

GUAM

STATE WILDLIFE ACTION PLAN

2025

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Acronyms and Abbreviations

AAFB – Andersen Air Force Base
ACOE – Army Corps of Engineers
AFWA – Association of Fish and Wildlife Agencies
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
DAWR – Division of Wildlife Resource
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
DAWR – 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
SWAP – State Wildlife Action Plan
HERA – Haputo Ecological Reserve Area
NCTS – Naval Computer and Telecommunications Station
NGO – Non-Government Organization
NOAA – National Oceanic and Atmospheric Association
NRCS – Natural Resources Conservation Service, USDA
OIA – Office of Insular Affairs, Department of the Interior
PL – Public Law, Government of Guam
SGCN – 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 Center
UOG CIS and SG ICL – University of Guam Center for Island Sustainability and Sea Grant Island Conservation Lab
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

The Guam State Wildlife Action Plan (SWAP) serves as the island's strategy to conserve its native biodiversity and sustain healthy ecosystems for present and future generations. The primary goal of the SWAP is to promote the recovery and sustainable use of Guam's priority native species by addressing conservation needs across terrestrial, marine, and freshwater environments. As required for continued funding through the State Wildlife Grant Program (SWGP), the revised 2025 Guam SWAP outlines priority actions for species of greatest conservation need (SGCN) and their habitats.

The revision process reflects a collaborative effort led by the Department of Agriculture (DOAG) Division of Aquatic and Wildlife Resources (DAWR), hereon referred to as the Department, and the University of Guam Center for Island Sustainability and Sea Grant Island Conservation Lab (UOG CIS and SG ICL). Local agencies, researchers, traditional knowledge holders, and conservationists were consulted through meetings and outreach events. Gaining public input and working with partners in the Commonwealth of the Northern Mariana Islands (CNMI) were also key practices throughout this process. These efforts shaped the identification of SGCN, threats, and conservation actions and priorities. As a result, the plan reflects community values, ecological and economic importance, and cultural relevance.

The 2025 revision builds upon the 2015 SWAP through incorporating community input and scientific data. While most information and structure were retained from the previous plan, key updates include:

- Revised criteria for species inclusion into the SWAP
- Expanded SGCN list to include culturally and ecologically significant species
- Updated species information and conservation actions
- Extensive public survey to garner community feedback
- Integration of landscape-scale conservation across the Mariana Islands

The revised Guam SWAP identifies a diverse range of SGCN across terrestrial, marine, and freshwater ecosystems. Species selection was based on conservation status, rarity, threats, ecological function, cultural or economic significance, and local and regional conservation priorities. Each species has a species account (Chapter 3) which reflects scientific data and expert opinion. These accounts describe the species' historic and current status, habitats, threats, and recommended conservation actions.
Guam's SWAP identified 128 species including:

- 60 terrestrial species (mammals-2, birds-14, reptiles-5, arthropods-1, snails-3, insects-2, and plants-33),
- 12 freshwater species (fish-4, eel-1, crustaceans-3, snails-2, and plants-2), and
- 56 marine species (marine mammals-14, fishes-14, skates & rays-3, echinoderms-6, corals-3, arthropods-1, gastropods-1, clams-4, reptiles-2, marine plants-8).

SGCN are found across Guam's varied habitats ranging from pristine limestones forests to wetlands, freshwater streams, savannas, and coral reefs. The health of these ecosystems is increasingly vulnerable to threats such as:

- Invasive species, particularly the brown treesnake (kulepbla, *Boiga irregularis),* hereon referred to as BTS, invasive plants, ungulates, and insect pests.
- Sedimentation and pollution affecting freshwater and marine systems.
- Habitat loss and fragmentation caused by development and improper land use.
- Lack of legal regulation and enforcement.
- Climate change effects, including ocean acidification and increased frequency and severity of weather events

These concerns emphasize the need to link species recovery efforts to the protection and restoration of key ecosystem types. The 2025 SWAP outlines conservation strategies in major categories:

- Conservation planning – Integrate species and habitat recovery into land-use planning
- Habitat management and restoration – Control invasive species, restore degraded lands, and support the protection of natural resources
- Monitoring and research – Fill data gaps and track conservation outcomes
- Education and outreach – Promote stewardship and increase public awareness

- Collaborative partnerships – Strengthen coordination among local agencies, community groups, and regional partners across the Mariana Islands

The strength of Guam's SWAP is the Department's ability to secure funding from the U.S. Congress through SWGP funding to carry out its plans. Acceptance of SWGP funding was contingent on the development of the initial SWAP (formerly the Guam Comprehensive Wildlife Conservation Strategy), and completion of the revised 2025 SWAP will qualify the Department for continued funding under this program. The success of the plan will rely on continued collaboration and adaptive management.

Implementation will be led by DAWR with aligned efforts from other local and federal agencies, academic institutions, and regional conservation networks. The Department will prioritize applying the SWAP's framework for monitoring the progress of conservation actions, evaluating effectiveness of these goals, and adjusting approaches as new information and challenges arise. Protecting Guam's unique biodiversity is a responsibility of all who call the island home. The 2025 Guam SWAP offers a roadmap for coordinated, science-based, and community-driven conservation. It invites all residents, agencies, and community groups to join in safeguarding Guam's natural heritage for the benefit of future generations and the resilience of the island's ecosystems.

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 SWAP meets the eight required elements. Table 1 details where each element was addressed in the 2025 Guam SWAP.

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, is indicative of the diversity and health of the state's wildlife.

Element 2. Descriptions of **locations and relative condition of key habitats** and community types are essential to conservation of species identified.

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.

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

Element 5. Proposed **strategies 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.

Element 6. Descriptions of **procedures to review** the Guam SWAP at intervals not to exceed 10 years.

Element 7. Plans for **coordinating, to the extent feasible, the development, implementation, review, and revision** of the Guam SWAP 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.

