addition, HH provides technical guidance and support amongst the Haggan Watch volunteer group, increasing knowledge and conservation of the sea turtles.

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# **Appendices**

**Appendix 1: Notices to public regarding the revisions to Guam's Wildlife Action Plan (GWAP)**

The following notices were sent out to the public via press releases to the public. The notices were an opportunity for the public to provide comments in regard to Guam's Wildlife Action Plan (GWAP).

Public Notice 2-17-2015



Edward J.B. Calvo  
Governor

Raymond S. Tenorio  
Lt. Governor

*Outreach*

**Department of Agriculture**  
**Dipartimento Agrikottura**  
163 Dairy Road, Mangilao, Guam 96913

Director's Office  
Agricultural Dev. Services  
Animal Health  
Aquatic & Wildlife Resources  
Forestry & Soil Resources  
Plant Nursery  
Plant Inspection Facility

300-7964/6566; Fax 734-6569  
300-7972/7367; Fax 734-6569  
300-7903/66; Fax 734-6569  
735-3955/66; Fax 734-6370  
300-7975/76; Fax 734-6569  
300-7974; Fax 734-6569  
475-1426/27; Fax 477-9487



Mariquita F. Tottaque  
Director

Matthew L.G. Salian  
Deputy Director

February 17, 2015

To Whom It May Concern:

The Department of Agriculture's Division of Aquatic and Wildlife Resources (DAWR) is conducting a ten-year review of the Guam's State Wildlife Action Plan and would like your input on the conservation of Guam's species of greatest conservation need.

Beginning in 2006, Congress required all states and territories to submit a State Wildlife Action Plan (SWAP) in order to receive federal state wildlife grants. The purpose of SWAPs are to define the species of animals in each state and territory that have the greatest conservation need and to develop conservation actions and monitoring plans that will prevent the need for listing new species under the Federal Endangered Species Act (1973). One of the requirements is that all states and territories must review and revise their SWAP every ten years.

A requirement of the review process is to develop, implement, and revise the plan in coordination with partners and with broad public participation. The SWAP has been revised within DAWR and we are now asking you, our partners and the public, to provide input.

The document is available as a pdf file and is available on CD as well as a download from: <http://dawr.guam.gov/wildlife/swap-revision-cwts/>. To facilitate the review process, we have provided a comment sheet. If more space is needed, feel free to attach additional documents. We ask that all comments be submitted by June 30<sup>th</sup>, 2015. It is a large document, covering a wide range of topics, and we ask that you only review sections that you, or your agency, are familiar with.

2

Should you have any questions or concerns, or need assistance navigating the document, please contact Mr. John Uzzardo via email at [John.Uzzardo@agriculture.guam.gov](mailto:John.Uzzardo@agriculture.guam.gov), or via phone at 735-3996. Comments may be submitted via email to Mr. Uzzardo, faxed to 734-6570, or mailed in to: 163 Dairy Road, Mangilao, Guam 96913.

Thank you for your cooperation and assistance.

Sincerely,



**MARIQUITA F. TAITAGUE**

Attachment(s):



Public Notice 6-10-2015



Edward J.B. CNIVO  
Governor

Raymond S. Tenorio  
Lt. Governor

**Department of Agriculture  
Dipattamenton Agrikottura**

163 Dairy Road, Mangilao, Guam 96913

Director's Office	300-7965/7966; Fax 734-6569
Agricultural Dev. Services	300-7973/7972; Fax 734-8096
Animal Health	300-7965
Aquatic & Wildlife Resources	735-3955/56; Fax 734-6570
Forestry & Soil Resources	300-7976; Fax 734-0111
Plant Nursery	300-7974
Plant Inspection Facility	472-1426; 475-1427; Fax 477-9487



Matthew L.G. Sablan  
Acting Director

Jessie B. Palican  
Deputy Director

DAWR/Wildlife  
Public Announce/PDN add  
6/5/15

**Request for Comments In Drafting Guam's State Wildlife Action Plan 2015**

The Department of Agriculture's Division of Aquatic and Wildlife Resources (DAWR) is in the process of revising its Comprehensive Wildlife Conservation Strategy (CWCS) initially mandated by U.S. Congress in 2005, to assist in the efforts to effectively manage, preserve, protect and restore Guam's natural resources now and for the future. DAWR requests your involvement with the revision process by reviewing Guam's CWCS. Revisions to the plan will be incorporated in drafting Guam's State Wildlife Action Plan (SWAP) 2015. A copy of Guam's CWCS may be obtained at DAWR's office in Mangilao, Comments on the SWAP or Guam's CWCS may be submitted to DAWR via fax at 734-6570, by emailing Mr. Jeffrey Quitugua, at [jeff.quitugua@yahoo.com](mailto:jeff.quitugua@yahoo.com), or in person at 163 Dairy Road, Mangilao, no later than July 31, 2015. For more information please call the DAWR office at 735-3955/56.

Approved       Disapproved

MATTHEW L.G. SABLAN  
Acting Director, Department of Agriculture

6/10/15  
Date

Appendix 2. Endangered and Threatened Species List for Guam  
Guam Endangered Species, List No. 9.

<b>Chamorro Name</b>	<b>English Name</b>	<b>Scientific Name</b>	<b>Status</b>
<b>Birds</b>			
Ko'ko'	Guam Rail	<i>Gallirallus owstoni</i>	Endangered
Pulattat	Common Moorhen	<i>Gallinula chloropus guami</i>	Endangered
Tottot	Mariana Fruit-Dove	<i>Ptilinopus roseicapilla</i>	Endangered
Puluman apaka'/Puluman fache'	White-throated Ground-Dove	<i>Gallicolumba xanthonura</i>	Endangered
Yayaguak	Mariana Gray Swiftlet	<i>Aerodramus vanikorensis bartschi</i>	Endangered
Sihek	Micronesian Kingfisher	<i>Todiramphus c. cinnamominus</i>	Endangered
Åga	Mariana Crow	<i>Corvus kubaryi</i>	Endangered
Chichirika	Rufous Fantail	<i>Rhipidura rufifrons uraniae</i>	Endangered
Såli	Micronesian Starling	<i>Aplonis opaca guami</i>	Endangered
Egigi	Micronesian Honeyeater	<i>Myzomela rubratra saffordi</i>	Endangered
Nossa	Bridled White-eye	<i>Zosterops c. conspicillata</i>	Endangered
<b>Mammals</b>			
Fanihi	Marianas Fruit Bat	<i>Pteropus m. mariannus</i>	Endangered
Fanihi	Little Marianas Fruit Bat	<i>Pteropus tokudae</i>	Endangered
Payesyeyes	Pacific Sheath-tailed Bat	<i>Emballonura semicaudata rotensis</i>	Endangered
<b>Reptiles</b>			
Guali'ek	Micronesian Gecko	<i>Perochirus ateles</i>	Endangered
Guali'ek	Pacific Slender-toed Gecko	<i>Nactus pelagicus</i>	Endangered
Guali'ek Halom Tåno'	Snake-eyed Skink	<i>Cryptoblepharus poecilopleurus</i>	Endangered
Guali'ek Kanton Tåsi	Tide-pool Skink	<i>Emoia atrocostata</i>	Endangered
Guali'ek Halom Tåno'	Azure-tailed Skink	<i>Emoia cyanura</i>	Endangered
Guali'ek Halom Tåno'	Slevin's Skink	<i>Emoia slevini</i>	Endangered
Guali'ek Halom Tåno'	Moth Skink	<i>Lipinia noctua</i>	Endangered
Haggan	Green Sea Turtle	<i>Chelonia mydas</i>	Endangered
Haggan Karai	Hawksbill Sea Turtle	<i>Eretmochelys imbricata</i>	Endangered
No name	Leatherback Sea Turtle	<i>Dermochelys coriacea</i>	Endangered

**Guam WAP 2018**

<b>Chamorro Name</b>	<b>English Name</b>	<b>Scientific Name</b>	<b>Status</b>
<b>Molluscs</b>			
Akaleha'	Mt. Alifan Tree Snail	<i>Partula salifana</i>	Endangered
Akaleha'	Humped Tree Snail	<i>Partula gibba</i>	Endangered
Akaleha'	Guam Tree Snail	<i>Partula radiolata</i>	Endangered
Akaleha'	Fragile Tree Snail	<i>Samoana fragilis</i>	Endangered
<b>Plants</b>			
Tsatsa	Tree-Fern	<i>Cyathea lunulata</i>	Endangered
Hayun-lågu	No name	<i>Serianthes nelsonii</i>	Endangered
Ufa-halomtåno'	No name	<i>Heritiera longipetiolata</i>	Endangered

### Appendix 3. Description of Terrestrial Habitats

Eight general habitat types are defined (Fosberg 1960, Stone 1970, Engbring and Ramsey 1984). Donnegan et al. (2002) provided additional habitat descriptions that are more specific to a few of the habitats defined.

#### KEY HABITAT TYPES:

- 1) **Primary Limestone Forest:** This is a forest composed principally of native vegetation of trees and plants, with a moderately dense canopy of 10-30 m high. There are no or only a few openings, and understory vegetation varies from open to dense. An area composed of native trees and plants. Much of the uninhabited areas of far northern Guam, as well as the cliff and bench areas along the coast, are of this type. Species of trees including the *Ficus*, *Intsia*, *Artocarpus* and *Elaeocarpus* are commonly found in this forest.

There several distinct limestone forest types including *Artocarpus-Ficus*, *Mammea*, *Merriliodendron-Ficus*, and *Pandanus*.

- 2) **Broken Forest:** This is mix woodland forest dissected by many small, open scrubby fields, which make up 10% - 25% of the area. Broken forest is the result of human disturbance and is confined mostly to the Central Plateau and Mt. Santa Rosa regions, near the Anao Conservation Area.

- 3) **Scrub Forest:** This diverse, brush forest generally has an open canopy under 10m high with dense understory. It is described by Jenkins (1983) as “second growth” or “scrub vegetation”. The plant speices are generally similar to those in more mature limestone forests, but are at an earlier stage of development. *Leucaena* is not found in this forest because it is shade intolerant. In northern Guam this habitat is dominated by *Vitex parviflora*. However, within this forested area native plants can be found.

Much of the Tarague Plateau and Northwest Field Region is scrub forest. Historically, these areas were cleared for military purposes and repeated typhoon destruction have played a major factor in creating these forests.

- 4) **Coconut Grove –** Historically, these areas were copra plantations or ranches. The canopy is, 15-25 m high, is moderately dense and generally complete. In most areas there is thick understory composed of a variety of native and non-native shrubs and young trees including numerous young *Cocos* sp. Some coconut groves may contain native plants.

- 5) Beach Scrub – Open sand beaches, barren coastal outcroppings, and coastal areas of sparse vegetation generally 2-3 m or shorter in height comprise this habitat. The dominant plant is *Pemphis acidula*, a salt-tolerant species. Scrubby stands of *Pemphis* are most extensive from Mt. Santa Rosa to Pati Basin.
- 6) Openfield – This habitat includes agricultural fields, and other open areas that are removed from urban or residential areas. The open field habitat is a result of human disturbance. Disturbed areas containing a mix of non-native grasses, succulents and *Chromoleana*. May contain *Nephrolepis*, and other ferns.
- 7) Agriforest: This is highly dissected mosaic of dwellings, open fields, gardens, scrub fores, limestone forest, and old *Cocos* groves. Much of central portion of northern Guam consists of this habitat, especially the Central Plateau Region of Guam.
- 8) Urban: Urban and residential areas, adjacent fields and openings, and runways comprise this habitat. Most of AAFB is urban, as are several towns (Dededo and Yigo) in more southerly regions. The Northwest Field Region has numerous abandoned runways that are classed as urban; a typical scrub forest surrounds these runways.
- 9) Grassland – Usually found in south, these areas are dominated by *Miscanthus floridulus*, and may contain others species such *Pennisetum polystachyon* and *Dimeria chloridiformis*.
- 10) Ravine Forest: Common ravine forests include the non-native *Areca catechu*, *Ficus prolixa*, *Glochidion mariannensis*, *Hibicus tiliaceous*, *Pandanas tectorious*, and *Premna serratifolia*.
- 11) Halophytic Forest: Halophytic (salt adapted) forests are found along beaches in the north and south. Commonly composed of *Casuarina equisetifolia*, *Cocos nucifera*, *Guettarda speciosa*, *Hernandia Sonora*, *P. tectorius*, *Scaevola taccada*, *Thespesia populanea*, and *Tournefortia argentea*.

Appendix 4. Draft Conservation Action Plan for Piti Bomb Holes Marine Preserve and Adjacent Watershed.

DRAFT CONSERVATION ACTION PLAN  
FOR PITI BOMB HOLES MARINE PRESERVE AND ADJACENT WATERSHED



Guam CAP Workshop  
6-7 August, 2009  
Hyatt Regency, Tumon, Guam

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**VISION STATEMENT FOR PITI**

**Vision for Piti (from the perspective of the management community)**

**Piti will be the model of a community-based, management driven, environmentally friendly village with sustainable resources in harmony with the environment... and continuance of cultural traditions and the enjoyment of future generations...**

**Results of brainstorming activity:**

- No sediment
- Masso Reservoir project completed
- Community-enforced management plan
- Eco-friendly development
- Improved land management
- More environmentally oriented DLM
- Increase in native bird population and healthy forest
- Native freshwater species in Masso
- Refuge for migratory birds & moorhen
- Community values the environment (stewardship)
- Recycling program
- Political will
- Sustainable water
- Appropriate and maintained infrastructure
- Managed Scuba divers in the MPA
- No snakes!!!
- Ungulate control
- Badlands restoration
- Natural levels of sedimentation
- Sustainable economic activities for the community
- Nice park & community center
- Restore high fish levels



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## 1. Introduction

### 1.1. A Context for Conservation

Guam is the southernmost island in the Mariana Archipelago, located at 13°28' N, 144°45' E. It is the largest island in Micronesia with a landmass of 560 km<sup>2</sup>. Over the last 50 years Guam has experienced tremendous domestic growth and suffered significant environmental degradation island-wide. Guam's native flora and fauna have been impacted by various threats, such as the introduction of invasive species, poor land management practices, and overexploitation. The various resource agencies of the Government of Guam continue to address these issues, knowing that economic prosperity and preservation of the Chamorro culture are dependent on the successful recovery and sustainable use of the island's natural resources.