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

Table 1: Locations of the 8 Required Elements

Required Element	Location(s)
Element 1 – Distribution and abundance of species	
Sources of information	Chapter 3
Abundance and distribution	Chapter 3; Species Accounts; Tables 9 & 11
Low and declining populations	Chapter 3; Species Accounts; Tables 9 & 11
Process for SGCN selection	Chapter 3; Table 9
Element 2 – Locations and relative conditions of key habitats	
Sources of information	Chapter 2
Abundance and distribution	Chapter 2
Element 3 – Problems that may adversely affect species and priority actions needed	
Sources of information	Chapter 4
Detailed threats	Chapter 4
Threats relevant to species and habitats	Chapter 4
Research and survey efforts needed	Chapters 4, 5, and 6
Element 4 – Conservation actions to conserve species and habitats and priorities for implementing actions	
How conservation actions address threats	Chapters 2, 5
Descriptions of conservation actions	Chapter 5; Species Accounts; Table 11
Linking conservation actions to identified threats	Chapter 5; Species Accounts; Table 11
Opportunities for collaboration with partners	Chapter 5; Species Accounts; Table 11
Research and survey efforts needed	Chapter 5; Species Accounts; Table 11
Element 5 – Proposed plans for monitoring species and habitats	
Plans for monitoring SGCN and habitats	Chapter 3; Chapter 6
Monitoring of conservation action outcomes	Chapter 6
Explanation if monitoring not applicable	Chapter 6
Monitoring at multiple levels	Chapter 6
Use of existing systems to assess conservation actions	Chapter 6
Consideration of geographic scale	Chapter 6
Adaptive management	Chapter 6
Element 6 – Procedures to review the Guam SWAP	
Review process	Chapter 8
Element 7 – Coordination with other conservation agencies	
Involvement of federal and local agencies and Indian tribes	Chapter 7
Continued involvement of agencies and tribes in implementation, review, and revision	Chapter 7
Element 8 – Public participation	
Public involvement in SWAP development	Chapter 7
Continued public involvement in implementation and revision	Chapter 7; Chapter 8

Chapter 1: Introduction

Geographic and Climatic Setting

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 land area of 560 km^2 . The northern portion of the island is a limestone plateau, rising nearly 200 meters above sea level in some places, and holds the northern Guam lens aquifer (Lander, 1994). 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) and holds the island's highest point at Mt. Lamlam with an elevation of 406 meters. This region is predominantly covered by savanna complexes, grasslands and ravine forests, with wetlands also comprising an important habitat type (Fosberg, 1960).

Guam has a tropical climate with average daily temperatures ranging from 24-30°C (75-86°F). The average annual rainfall is 84-116 inches (2133-2946 mm) (USGS, 2015). The climate is marked by two distinct seasons: a wet season from June to November and a dry season from January to April. December and May serve as transitional months. The wet season is characterized by high humidity and weak southerly to southeasterly winds, while the dry season brings lower humidity and northeasterly trade winds (Engbring & Ramsey, 1984). Humidity levels range from 65-90%. Typhoons can occur throughout the year but are more frequent during the wet season (National Oceanic and Atmospheric Association [NOAA], 1982).

The El Nino Southern Oscillation (ENSO) is the primary driver of climate variability in the Pacific with events causing significant fluctuations in rainfall, wind patterns, air and sea surface temperature, sea levels, and cyclone activity, with impacts across the Central and Western Pacific Islands (Fletcher et al., 2012; Keener et al., 2012; Romine et al., 2013; Crausbay et al., 2014; Frazier & Giambelluca, 2017; Brainard et al., 2018; Herring et al., 2018).

Climate Change and Its Impacts

Changes in Guam's seasonal climate patterns, particularly those driven by natural variability such as ENSO, already pose threats to the island's physical, ecological, cultural, and economic systems. These include impacts on coral reefs, aquatic and terrestrial wildlife, and the habitats and ecosystem services provided. To address these challenges effectively, the Department must be equipped with actionable scientific research to understand the potential impacts of both natural variability and anthropogenic climate change. This knowledge is vital for developing and implementing effective adaptive management strategies that safeguard key assets such as land, water, fish and wildlife, plants, and the broader ecosystems upon which island communities depend.

In addition to the natural climate, Guam is increasingly affected by anthropogenic climate change. Across the Pacific, there is clear evidence of rising air and sea surface temperatures, sea-level rise, increased frequency and duration of droughts, saltwater intrusion into freshwater lenses, shifting habitat composition and species distributions, and altered ocean chemistry. Additional indicators include ocean acidification, shifting rainfall patterns, and altered wind and wave regimes. These changes present further challenges for small island ecosystems, including:

- Increased coastal flooding and shoreline erosion (Yeo et al., 2023)
- Increased intensity of tropical storms (Yeo et al., 2022)
- Loss and migration of forest ecosystems (Grecni et al., 2020)
- Elevated extinction risk for native species (Grecni et al., 2020)
- More frequent coral bleaching events (Cipolla, 2021)
- Intensified threats to marine ecosystems (Grecni et al., 2020)

These changes contribute to more extreme weather events, affecting ecosystems and species distributions. The implications are far-reaching, threatening freshwater availability, food security, wildlife habitats, human health and infrastructure. Without proactive adaptation, these impacts are expected to intensify in

the coming decades.