The island possesses a variety of terrestrial habitats, including limestone and ravine forests, savanna, and strand vegetation. One hundred named rivers are found in the southern part of the island, along with 2 man-made reservoirs. Marine habitats include fringing, patch, submerged and barrier reefs, offshore banks, seagrass beds, and mangroves. The Piti Bomb Holes Marine Preserve was one of five marine preserves established by Public Law 24-21 in order to restore dwindling inshore reef fish stocks. It was selected for the high degree of complexity reflected in its wide range of coral reef and sandy bottom habitat types. These complex habitats support one of the highest levels of diversity of fish, mollusks, echinoderms, crustaceans and other fauna on the island. Much of the shoreline is also fringed by sea grass beds which provide valuable refuge for juvenile fish. In addition, the estuaries of 3 rivers draining into the bay provide rich feeding and nursery grounds for many species. The preserve has an area of approximately 3.64 km<sup>2</sup>.

This project is part of an ongoing effort in the Piti Watershed to preserve and enhance water quality, native forest, coral reef ecosystems, and species of greatest conservation need.

### 1.2. Overview of this Report

This draft conservation action plan (CAP) includes a list of conservation targets, a situation analysis, ranked threats, potential strategies for addressing these threats, and a capacity assessment developed by team members at workshops in January 2008, April 2008, and August 2009. It is intended to be a reference for the development of a management plan for Piti Bomb Holes Marine Preserve and the adjacent watershed. The report is organized around the steps of the Conservation Action Planning (CAP) Adaptive Management Cycle (Figure 1), which was also used to organize the workshop. Each step will be described briefly and the main products of that step will be discussed. Please refer to the excel workbook for details of the workshop's input.



Figure 1. Conservation Action Planning (CAP) Adaptive Management Cycle, the project planning method used to organize the planning workshops and this report.

**2. Conservation Planning and Adaptive Management**

The CAP Adaptive Management Cycle is an iterative process which helps conservation projects develop and implement strategies, and then evaluate and learn from their experiences. The general steps of the process are to 1) define the project team and scope, 2) identify the conservation targets and assess their viability, 3) identify and assess the critical threats, 4) conduct a situation analysis, 5) develop conservation strategies, 6) establish measures, 7) implement the strategies and measures, and 8) analyze, reflect and learn from the results. The use of adaptive management means that the planning is never fully completed, but is continually refined, improved, and adapted over time. Future work will include a re-evaluation and refinement of the products to better reflect our growing knowledge and experience.

**2.1. Identify Conservation Targets and Assess Viability**

Conservation targets are species, communities, or ecological systems that represent the biological diversity of the project area and or what communities care about to conserve and protect. A good set of conservation targets should be designed to include those elements of the system that, if properly conserved, will result in the conservation of the full diversity of the landscape. Coarse-filter targets are intended to capture a large amount of smaller-scale biodiversity, both common and rare, within them, while fine-filter targets should include those small-scale elements that “fall through” the coarse filter and require individual attention.

In order to assess the targets’ viability, or ability to persist over the long term, the CAP process has developed a system to help teams define what they consider a “healthy” state for each target. The benefit of this exercise is in understanding the current status of the targets, as well as having a clearly defined desired status as a measurable objective toward which to work. The process for doing this involves identifying key ecological attributes (KEAs), indicators, ranges of variation, and rating schemes for each target. KEAs are characteristics of the target that are critical to its biology and that if altered would lead to the loss of the target. KEAs tend to fall into the broad categories of size, condition, and landscape context. Since KEAs are often not directly measurable, associated indicators (key characteristic of a target that can be measured) are selected in order to develop a rating scheme by which to evaluate the target status (Table 1).

Table 1. Viability assessment of conservation targets.

#	Conservation Target	Key Attribute	Indicator	Date	Current Indicator Measurement	Current Rating	Desired Rating
1	Coral Reef Ecosystem	Water chemistry	water quality	Jul-06		Fair	Good
		Water clarity	sediment load	Jul-06		Good	Very Good
		Water clarity	turbidity	Jul-06		Fair	Good
		community structure	percent live coral cover	Jul-06		Fair	Good
		Coral species composition / dominance	coral species diversity	Jul-06		Fair	Good
		Population structure & recruitment	population structure	Mar-08	varies within preserve area, but average of low to medium density with small to medium colonies (with a few rare large colonies)	Fair	Good
		Population structure & recruitment	recruitment	Jul-06	Poor	Fair	Good
		Size / extent of characteristic communities / ecosystems	areal extent of key habitat types	Mar-08	existing condition	Fair	Good
2	Native forest	Landscape pattern (mosaic) & structure	Veg Classification	Jul-06	Poor	Poor	Fair
		Soil / sediment stability & movement	% of leaf litter, % of organic material in soil	Jul-06	Poor	Poor	Fair
		Canopy cover	% canopy cover	Jul-06	Poor	Poor	Fair
		Species composition / dominance	species composition	Jul-06	Poor	Poor	Fair

#	Conservation Target	Key Attribute	Indicator	Date	Current Indicator Measurement	Current Rating	Desired Rating
		Size / extent of characteristic communities / ecosystems	ecosystem size	Jul-06	Poor	Poor	Fair
3	Fresh Water Ecosystem	Water chemistry	water quality	Mar-08	tbd based on assumptions of resource managers	Fair	Good
		Water clarity	turbidity	Mar-08		Fair	Good
		Species composition / dominance	number of native species	Mar-08	approx. 4-5 species piti-wide	Fair	Good
4	Native Terrestrial Wildlife	Population size & dynamics	species count	Mar-08	no rails released	Poor	Fair
5	Reef fish	Water chemistry	water quality	Jul-06		Fair	Good
		Population density	population density (by family and overall)	Mar-08	Fair	Fair	Good
		Population structure & recruitment	Density (by size class range)	Jul-06	Good	Good	Very Good
		spawning aggregating sites	number, size, and species compositions of SPAGS				
		Species composition / dominance	species composition	Jul-06	Fair	Fair	Good
		Presence of key communities or seral stages	undefined indicator	Jul-06	Fair	Fair	Good

A summary of the overall viability ranks for the five targets selected by Piti is found in Table 2.

Table 2. Summary of viability ranks for conservation targets.

Conservation Targets	Landscape Context	Condition	Size	Viability Rank
1 Coral Reef Ecosystem	Fair	Fair	Fair	Fair
2 Native forest	Poor	Poor	Poor	Poor
3 Fresh Water Ecosystem	Fair	Fair	-	Fair
4 Native Terrestrial Wildlife	-	-	Poor	Poor
5 Reef fish	Fair	Fair	Fair	Fair
<b>Project Biodiversity Health Rank</b>				<b>Fair</b>

Based on information provided by the Piti team and additional planning documents (FSM NBSAP, 2003; TNC, 2003), the overall ranking of the conservations targets is at fair. Upland forest was ranked as poor due primarily to invasive species, but also loss of coverage from clearing. Most of the targets were ranked as fair due to overharvest and habitat loss.

**2.2. Situation Analysis**

In order to document our understanding of the social and ecological context surrounding threats and targets, the team did a SWOT analysis to identify internal Strengths and Weaknesses and external Opportunities and Threats (Table 3) and a conceptual model showing the connections between the threats and the factors assumed to be driving them (Figure 2). The model is by necessity incomplete, and represents the working assumptions of the project team, as opposed to actual ecological relationships. It is intended to be a flexible tool that can be altered over time as our conception of the system develops.

Table 3. SWOT Analysis

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>▪ Stakeholders willing to participate</li> <li>▪ Well-studied area, lots of research, information</li> <li>▪ Existing management actions are working (e.g. MPA data showing improvements)</li> <li>▪ Environment starting to come back</li> <li>▪ Political will (Mayor wanting to do something)</li> <li>▪ Plans at Santos Memorial Park to alleviate some of the pressure of use of the Bomb Holes</li> <li>▪ Masso Reservoir Project</li> <li>▪ Diverse expertise in the group</li> <li>▪ People focused on Piti (Elaina – marine; Esther – watersheds)</li> <li>▪ Optimism (naiveté?)</li> <li>▪ High resilience of the resources (i.e. compared to the Caribbean)</li> <li>▪ High biodiversity (especially helps with</li> </ul>	<ul style="list-style-type: none"> <li>▪ Need clarity on enforcement for all violations (jurisdictions, who to call, procedures, 24 hour hotline, etc.)</li> <li>▪ No educational training for marine operators (e.g. tourist industry guides have to go through training on Guam history and then get certification)</li> <li>▪ Need new regulations for recreational operators (currently only need a business license)</li> <li>▪ Coastal erosion</li> <li>▪ Cutting of beach vegetation</li> <li>▪ Need more education for Mayor’s office staff</li> <li>▪ Need to bring other operators to the table</li> <li>▪ Small pool of people working on too many things island-wide (time and capacity issues)</li> <li>▪ Need more education on native plants</li> <li>▪ Need better regulations and enforcement for</li> </ul>

preventing marine invasives)	burning permits • Some "cultural" practices aren't eco-friendly
<p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>• Marine tour guide certification program through GCC</li> <li>• Proposed Guam Seashore Reserve Plan</li> <li>• Guam Eco-permit program</li> <li>• Educate Mayor's staff</li> <li>• Outreach easier in Piti – discreet community</li> <li>• Family-by-family outreach</li> <li>• Brown tree snake brings attention to invasive species issues</li> <li>• UOG – can fill information gaps</li> <li>• Need to engage additional federal partners (NRCS, Refuge, etc.)</li> <li>• Engage Guam leaders</li> <li>• Students involvement (Jose Rios Middle School – science club, Chamorro club, etc.)</li> </ul>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>• "Fly-by-night" operators</li> <li>• Fishermen illegally fishing in Piti MPA</li> <li>• No access for commercial operators to use the Port anymore (shift of use to Piti MPA)</li> <li>• More recreational users due to military build-up</li> <li>• Over-development in Nimitz Hill</li> <li>• Fire and badlands</li> <li>• Upland erosion issues</li> <li>• Climate change</li> <li>• Invasive species</li> </ul>



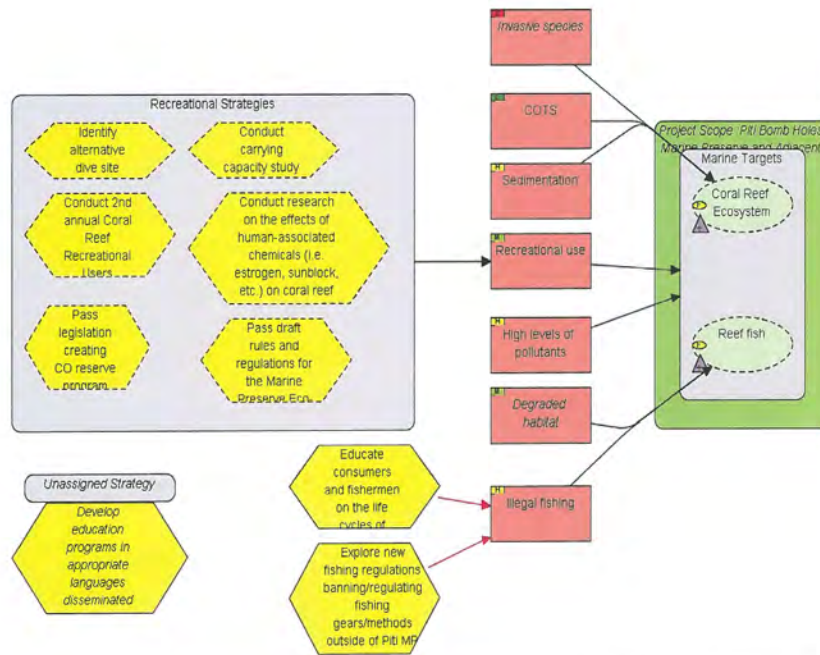


Figure 2. Conceptual Model for Marine Targets. Targets shown in green, direct threats shown in pink, and potential strategies shown in gold.

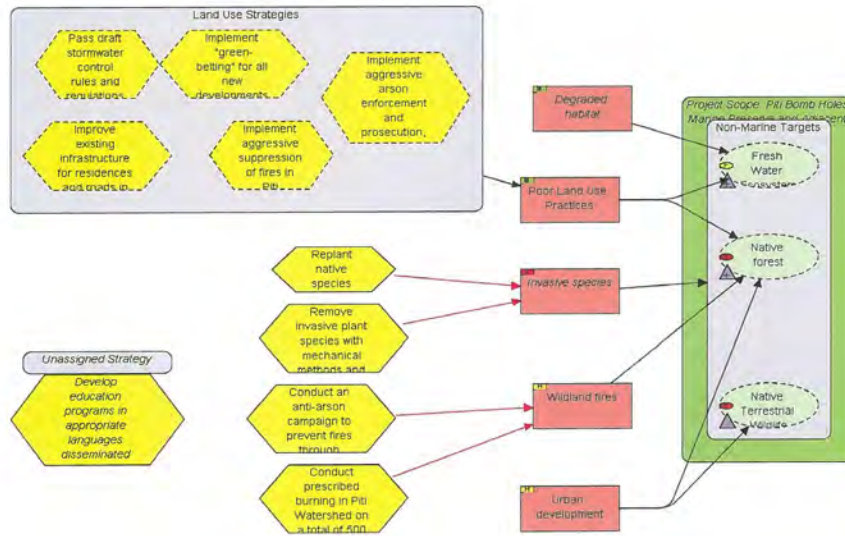


Figure 3 Conceptual Model for Non-Marine Targets. Targets shown in green, direct threats shown in pink, and potential strategies shown in gold.