Rich Species Diversity

Under natural conditions, Guam hosts 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 & Glass, 1991; Engbring & Fritts, 1988). Three native mammals are also known to Guam, the fanihi (*Pteropus mariannus mariannus*, Mariana fruit bat), *Pteropus tokudae* (little Marianas fruit bat) and the fanihi liyang (*Emballonura semicaudata rotensis*, Pacific sheath-tailed bat), although the fanihi 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 in Guam with four snails listed as endangered under the Endangered Species Act (ESA; 1973) (*Samoana fragilis, Partula radiolata*, *Partula langfordi,* and *Partula gibba)*. There are more than 320 native plant species with fifteen being ESA-listed species. In addition, Guam holds more than 5,000 known marine species (Paulay, 2003a). Guam's SWAP identified 128 species including 60 terrestrial species (mammals-2, birds-14, reptiles-5, arthropods-1, snails-3, insects-2, and plants-33), 12 freshwater species (fish-4, eel-1, crustaceans-3, snails-2, plants-2), and 56 marine species (marine mammals-14, fishes-14, skates & rays-3, echinoderms-6, corals-3, arthropods-1, gastropods-1, clams-4, reptiles-2, marine plants-8).

Threats to Biodiversity and Ecosystems

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 unsustainable economic development, poor land management practices, overexploitation, and invasive species. High demand for imported goods increases the number of invasive species entering the island, emphasizing the need for effective biosecurity measures. Anthropogenic threats are exacerbated by the increased frequency of natural disasters and other effects of climate change. 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 SGCN 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 CHamoru culture are dependent on the successful recovery and sustainable use of the island's natural resources.

Habitat Types and Management

Guam supports a wide range of terrestrial and aquatic habitats, despite its small size. The entire island is locally and federally designated as a coastal zone, enabling comprehensive watershed-based management. This designation allows resource managers to plan, fund, and implement conservation actions that support freshwater and coastal systems throughout the island.

Terrestrial habitat types include limestone and ravine forests, savanna complexes, grasslands, and strand vegetation. There are numerous freshwater systems, including 100 named rivers, streams, and several man-made reservoirs mainly constructed after World War II.

The southern half of the island is characterized by volcanic terrain and holds most of Guam's rivers and streams. A mountain ridge running along the western coast forms small, steep watersheds that drain westward, while the eastern coast features broader floodplains and larger rivers. Of Guam's 100 named rivers and streams, 46 discharge into the ocean, with Talo'fo'fo' River being the largest, draining approximately 72.84 km^2 (~1800 acres) (Best & Davidson, 1981). This area also holds 19 delineated watersheds which typically range from 10,000 to 40,000 acres and serve as a basis for resource management and conservation planning in southern Guam.

In comparison to the south, the northern half of Guam is composed primarily of a permeable limestone plateau. Surface water is scarce in this area due to shallow soils and a lack of clearly defined drainage systems. The Northern Guam sub-watershed, identified in the Guam Clean Water Action Plan (1998), was originally treated as a single unit, but has since been divided into smaller sub-basins as more hydrological data has become available. These sub-basins help resource managers better understand and protect the Northern Guam Lens Aquifer, which plays a vital role in providing water to over 80% of the island's population.

Marine habitats include fringing, patch, submerged and barrier reefs, offshore banks, seagrass beds, and mangroves. Nearshore coral reef and lagoon habitats cover approximately 69 km^2 within 0-3 nautical miles, with an additional range extending beyond 3 nautical miles offshore (Hunter, 1995). Sea

surface temperatures range from 27-30°C, with higher temperatures measured on reef flats and in lagoon areas (Paulay, 2003a).

Department Authority and Mandates

The Department is responsible for the control and regulation of fish and game in and about Guam, including administration of related laws (5 Guam Code Annotated (GCA), Chapter 63, §63102, see Table 2). Fish and game is referred to as "any aquatic animal life" and "all native or introduced species of wild birds or wild animals." The Department is also empowered to regulate endangered species (Title 5 GCA, Chapter 63, §63205) and promulgate a list of endangered species through the Administration Adjudication Act with approval from the Guam Legislature. The Department may also enter into agreements with federal public agencies or individuals for resource administration, research, or management. In cooperation with the Department of Parks and Recreation (DPR) and other government agencies, the Department has authority to control and manage conservation reserves on Guam (Title 5 GCA, Chapter 63, §63401).

Federal Partnerships and Legal Obligations

The Under Section 6 of the Endangered Species Act, the Department has a cooperative agreement with the U.S. Fish and Wildlife Service (USFWS) to protect federally listed species. This agreement facilitates funding and program implementation for endangered species research and recovery. 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) (Table 2).

Related Government Agencies

Other Government of Guam agencies contribute to natural resource management. The Guam Environmental Protection Agency (GEPA), established in 1973 under Public Law 11-191, aims to lead island-wide environmental protection efforts (Title 10 GCA, Chapter 45, §45102). The Bureau of Statistics and Plans (BSP) administers the Guam Coastal Management Plan (GCMP) pursuant to the Coastal Zone Management Act of 1972, guiding the use, protection, and development of land and ocean resources within Guam's coastal zone, defined as all non-federal lands and submerged waters out to three nautical miles.

Funding Sources

The strength of the Guam SWAP will be the Department's ability to secure funding to carry out its plans. Guam has received annual appropriations from U.S. Congress through the SWGP. Acceptance of SWGP funding was contingent on the development of the initial SWAP (formerly the Guam Comprehensive Wildlife Conservation Strategy), and completion of the revised 2025 SWAP will qualify the Department for continued funding under this program. Guam also 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 Fishery Management Council. The Department has also received funding from the Office of Insular Affairs (OIA) for BTS 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 the 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 federal Land Acquisition Grants.

Changes and Additions for the 2025 Guam State Wildlife Action Plan

The Guam SWAP is a living document, intended to be revised every ten years or as needed to reflect new information, priorities, and conservation needs. The goal of the 2025 SWAP is to promote the recovery and sustainable use of Guam's native aquatic and terrestrial species, particularly those of greatest conservation need.

This revision builds upon the 2015 plan with several key updates. Methods for identifying SGCN, evaluating threats, and prioritizing conservation actions have been revised and integrated into this revision. These improvements aim to provide a more consistent and effective framework for assessing species status and inclusion in the SGCN to guide conservation strategies.