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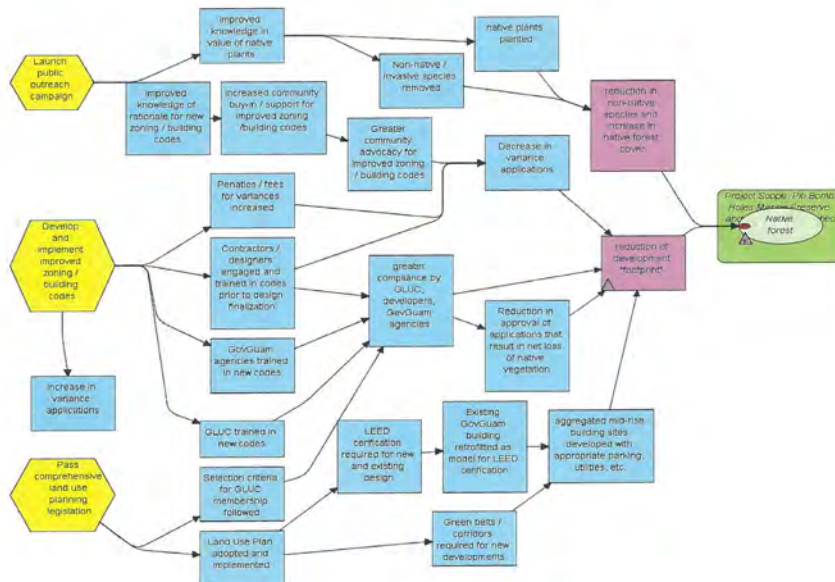


Figure 4. Draft results chain. Improving the health of native forest through three separate strategies.

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2.3. Identify and Assess Critical Threats

Twenty-one stresses were identified as reducing the viability of the targets (Table 4). Stress is the impairment of key ecological attribute for a given target. The overall ranking of the threat is affected by the severity and scope of a given stress on the target. Scope is the extent of an area within the conservation target that could potentially be impacted within 10 years given current situations. Severity is the level of damage to the conservation target that can be reasonably expected within 10 years under current circumstances. The threats were also ranked according to two factors, contribution and irreversibility in order to gauge the degree of the threat. Contribution is the level at which the threat acting contribute to the source of stress on a given target. Irreversibility is the likelihood for the target to recover given certain threat to that target.

Table 4. Stresses affecting the viability of conservation targets.

Stresses Across Targets (Altered REAs)		Coral Reef Ecosystem	Native forest	Fresh Water Ecosystem	Native Terrestrial Wildlife	Reef fish
		1	2	3	4	5
1	Altered species composition / dominance		Very High			Medium
2	Lack of recruitment				Very High	
3	Low or no population size				Very High	
4	Reduced area of native forest		Coral High			
5	Altered landscape pattern (mosaic) & structure		High			
6	Change in size class structure	Medium				High
7	Change in species composition	High				
8	Change in trophic structure					High
9	Decrease in percent live coral cover	High				
10	Decrease in population density / biomass					High
11	Decreased canopy cover		High			
12	Decreasing areal extent of critical habitat types	High				
13	Loss of topsoil		High			
14	Low Recruitment	High		Medium		
15	Altered characteristics of SPAGS					Medium
17	Decreased food availability			Medium		
19	Decreased species diversity			Medium		
20	Poor water quality			Medium		

After the threats were ranked for each target, the CAP excel workbook consolidated threats that occurred for multiple targets and use an algorithm to roll the individual rankings up to an overall

rank for that threat. Table 5 summarizes the target ranks and overall rank for each of the ten threats identified. Based on this ranking system, invasive species were ranked very high and various forms of unsustainable land use practices and illegal fishing were ranked as high threats affecting the conservation targets most important to the community of Piti.

Table 5. Summary of rankings for threats to conservation targets.

Threats Across Targets		Coral Reef Ecosystem	Native forest	Fresh Water Ecosystem	Native Terrestrial Wildlife	Reef fish	Overall Threat Rank
Project-specific threats		1	2	3	4	5	
1	Invasive species	Medium	Very High	Low	Very High		Very High
2	Urban development		High		Very High		High
3	High levels of pollutants	Very High				Medium	High
4	Illegal fishing					Very High	High
5	Sedimentation	Very High					High
6	Wildland fires		Very High				High
7	Degraded habitat			Medium		High	Medium
8	Poor Land Use Practices		High	Medium			Medium
9	Recreational use	Medium				Medium	Medium
10	COTS	Medium					Low
Threat Status for Targets and Project		Very High	Very High	Medium	Very High	High	Very High

**2.4. Conservation Strategies**

Strategies consist of one or more measurable objectives, the associated strategic actions, and their action steps. Measurable objectives are detailed statements that describe the desired outcome of the strategy. Strategic actions are the general activities undertaken by the project team to achieve these objectives. Action steps are the specific tasks required to carry out each strategic action. Table 6 lists the strategies developed by the community members during the workshops.

Table 6. List of objectives and strategic actions.

#	Objectives, Strategic Actions and Action Steps
<b>Objective</b>	<b>Decrease the occurrence of all invasive plant species by 50% in Piti Watershed by 2018.</b>
Strategic action	Remove invasive plant species with mechanical methods and herbicides.
<b>Objective</b>	<b>Decrease the population of invasive animal species in Piti Watershed by 2018.</b>
<b>Objective</b>	<b>Implement a 2-year public outreach campaign to promote watershed stewardship among Piti residents (2010-2012)</b>
<b>Objective</b>	<b>Increase CPUE in adjacent, non-protected areas (e.g. Asan) by 25 percent by 2012</b>
<b>Objective</b>	<b>Increase density/ mean size/ species diversity of reef fish in Piti Marine Preserve by 25 percent by 2013</b>
Strategic action	Pass legislation creating CO reserve program within 6 months.
Strategic action	Develop education programs in appropriate languages disseminated through associations, schools, UOG, churches within 6 months.
Strategic action	Educate consumers and fishermen on the life cycles of important food fish within 6 months.
Strategic action	Explore new fishing regulations banning/regulating fishing gears/methods outside of Piti MP within 1 year.
<b>Objective</b>	<b>Increase in relative abundance of native species in the freshwater ecosystems of Piti Watershed by 2015.</b>
<b>Objective</b>	<b>Increase native canopy cover by 2018 [absolute and relative to existing]</b>
Strategic action	Implement aggressive arson enforcement and prosecution, including increased surveillance, in Piti Watershed by end of CY06.
Action step #1	Acquire the dedicated time of the natural resource prosecutor (3 months).
Action step #2	Acquire the dedicated time of the natural resource prosecutor (3 months).
Action step #3	Engage GPD to enforce natural resource laws, including arson.
Action step #4	Engage GPD to enforce natural resource laws, including arson.
Action step #5	Implement community "watch" program (lead: FSRD)
Action step #6	Implement community "watch" program (lead: FSRD)
Action step #7	Conduct 80 hr. USFS course in wildland arson investigation for 30 people (FSRD, GPD, GFD, DAWR, GEPA)
Action step #8	Conduct 80 hr. USFS course in wildland arson investigation for 30 people (FSRD, GPD, GFD, DAWR, GEPA)
Action step #9	Add 5 FTEs for 1 year to conduct surveillance (could be details).
Action step #10	Add 5 FTEs for 1 year to conduct surveillance (could be details).

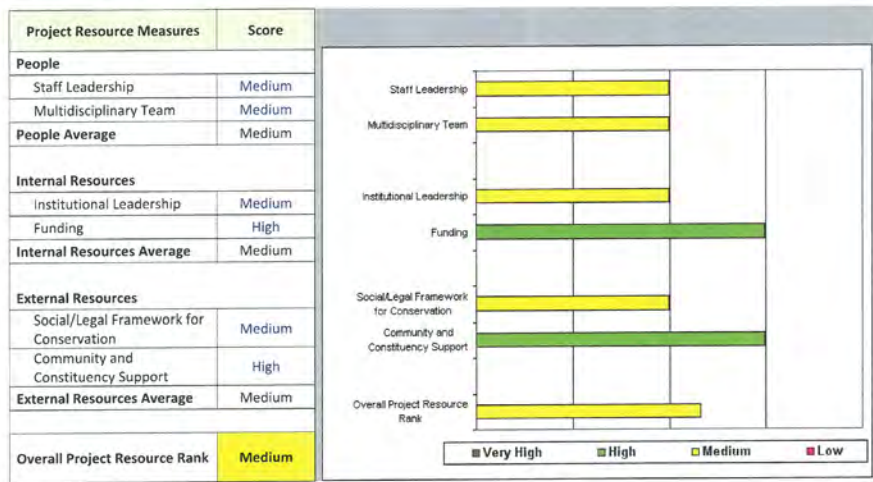
#	Objectives, Strategic Actions and Action Steps
<b>Strategic action</b>	<b>Implement aggressive suppression of fires in Piti Watershed by end of CY06.</b>
Action step #1	Conduct active fire patrol in Piti (5 yrs, 2 engines, 6 additional FTEs – maybe volunteer fire department)
Action step #2	Conduct active fire patrol in Piti (5 yrs, 2 engines, 6 additional FTEs – maybe volunteer fire department)
Action step #3	Ensure earlier notification of fires through community “watch” program (establish within 3 months; lead: FSRO)
Action step #4	Ensure earlier notification of fires through community “watch” program (establish within 3 months; lead: FSRO)
Action step #5	Reinforce MOU with HC-5 for water drop within 3 months.
Action step #6	Reinforce MOU with HC-5 for water drop within 3 months.
<b>Strategic action</b>	<b>Conduct prescribed burning in Piti Watershed on a total of 500 acres per year for 5 years.</b>
<b>Strategic action</b>	<b>Conduct an anti-arson campaign to prevent fires through education (by 9/30/06).</b>
<b>Strategic action</b>	<b>Replant native species over the next 10 years.</b>
<b>Objective</b>	<b>Increase percent coral cover/ community structure (histogram viable population – coral recruitment)/ increase diversity (number of species) by 2018</b>
<b>Objective</b>	<b>Positive change in the coverage/occurrence/abundance of indicator species (TBD, eg. soft corals) in coral reef habitat in Piti Bomb Holes Marine Preserve by 2015.</b>
<b>Strategic action</b>	<b>Pass draft stormwater control rules and regulations users manual within 6 months.</b>
Action step #1	Conduct public hearing as part of Triple A process.
Action step #2	Conduct public hearing as part of Triple A process.
Action step #3	Combine the above workshop with a workshop on Guidelines for Development and tie both to some sort of certification to ensure better turnout(100-150 people, \$5K from GCMP)
Action step #4	Combine the above workshop with a workshop on Guidelines for Development and tie both to some sort of certification to ensure better turnout(100-150 people, \$5K from GCMP)
Action step #5	Conduct workshop on rules and regulations and users manual for Guam Contractor’s Association, Chamber of Commerce, GHIA, PEALS by 9/30/06 (lead: Adrienne Loerzel)
Action step #6	Conduct workshop on rules and regulations and users manual for Guam Contractor’s Association, Chamber of Commerce, GHIA, PEALS by 9/30/06 (lead: Adrienne Loerzel)
Action step #7	Engage Mayor’s office to notify GEPA/DPW about violations/educate staff.
Action step #8	Engage Mayor’s office to notify GEPA/DPW about violations/educate staff.
Action step #9	Incorporate implementation of “green infrastructure” into above workshops (lead: David Limtiaco)
Action step #10	Incorporate implementation of “green infrastructure” into above workshops (lead: David Limtiaco)
Action step #11	Train inspectors on new rules and regulations.
Action step #12	Train inspectors on new rules and regulations.
<b>Strategic action</b>	<b>Improve existing infrastructure for residences and roads in Piti village by 2008.</b>
Action step #1	Explore a formal mechanism (i.e. USCRTF resolution, letter from Governor, etc.) for engaging Department of Transportation on tying Highway funds to compliance with reg. (lead: Vangie Lujan, Adrienne Loerzel, Trina Leberer)
Action step #2	Explore a formal mechanism (i.e. USCRTF resolution, letter from Governor, etc.) for engaging Department of Transportation on tying Highway funds to compliance with reg. (leads: Vangie Lujan, Adrienne Loerzel, Trina Leberer)
Action step #3	For residences, install “rain garden” at Piti Mayor’s Office as pilot/demonstration site and engage KUAM, other media to do feature (lead: David Limtiaco)
Action step #4	For residences, install “rain garden” at Piti Mayor’s Office as pilot/demonstration site and engage KUAM, other media to do feature (lead: David Limtiaco)

#	Objectives, Strategic Actions and Action Steps
Action step #5	Train DPW staff (building permit staff, inspectors, engineers) in stormwater control and inspection (lead: GCMP, \$15K)
Action step #6	Train DPW staff (building permit staff, inspectors, engineers) in stormwater control and inspection (lead: GCMP, \$15K)
Strategic action	Implement "green-belting" for all new developments in Piti Watershed within 6 months.
Objective	<b>Reduce number of negative impacts of recreational users (coral breakage, kicking up sediment, and trampling sea grass) on coral reef habitat and seagrass in Piti Bomb Holes Marine Preserve by 25% by 2015.</b>
Strategic action	Conduct carrying capacity study in Piti MP by 9/30.
Strategic action	Conduct 2nd annual Coral Reef Recreational Users Workshop for 300 people by end of CY 06.
Strategic action	Conduct research on the effects of human-associated chemicals (i.e. estrogen, sunblock, etc.) on coral reef ecosystem in Piti Bomb Holes MP by 2008.
Strategic action	Pass draft rules and regulations for the Marine Preserve Eco-permit Program within 6 months.
Action step #1	Reprioritize workload of natural resource prosecutor (lead: Vangie Lujan)
Action step #2	Reprioritize workload of natural resource prosecutor (lead: Vangie Lujan)
Action step #3	Conduct public awareness campaign (\$10K from GCMP)
Action step #4	Conduct public awareness campaign (\$10K from GCMP)
Action step #5	Conduct public hearing as part of Triple A process (lead: Jay Gutierrez)
Action step #6	Conduct public hearing as part of Triple A process (lead: Jay Gutierrez)
Action step #7	Train enforcement officers on rules and regulations (DAWR in-house)
Action step #8	Train enforcement officers on rules and regulations (DAWR in-house)
Strategic action	Required video/ training program and proof of certification
Strategic action	Increased coordination with Department of Revenue and Taxation
Strategic action	Control of fly-by-nighters dive operators
Strategic action	Intern/ volunteer monitors and educators
Strategic action	Relaunch Kika video campaign
Objective	<b>Reduce turbidity by x percent by 20xx</b>