Climate change is now addressed more explicitly in this plan. Anticipated impacts to Guam's flora and fauna, ecosystems, and natural resources require focused, adaptive management. This revision includes a commitment to collaborate with partner agencies to investigate and monitor the effects of climate change on biological resources.

Species accounts have also been updated with new information, resulting in changes to the objectives, actions, and conservation statuses for several species, including the forest birds, *Hypolimnas octocula marianensis* (Mariana eight-spot butterfly), and marine fish (see Chapter 3: Species Accounts). In addition, native plants used for traditional medicine are now included. Their inclusion supports the research and protection of these valuable species to reflect the importance of safeguarding Guam's cultural healing practices. Several marine species were added to this 2025 iteration, such as six balåti (sea cucumber) species and three manta ray species. Candidate species under consideration, especially those with minimal information, will be evaluated for future inclusion. Taxonomic updates have been made for a few bird species. Only one SGCN was removed in this revision and ongoing assessments will help refine the list by identifying priority species based on current and available research. The 2025 SWAP also includes landscape-scale conservation across the Mariana Islands through collaboration between the Guam and CNMI teams. In these efforts, conservation managers identified priority species in the region to establish common goals to support species' habitats, populations, and movement throughout the islands.

Finally, new strategies to improve partner engagement and community involvement are outlined in Chapter 8. Although participation in this SWAP iteration was much higher than that of previous versions, the Department is committed to continue building meaningful partnerships with technical experts, community members, cultural groups, students, and partner agency representatives to ensure the SWAP remains a relevant and effective conservation tool.

Table 2: Authorities Related to Natural Resource Management in Guam

Authority of Law	Summary
Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884)	Affords protection of federally listed species.
Guam Endangered Species Act, 5 GCA 63208, PL – 15-36	Law allows for the adjudication of an endangered species list for Guam.
Migratory Bird Treated Act of 1918 (16 U.S.C.)	Affords protection for specifically listed migrant species.
Sikes Act of 1960	Promotes effectual planning, development, maintenance, and coordination of wildlife, fish, and game conservation and rehabilitation in military reservations.
USFWS Cooperative Agreement	An agreement that allows Guam to implement endangered species recovery programs.
Game, Forestry and Conservation, 5 GCA, Chapter 63, PL 6-85	Law describing the authority of the Department of Agriculture
Protection of Wild Animals, 5 GCA 63121	Lists species that are considered protected.
Fish, Game, Forestry and Conservation, 5 GCA, 63101-63117	Laws protecting Guam's fish resources.
Concurrent Jurisdiction	Organic Act of Guam
Lacey Act of 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.
Marine Mammal Protection Act of 1972	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.
Convention of International Trade of Endangered species (CITES)	An international agreement between governments that ensures international trade in specimens of wild animals and plants does not threaten their survival.

Chapter 2: Key Habitats, Conservation Lands, and Marine Preserves (Element 2)

Terrestrial Habitats

Prior to their decline, many of Guam's terrestrial native species were found more readily throughout the island and in a variety of habitats (Jenkins, 1983). There are eight general terrestrial habitat types found in Guam as described by Fosberg (1960), Stone (1970), and Engbring and Ramsey (1984). Guam's terrestrial habitats have faced degradation since the introduction of babuen hålom tåno' (*Sus scrofa,* feral pigs) (Intoh, 1986) and binådu (*Cervus mariannus,* Philippine deer) (Conry, 1988) in the late 1600s and 1770s respectively, as these non-native animals disrupt forest regeneration by trampling and uprooting native plants, consuming seedlings, and facilitating the spread of invasive species. The introduction of the BTS has resulted in the loss of many of Guam's native species of birds and lizards and the fanihi (Savidge, 1987; Rodda et al., 1997; Wiles, 1987a), drastically reducing the number of key pollinators and key dispersers. This decline has also contributed to reduced regeneration and diversity of native vegetation. These biological pressures are exacerbated by the ongoing loss and fragmentation of habitat due to urban development, military expansion, and infrastructure projects, which further isolate remnant native habitat patches. Climate change adds another layer of stress through increased temperatures, and more frequent extreme weather events, which can intensify erosion, alter plant flowering and fruiting cycles, and create conditions favorable for invasive species to expand into areas once dominated by native vegetation.

Limestone forests, scrub (secondary forest), mixed woodland, ravine forests, strand, and beach strand are important habitats for all of Guam's native avian, invertebrate, reptilian, and mammalian species. Grasslands, coconut groves, and open fields provide habitat to native species, though to a lesser degree. The following describe the key habitat types, their locations, and current statuses important to the management and conservation of Guam's SGCN (Element 1). A summary of the status of these habitats and their conservation actions is provided in Table 3.

Limestone forest. Limestone forests typically grow on uplifted coral reef limestone formations. The terrain is rugged with sharp karst outcrops, sinkholes, and caves. Unique plant communities have adapted to thrive in these conditions. Limestone forests have a multi-layered canopy. The canopy is composed of large native tree species such as *Ficus* sp., ifit (*Intsia bijuga,* ifil), dokduk (*Artocarpus mariannensis*, seeded breadfruit) and yoga (*Elaeocarpus joga*, blue marble tree), 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. There are several distinct limestone forest types including *Artocarpus-Ficus, Mammea, Cordia, Merrilliodendron-Ficus*, and *Pandanus* (Fosberg, 1960; Donnegan et al., 2002).

Limestone forests are found on the northern limestone plateau and on large limestone outcroppingsin southern Guam. Donnegan et al. (2002) combined scrub forest and limestone forest into a single category, reporting that together they made up 34% of Guam's available habitat. As a result, the actual extent of true limestone forests remains unknown. Vegetation mapping in 2005 indicated that only 13% of forested areas were composed of limestone forests (Brown, 2005). Most recent vegetation mapping reported that limestone forests made up only 10% of forested areas (Amidon et al., 2017). Increased development and quarrying for limestone aggregate have caused much of this decline. Habitat loss from these activities continues to reduce limestone forest cover. The structure of the remaining limestone forests has been altered by binådu and babuen hålom tåno', which browse on seeds and seedlings, suppressing regeneration (Wiles et al., 1999). These ungulates also harm the integrity of the forest in many other ways (e.g. stripping bark from adult trees, causing erosion by wallowing, consuming bulbs of native orchids, etc.). Invasive plant species such as *Vitex parviflora* (molave), an introduced species from the Philippines, and *Mikania micrantha* (climbing hemp vine) alter forest structure by outcompeting native trees and understory plants, forming dense thickets that block light and prevent native species regeneration. Over time, this shifts forest composition toward monocultures of invasive plants, reducing biodiversity and degrading overall ecosystem function. Large-scale alterations of the limestone forests, whether from human activities

like pesticide use and bulldozing, or storms such as Typhoon Mawar, are exacerbated by the presence of feral ungulates and invasive plants. Typhoons, especially in areas already degraded by invasives, accelerate canopy loss and erosion. The combined effects of these threats continue to drive the decline and poor health of Guam's limestone forests. Without intervention and restoration, this habitat type will be altered so severely that it will not be a suitable habitat for re-introduction of SGCN. This habitat is vital for almost all of Guam's native forest birds, snails, insects, lizards, and the fanihi. These species developed ecological relationships over thousands of years with native trees and understory plants, relying on them for food, shelter, and nesting sites. These species often depend on specific native plants for fruit, nectar, leaves, or habitat structure, and in turn, some native plants rely on birds and fanihi for seed dispersal and pollination. This co-evolution means that the loss of limestone forests disrupts these long-standing ecological relationships, putting many native species at greater risk.

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 & Ramsey, 1984). While some native species typical of mature limestone forests persist, scrub forests often have a higher abundance of invasive plant species and lack the structural complexity and canopy closure of intact limestone forests. In northern Guam, this habitat is dominated by *V. parviflora*. Other introduced species that may be found include tangåntangån (*Leucaena leucocephala)*, and lemon de china (*Triphasia trifolia)*. However, within this forested area native plants can be found as understory cover including amahåtyan (*Pipturus argenteus,* false stinger), pengua (*Macaranga thompsonii)*, fagot (*Ochrosia oppositifolia),* kaffo' (*Pandanus tectorius),* gulos (*Cynometra ramiflora),* and other species.

Examples of scrub forest are the Tarague Plateau and Northwest Field region in northern Guam. Donnegan et al. (2002) combined scrub forest and limestone forest into a single category, reporting that together they made up 34% of Guam's available habitat. Brown (2005) later reported that this habitat made up 22.62% of the land cover in Guam. Amidon et al. (2017) reported that scrub forest made up 8% of the land cover on Guam. Examples of these forest types tend to be rare and mixtures of primary and secondary species. Historically, these areas (Tarague and Northwest Field) werecleared for military purposes and repeated destruction by typhoons have played a major role in altering the species composition of these habitats because of the presence of invasive species. Invasive tree species are often not adapted to typhoons and will fall over during typhoons but regrow in an uncontrolled manner after.

The structure of scrub forests is being altered by many of the same factors affecting limestone forests (feral ungulates, invasive plant species, and typhoons). In the absence of ungulates and invasive plants, scrub forest regeneration into primary limestone forest habitat might one day be possible, although this would be limited by the lack of seed dispersers. Intervention is needed to ensure the continued existence of this habitat type. Although this habitat type contains many invasive plant species, it still supports numerous native limestone forest plants that provide resources for Guam's native forest birds, snails, insects, lizards, and fanihi. With targeted forest restoration, including the removal of invasive plants and replanting of native species, these areas can be restored over time to functioning limestone forest.

Developed vegetation. Areas of developed vegetation comprise about 11% of the available habitat in Guam and include agriculture fields (ranches and cattle pasture) and other open areas including the unpaved areas around runways and parks (Engbring & Ramsey, 1984). These habitats contain a variety of grass species including *Paspalum conjugatum, Panicum maximum, Chrysopogon aciculatus,* and *Sorghum halepense.* Scrub forests surround this habitat type in most places within the central portion of northern Guam (Fosberg, 1960). While open field habitats are the result of human disturbance, those that are mowed and maintained can provide important habitat for migratory birds including plovers and sandpipers. Unfortunately, these fields also provide ideal habitat for invasive weeds to take hold.

Coconut grove. Coconut groves consist of stands of abandoned coconut plantations (Engbring & Ramsey, 1984). A coconut grove consists of 15-25m high trongkon niyok (*Cocos nucifera,* coconut tree) with an understory comprising a variety of native and non-native shrubs and young trongkon niyok. Coconut groves make up about 1% of the available habitat in Guam (Amidon et al., 2017) and are more common along sandy coastal areas such as Tarague, Tanguissan, Ritidian, Urunao and Pajon Basins. Small patches of trongkon niyok are found throughout the northern plateau and most cover less than 5 ha of area.

Trongkon niyok is culturally significant and ecologically valuable in Guam, providing traditional food, medicine, materials, and habitat for wildlife. As a coastal and lowland species, coconuts also help stabilize shorelines

and support nutrient cycling in open forest habitats. Recognizing its ecological and cultural importance, trongkon niyok has been included as a SGCN. However, trongkon niyok are susceptible to termites and *Oryctes rhinoceros* (coconut rhinoceros beetles) (CRB). Although this species was once the second most abundant tree on island (following the endemic cycad), many coconut and ornamental palms in Guam have been severely damaged or killed by CRB. There is no official estimate of the proportion of trongkon niyok killed but die-offs are occurring at an alarming rate (A. Moore, *pers. comm.*). Coconut groves and mixed palm stands, where trongkon niyok still persists, are also experiencing ecosystem degradation from extensive rooting and soil disturbance by babuen hålom tåno', which further limits regeneration of niyok seedlings and associated vegetation. These altered habitats, while degraded, are still used by native species such as the sihek (*Todiramphus cinnamominus cinnamominus*, Guam kingfisher), ko'ko' (*Hypotaenidia owstoni,* Guam rail), and CHichirika/naabak (*Rhipodura rufifrons uraniae,* Micronesian rufous fantail), which historically depended on trongkon niyok strands for foraging and shelter. Protecting and restoring these habitats, including controlling babuen hålom tåno' and CRB, is critical for maintaining the ecological and cultural role of trongkon niyok in Guam.