### 3. Capacity Assessment

An analysis of the local capacity of agency staff was conducted during the workshop and facilitated by the facilitators. The following table describes the results of this analysis. The overall project resource rank was determined as "medium".

**Table 7: Local Capacity Assessment**





#### 4. Conclusion

This report documents the results and products of conservation planning workshops held in January 2008, April 2008, and August 2009. It is intended to be used by the Piti community as a reference for the development of a management plan.

#### 5. List of References

Conservation Action Planning: Excel Toolkit, Version 6.0

Appendix 5. GCRICC Local Action Strategies.

Guam recognizes the important benefits that coral reefs provide, and has developed a diverse assortment of laws, regulations, permits, policies, plans and education programs to serve as mechanisms for management of human activities that impact Guam's coral reefs (Gawel, 1999). Many of these, such as the Environmental Impact Assessment requirements, were not created specifically to protect coral ecosystems but now serve that purpose. Guam continues to expand and improve its management activities to address the threats identified above.

This process has been facilitated by the creation of the Guam Coral Reef Initiative Coordinating Committee (GCRICC) by Executive Order 97-10 in 1997. This committee prioritized the 13 threats identified in the National Coral Reef Action Strategy and selected the top five on which to focus for the next three years. By February 2003, the GCRICC had identified local navigators and drafted local action strategies (LAS) for the prioritized focus areas of land-based sources of pollution, fisheries management, outreach and education, recreational misuse and overuse, and climate change and coral bleaching. These local action strategies have provided a guiding framework for local resource agencies and have facilitated improved management and coordination between agencies. Current conservation management activities can be grouped according to the threat that they address.

The LAS process has also served to broaden the network of stakeholder groups working on coral reef issues. Members of the Guam Watershed Planning Committee (WPC), a group of local, federal, and non-governmental agencies involved primarily with watershed restoration, have become involved in the LAS development and members of the GCRICC now participate in the WPC. In addition, the University of Guam Marine Laboratory and Water and Environmental Research Institute, guided by the needs of the local natural resource agencies, have shifted much of their focus toward management-driven research. Recently, another crucial stakeholder group has been engaged. The Guam Visitors Bureau and the tourism industry are now working with the natural resources agencies to market Guam's coral reefs, and in particular the marine preserves, to the 1 million visitors that come to our island yearly. This new awareness of the economic value of our coral reef resources is beginning to create a sense of stewardship in the industry, absent during the economic boom of the 1980s and recession of the 1990s.

## Current Conservation Management Activities in Guam

### Land-Based Sources of Pollution



- Guam Seashore Protection Plan
- Soil Erosion and Sediment Control Regulations of 2000
- GEPA enforcing Section 401 and NPDES permits
- Watershed Restoration (DoAg)
- Watershed Planning Group
- Permit Conditions to Limit disturbance during coral

### Fisheries Management



- Marine Preserve Areas (GDAWR)
  - Enforcement
  - MPA Campaign -Piti-Pride Tepungan Wide Monitoring
- Creel Surveys (GDAWR)
- School Presentations

### Lack of Public Awareness



- Coral Awareness Campaign
  - Video
  - PSAs
  - Hotel Tent Cards
  - Coloring Books
- Island Pride Campaign
  - Trash Collections
  - Tree Planting
  - Snorkeling

### Recreational Overuse & Misuse



- Informational campaign for Tumon Bay (GCMP/GVB)
- Beach Cleaning Permit Conditions (GVB)
- Eco-Permit for Marine Preserves (GDAWR)
- Pride Campaign for Tumon by GDAWR 2016

## *Local Action Strategies*

### *Land-based Sources of Pollution*

Guam identified land-based sources of pollution as its number one priority focus area in 2002 and local and federal stakeholders have developed a 3-year local action strategy to address this threat. This is also the most difficult threat to address as it involves a large number of stakeholders. This is complicated by the lack of cooperation from some key government of Guam agencies. The goal of the land-based sources of pollution local action strategy (LBSP LAS) is to improve the health of coral reef ecosystems by reducing the amount of sedimentation and pollution from anthropogenic sources such as development, fires, and agriculture in three priority watersheds on Guam.

Completed or ongoing projects identified in the LBSP LAS include: implementation of reforestation and best management practices in partnership with business and community groups on 5 demonstration plots in highly visible and commercially-developed sites in the villages of Tumon and Harmon; completion of a drainage and runoff study plan for reforestation of Ypao Beach Park; hiring of an anti-arson campaign coordinator who will develop workshops, PSAs, posters, and other outreach materials to address the problem of wildland fires in southern Guam; incorporation of USEPA Environmental Monitoring and Assessment Program (EMAP) protocols into a new Guam Water Quality Monitoring Strategy; development of a GIS based erosion potential model for estimating sediment delivery to estuarine and coral reef environments of southern Guam; and reforestation and implementation of erosion-control practices in gullies and ravines of the Fouha watershed.

Several new projects in support of the goal of our LBSP LAS are proposed for funding under the NOAA State and Territory Coral Reef Management Grant, including: developing a digital watershed atlas for Guam that can be used by resource managers, regulators, and contractors in future restoration planning efforts, but also as an educational tool for teachers and the general public; measuring the effectiveness of the previous tree planting and implementation of erosion-control measures in Fouha watershed; evaluation of soft corals as a bioindicator alternative to more expensive semi-permeable membrane devices (SPMDs) to detect persistent contaminants in Guam's coastal waters (this is phase II, phase I was funded under the Guam FY04 Coastal Zone Management Grant); and providing workshops and training to senior managers, engineers, resource managers, regulators, and technical staff in key government agencies and the private sector encompassing concepts such as watershed assessment, planning, restoration, and implementation of innovative methods of riverbank and shoreline protection.

### *Coral Reef Fisheries Management*

Traditionally, coral reef fishery resources formed a substantial part of the indigenous Chamorro community's diet and included finfish, invertebrates, and sea turtles (Amesbury and Hunter-Anderson, 2003). Today coral reef resources are both economically and culturally important. Reef fish, sea cucumbers, sea urchins, a variety of crustaceans, mollusks, and marine algae are all eaten locally. In addition to the cash and subsistence value of edible fish and invertebrates, reef-related fisheries are culturally important as family and group fishing is a common activity in Guam's coastal waters.