Broken forest or *Mixed woodland.* Mixed woodland is a habitat similar to limestone and ravine forest but dissected by many small, open or scrubby fields (Engbring & Ramsey, 1984). This habitat type contains both native and naturalized vegetation having a much lower, more open canopy unlike mature limestone forest containing*Neisosperma, Artocarpus, Pandanus, and* trongon niyok (Jenkins, 1983). Like open fields, broken forests are a result of human disturbance occurring in northern and central Guam (Jenkins, 1983; Enbring & Ramsey, 1984). Broken forests take up an estimated 37% of land area in Guam (Amidon et al., 2017). This number consists of percentages of bamboo thicket, tangantangan thicket, *Acacia* forest, *Vitex* forest, *Casuarina* forest, mixed grass and herbaceous areas, and mixed introduced forest.

Ravine forest. Ravine forest is a patchy forest type found in narrow, steep-sided ravines. Its structure is highly variable but generally consists of a tangled mix of low-stature trees, shrubs, and dense brush, with an irregular canopy only a few meters above the ground. Vegetation tends to be denser around the edges of ravines, transitioning to a slightly more open, taller forest in the deeper ravine bottoms where a tree layer and shrub/herb layer may be distinguishable. Due to the limited extent of these habitats, their overall species diversity is generally lower than that of limestone forests. Ravine forests serve as important refuges for native plants and wildlife in otherwise degraded landscapes. This habitat type tends to follow topographic contours such as river valleys and depressions and is only found in southern Guam. Ravine forests are highly degraded and contain many non-native species including pugua (*Areca cathecu,* betelnut) and *heterospathe elata* (palma brava). Native plant species that can be found in these forests are nunu (*Ficus prolixa,* banyan*),* åbas duendes *(Phyllanthus mariannensis),* pågu (*Hibiscus tiliaceus,* sea hibiscus*),* kaffo', påhong (*Pandanus dubius),* and åhgao (*Premna serratifolia,* false elder).

Historically, ravine forests were more abundant but have been reduced in both quality and extent due to damage from binådu, babuen hålom tåno', fire, and invasive plant species. Feral ungulates browse on seedlings and young plants, preventing regeneration and disturbing the soil, which accelerates erosion on steep ravine slopes. Fires, often human-caused, open the forest structure, allowing invasive grasses and shrubs to establish and dominate. Invasive plant species further alter forest composition by outcompeting native plants, choking understory growth, and preventing natural recovery. These combined pressures have led to the degradation and fragmentation of Guam's ravine forests. This habitat type is estimated to take 6% of land cover in Guam (Amidon et al., 2017). There are few native ravine forests 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 outplanting *Acacia* spp. in the badlands, areas where much of the organic topsoil had eroded. *Acacia* are fast-growing, nitrogen-fixing trees that stabilize soils and improve soil fertility, creating conditions suitable for later native species establishment. In August 2005, FSRD expanded restoration efforts to include outplantings of several native species to reclaim these areas. Restoration of these degraded lands directly benefits SGCN by increasing available habitat, supporting food resources, and restoring ecological processes essential for native birds, bats, snails, and other species. Over time, these efforts aim to transition restored areas from early successional stands into functioning native forests.

Savanna or Grassland. Guam's savanna ecosystems are composed of several distinct plant communities that occupy specific habitats based on Fosberg (1960). These include the *Miscanthus* community,

dominated by tall grasses in less degraded areas; the *Dimeria* community, found on drier, open slopes; the *Phragmites* (reed) community, which grows in wetter low-lying areas; and the weed community, which establishes after disturbances like fire or clearing. A key feature of the savanna is the erosion scar community, found on exposed, degraded slopes. These scars are first colonized by *Dicranopteris lineraris* (Old World forked fern), a fern that spreads across bare soil using horizontal rhizomes. Shrubs such as *Myrtella bennigseniana* (Bennigsen's myrtella), *Wikstroemia indica* (tie bush), nanåso (*Scaevola taccada,* beach cabbage), *Geniostoma rupestre* (hangehange), and gafao (*Melastoma malabathricum,* Indian rhododendron), and intermix with sedges and grasses such as *Dimeria chloridiformis* (chloride grass). Two rare and listed species, *Phyllanthus saffordii* and *Hedyotis megalantha,* can be found in this plant community. These plant communities can get colonized by fire-susceptible gågu (*Casuarina equisitifolia*, coastal she-oak) and fire-resistant kaffo' that are typically stunted and in poor condition (Stone, 1970). Although initially sparse, these communities slowly fill in as more plants establish, helping to stabilize slopes and control erosion across Guam's savanna landscapes. Savanna is a habitat type primarily found on hillsides with volcanic soils in southern Guam (Fosberg, 1960). These savanna habitats are frequently entirely burned by uncontrolled (and often deliberately started) grass fires. As a result, marginal trees are killed, allowing sword grass and other associated savanna species to expand their total area (Stone, 1970). While Stone observed colonization of native species, nowadays invasive grasses and non-native weeds and trees fill the gaps. This condition is further exacerbated by off-road vehicles that erode the bare soil especially during the rainy season. Frequent fires in Guam's savanna and forest edges burn away vegetation, leaving the soil exposed and vulnerable to erosion. Without plant cover to protect and stabilize the soil, heavy rains quickly wash the topsoil away, creating bare, degraded areas known as badlands. Over time, these badlands expand as erosion deepens and widens scars, making natural recovery increasingly difficult. The sediment from this erosion is carried by streams and runoff into coastal waters, where it settles on coral reefs. This sedimentation smothers corals, blocks sunlight needed for photosynthesis, and disrupts reef ecosystems, contributing to the decline of Guam's already stressed coral reefs. Currently, savanna covers 16% of land area in the southern region encroaching into surrounding forested areas (Amidon et al., 2017). This habitat is important as a foraging habitat for the yayaguak (*Aerodramus bartschi,* Mariana swiftlet).

Beach strand. Guam's beach strand supports specialized plant communities adapted to harsh coastal conditions. On sandy shores, vegetation typically establishes just behind the active beach, where plants form a mix of woody and herbaceous species on beach ridges and sandy flats. On rocky shores, vegetation is limited to terraces, cliff edges, and crevices, where hardy shrubs and small trees grow directly from pockets of soil on fossilized reefs and limestone formations. The structure and composition of coastal vegetation vary depending on wind exposure, with stunted, wind-shaped plants dominating exposed northern shores, while taller, more diverse plant communities occur on more sheltered western coasts. Beach strand is a habitat consisting of open sand beaches, barren coastal outcroppings, and coastal areas of sparse vegetation generally 2-3 m or shorter in height (Engbring & Ramsey, 1984). In most areas, open sand beaches are bordered with a mix of scrub and limestone forest. The dominant plant of this habitat is *Pemphis acidula* (bantigue), a salt-tolerant species common on the pitted limestone of the windward coast. Hunik (*Tournefortia argentea,* tree heliotrope) and gågu are two other salt-tolerant tree species found along beach strands. Currently this habitat is found in most areas such as Cocos Island, Ritidian, Pati, Tarague and Pajon Basins, and islets around southern Guam. It is estimated to cover less than 2% of land cover around the island (Amidon et al., 2017). Beach strands are important for nesting seabirds, reptiles (nesting turtles and lizards), and invertebrate species.

Strand forest. Strand forest generally grows on the inland border of beach strand habitat (Fosberg, 1960) and is characterized by a mixture of trees at the top of the beach, adjacent to a forest comprising umumu (*Pisonia grandis,* grand devil's-claws), nonak (*Hernandia sonora,* lantern tree), niyoron *(Cordia subcordata,* bird lime tree), puting (*Barringtonia asiatica,* fish poison tree), and gågu along sandy beaches (Stone, 1970). Along the rocky coasts you can find halophytic forests composed of different species, such as gågu, chopak *(Mammea odorata,* mammee apple), talisai (*Terminalia catappa,* tropical almond) and da'ok (*Calophyllum inophyllum,* oil-nut). Strand forest coverage is dependent on location, varying between northern and southern Guam.

Table 3: Summary of Terrestrial Habitats

Habitat	Location	Percent Area of Guam	Relative Condition	Threats	Current Needs	Conservation Actions
Limestone forest	Mostly Northern some Southern	10%	Decreasing	• Ungulates • Typhoons • Loss of pollinators • Development • Invasive plant species • Plant diseases	• Control feral ungulates • Remove and prevent invasive species • Native tree reforestation • Public Awareness • Prevent filling of caves • Prevent human disturbance to caves • Reforest surrounding areas with native species	• Research practicable and effective methods of controlling ungulates • Research practicable and cost-effective methods of eradicating invasive plants • Explore cave ownership with DLM and DPR via MOA • Investigate status of cave habitats, and probability to restore caves for yayaguak translocation in northern Guam
Scrub forest	Northern-Southern	8%	Increasing	• Ungulates • Typhoons • Loss of pollinators • Development • Invasive plant species • Plant diseases	• Control feral ungulates • 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
Developed vegetation	Northern-Central	11%	Increasing	• Invasive plant species	• Remove and prevent invasive species • Continue mowing and lot maintenance • Control feral ungulates	• Research practicable and cost-effective methods of eradicating invasive plants and ungulates
Coconut grove	Northern	1%	Decreasing	• Termites • CRB • Typhoons • Human disturbance • Feral ungulates • Plant diseases	• Implement feral ungulate control • Remove and prevent invasive species • Native tree outplanting • Public awareness	• Research practicable method to eradicate control CRB • Research practicable and effective methods of controlling ungulates • Share studies and findings with public
Broken forest	Northern/ Southern Guam	37%	Stable	• Ungulate damage • Human disturbance	• Implement ungulate control • Native tree reforestation	• Collaborate with Forestry Division and other partners to encourage native reforestation efforts in this habitat type.
Ravine forest	Southern Guam	6%	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

Habitat	Location	Percent Area of Guam	Relative Condition	Threats	Current Needs	Conservation Actions
Savanna/ Grassland	Mostly Southern Guam	16%	Increasing	• Lack of marginal trees • Grassland fires • Ungulate damage • Human disturbance • Erosion • Invasive plant species	• Control/Prevent grassland fires • Prevent off-road vehicle impacts • Improve public awareness • Monitor development and clearing • Biocontrol for invasive plant species • Native tree reforestation	• Employ soil erosion tools at highly susceptible grasslands to minimize loss of habitat • Collaborate with FSRD and other partners • Investigate impact of recreational users and design • Plan to manage grasslands
Beach strand	Northern/ Southern	<2%	Stable	• Human disturbance • Ungulate damage • Invasive plant species • Marine debris	• Implement erosion control • Implement invasive species control • Implement coastal management plans	• Coordinate monthly beach clean-ups 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	Dependent on location (volcanic or limestone soil)	Unknown	• Ungulate damage • Human disturbance • Typhoons • Invasive species infestation	• Control feral ungulates • Remove and prevent invasive species • Prevent further loss	• Investigate feasible methods to remove and control tangantangan growth at these habitats • Reduce ungulate populations in these habitats for native tree outplanting to occur

Freshwater Habitats

Guam has considerably more wetlands and a wider variety of types than any of the other Mariana Islands. All 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 and conservation actions summarized in Table 7.