Because of the value derived from Guam's coral reef fisheries, both economically and culturally, the threat of overfishing is a serious concern. This threat became more apparent in the 1980's, when inshore fisheries data indicated that the number of hours spent fishing almost doubled, from 161,602 hours in 1984 to 300,861 in 1987, while the average catch per hour for reef fish declined (Sherwood, 1989). Data from recent creel surveys suggest that Guam's fisheries have not recovered from this decrease in the 1980s (Gutierrez, 2004). In response to these declines, GDAWR established five marine preserves in 1997, representing 11% of Guam's coastline (Tumon Bay, Piti Bomb Holes, Sasa Bay, Achang Reef Flat, and Pati Point). The preserves were fully implemented in 2001. Fishing activity is restricted in the preserves with limited cultural take permitted in three of the five areas.

Guam has completed most of the projects identified in our first fisheries management local action strategy (FM LAS), the goal of which was to increase the effectiveness of the 5 marine preserves through greater support of enforcement, public outreach, and targeted research. Completed or ongoing projects identified in the FM LAS include: studies on connectivity of the marine preserves with adjacent areas using larval tracking and telemetry for adult fish; development of marine preserve flyers, posters, PSAs, and continued educational presentations to schoolchildren and the general public, hiring a natural resource prosecutor; implementation of a Conservation Officer Reserve Program; purchase of vehicles, a vessel and trailer, and equipment for law enforcement; drafting rules and regulations for a newly adopted marine preserve eco-permit, which will guide the types of non-fishing activities allowed within the marine preserves; and assessing the role of soft corals as reef fish habitat in Piti Bomb Holes marine preserve.

Currently, the second iteration of the FM LAS is being developed under the guidance of the Assistant Chief at GDAWR and the goal broadened to work toward achieving sustainable use of coral reef fisheries resources. New projects under the FM LAS proposed for funding under the NOAA State and Territory Coral Reef Management Grant include: additional support for the Conservation Officer Reserve Program to further improve enforcement of the marine preserves; development of pocket-sized fishing regulation booklets to increase public awareness of the marine preserves; and an assessment of algal abundance on Guam reef flats in relation to herbivore stocks and nutrients in marine preserves, to provide a better understanding of the relative importance of addressing overfishing versus land-based sources of pollution in restoring coral reef ecosystem health.

*Education and Outreach*

The need to foster an informed population in regard to coral reefs and their importance to the island is critical to the success of any long-term conservation efforts. Thus, the GCRICC identified a lack of public awareness as a priority threat to coral reefs. This threat and the subsequent local action strategy developed to address it offer the greatest opportunity for coordination among the other LAS.

Recently, another crucial stakeholder group has been engaged in the LAS process. The Guam Visitors Bureau and the tourism industry are now working with the natural resources agencies to market Guam's coral reefs, and in particular the marine preserves, to the 1 million visitors that come to our island yearly. This new awareness of the economic value of our coral reef resources is beginning to create a sense of stewardship in the industry, absent during the economic boom of the 1980s and recession of the 1990s. The goal of the education and outreach local action strategy (EO LAS) is to increase awareness of the need for the protection of Guam's coral reefs through improved efforts in the community, in the classroom, and with policy makers.

Completed or ongoing projects in support of the EO LAS include: development of an environmental curriculum (with an emphasis on coral reefs) for Guam's public and private schools; providing a scholarship for a student at UOGML to study coral reef conservation biology; conducting a coral reef managers course at UOGML; and contracting a professional marketing firm to develop and launch a professional, multi-media, coral reef awareness campaign featuring the same clownfish character ("Professor Kika Clearwater") in an educational video for use on incoming flights, movie theater slides, hotel room tent cards, coloring books, advertisements, and street side banners. The second year of funding for the scholarship at UOGML is proposed for funding under the NOAA State and Territory Coral Reef Management Grant.

### *Recreational Use*

There are a number of recreational activities that utilize or impact coral reefs including snorkeling, SCUBA diving, and jet skiing. These activities are enjoyed by the over 1 million tourists visiting the island annually. According to the Guam Economic Development Authority, the tourism industry accounts for up to 60% of the government's annual revenues and provides more than 20,000 direct and indirect jobs. A previous exit survey of Japanese visitors noted that the highest rated optional tour categories were: Parasailing, Health Spas, Underwater Observation, and Jet-skiing (Japanese Exit Survey, 2001). This suggests that marine resources are very important to the tourist industry.

Guam residents enjoy a great many water and reef-related recreational activities as well, and in many cases these recreational users are some of the reefs strongest advocates. The goal of the recreational use local action strategy (RU LAS) is to identify and quantify major recreational uses of Guam's coastal and coral ecosystems, and reduce the negative impacts from recreational uses on these ecosystems. Completed and ongoing projects that fall under the RU LAS include: assessment of the effects of motorized personal watercraft on Guam coral reef ecosystems; development of kiosks containing informational brochures about coral reefs in hotel lobbies and hotel rooms, hiring of an additional Department of Parks and Recreation park ranger; maintenance and repair of shallow water mooring buoys at popular sites; and monitoring the impacts of recreational users on sea grass beds in Piti Bomb Holes marine preserves. New projects under the RU LAS proposed for funding under the NOAA State and Territory Coral Reef Management Grant include: mapping recreational areas of Guam's coast and include information on the type and frequency of use at each site; and identifying appropriate recreational areas for beginning scuba classes.

### *Climate Change, Coral Bleaching, and Disease*

Large-scale coral bleaching events and associated coral mortality are not common on Guam. Since the establishment of the University of Guam Marine Laboratory in 1970, there have been only two recorded bleaching events, characterized by considerable inter-specific variation in bleaching response and little mortality. However, as sea surface temperatures continue to rise, coral bleaching events may become more frequent and more deleterious on Guam. Disease outbreaks threaten reefs worldwide and recent evidence points to an increase in both the number of diseases reported and their severity and geographic extent (Ward and Lafferty 2004).

Our current inadequate state of knowledge prevents the formulation of meaningful management strategies, particularly for poorly studied Indo-Pacific reefs. Virtually nothing is known regarding diseases affecting the coral reefs of Guam, as no baseline assessment of disease prevalence has been accomplished to date. The climate change, coral bleaching, and disease local action strategy (CCCBD LAS) is under the guidance of a new faculty member at UOGML and is not yet fully developed. However, the current goal is to facilitate the inclusion of climate change, coral bleaching, and disease in monitoring and management plans and activities on Guam's coral reefs. There are currently no completed or ongoing projects. Two projects submitted under the NOAA State and Territory Coral Reef Ecosystem Monitoring Grant will support this LAS: monitoring of coral bleaching, among other parameters at permanent monitoring sites; and assessment of baseline levels of coral disease.

## **Guam WAP 2018**

Both are components of a long-term, comprehensive coral reef monitoring strategy that is currently being developed by the Guam Coral Reef Monitoring Working Group.

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