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. Pågu is usually the major species involved, although the largest tract of swamp forest on the island, the Talo'fo'fo' River Valley, is dominated by langasat (*Barringtonia racemosa,* powder-puff tree) (Fosberg, 1960). Other trees that may be present are kaffo', gulos, ufa' *(Heritiera littoralis,* looking-glass mangrove tree), and pugua.

Freshwater marshes. Natural freshwater marshes are also common, with individual sites varying in size from the Agana Swamp (approximately 0.96 km2 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 2-5m tall (Fosberg, 1960). Other grasses (e.g. *Panicum muticum*), sedges (e.g. *Eleocharis ochrostachys* and *Cyperus* spp.) and the fern langayao (*Acrostichum aureum,* golden-leather fern) are often present but usually less prevalent. Two other natural wetlands important to the pulattat (*Gallinula chloropus guami,* Mariana common moorhen) include the Atantåno and Namo wetlands (Takano, 2003; Ritter & Savidge, 1999).

Reservoirs. Manmade 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 km2 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 pulattat (Stinson et al., 1991) and are very important to migratory species. The Masso Reservoir is a 9105 m^2 (2.25 acre) man-made reservoir located in Piti. DAWR started work in 2005 to restore the reservoir to a state suitable for public fishing and also enhance it as habitat for the endangered pulattat. 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). DAWR received funding several years ago. Work on the site included dredging the reservoir to its original depth and replacing the fishing platform.

Estuarine Areas

Estuarine wetlands occur in areas of tidal intrusion or brackish water and consist primarily of mangroves and the lower channels of rivers. Mangroves are dicotyledonous trees or shrubs found in the coastal area between nearshore shallow marine and terrestrial environments. They consist of all species of plants and shrubs that have evolved physiological and morphological adaptations to live in salty, wet soil. They are defined by their ability to exist in the intertidal zone, which 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 Malesso' and Inalåhan. Although they only total about 0.02 km^2 (5.56 acres), Guam's mangroves are the most extensive and diverse in the Mariana Islands. Species include *Rhizophora mucronata* (mangle hembra, red mangrove), *Rhizophora apiculata* (red mangrove), mangle macho (*Bruguiera gymnorrhiza*, large-leafed orange mangrove), *Avicennia marina* (grey mangrove), ngånga' (*Lumnitzera littorea*, black mangrove), nipa (*Nypa fruticans*, mangrove palm), and lalanyok (*Xylocarpus moluccensis*, cannonball mangrove) (Fosberg, 1960; Moore et al., 1977). Other plants that are sometimes considered a mangrove, or otherwise a mangrove associate, are ufa', pågu and langayao. Records also have noted the presence of *R. stylosa* (mangle hembra, red mangrove), which is extremely similar to *R. mucronata*, with *R. stylosa* just being distinguished by a slightly longer style in the flower. Some genetics studies have also considered the two species to be essentially the same. *Rhizophora* spp. mangroves are the most

common and provide significant habit and coastal protection with large prop roots. Ngånga' in particular seems to experience extremely low germination rates due to insect predation of the seeds and potentially lower pollination from the lack of birds in Guam. Mangle macho also may be suffering lack of pollination and potentially lower reproductive rates, due to the local extinction of the egigi (*Myzomela rubratra saffordi,* Micronesian honeyeater), which pollinates this tree in Saipan. These two species, in addition to lalanyok are of greater concern due to these threats and their smaller populations, with a smaller range of suitable habitat given they tend to exist between the seafront *Rhizophora* mangroves and the terrestrial forest. 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). Nipa is a common indicator plant of river zones with brackish water regimes. Marshes of *Scirpus littoralis* (bulrushes) 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.

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 & 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 Talo'fo'fo' river, drains an area of approximately 72.83 km^2 (Best & Davidson, 1981). Tables 4-6 show data for some of the representative rivers of Guam. Note the greater lengths and watersheds for rivers draining to the east coast.

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 include few native freshwater species, but many marine species including Lutjanidae (snappers), Carangidae (jacks), Hemiramphidae (halfbeaks), and Mugilidae (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, nipa, 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 have become the dominant predator. The 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 4: West Coast Rivers

River	River length	Area drained *	Max flow *	Min flow*	Average flow *
Aplacho	2.805 kilometers	1.3 km2	1690 ft3/sec	.12 ft3/sec	NA
La Sa Fua	4.633 kilometers	2.75 km2	1440 ft3/sec	.12 ft3/sec	4.39 ft3/sec
Humåtak	2.987 kilometers	5.46 km2	7460 ft3/sec	.10 ft3/sec	8.59 ft3/sec

Table 5: Central Rivers

River	River length	Area drained *	Max flow*	Min flow*	Average flow*
Imong	2.088 kilometers	5.05 km2	6100 ft3/sec	.36 ft3/sec	9.52 ft3/sec
Almagosa	2.195 kilometers	3.42km2	2650 ft3/sec	.05 ft3/sec	5.98 ft3/sec
Maulap	2.438 kilometers	2.98km2	2420 ft3/sec	.31 ft3/sec	5.02 ft3/sec

Table 6: East Coast Rivers

River	River length	Area drained *	Max flow*	Min flow*	Average flow*
Ugum	11.460 kilometers	14.92km2	14,700 ft3/sec	2.7 ft3/sec	24.2 ft3/sec
Ylig	11.994 kilometers	16.78km2	4900 ft3/sec	.07 ft3/sec	27.2 ft3/sec
Pago	10.060 kilometers	14.69km2	17,300 ft3/sec	No flow	26.1 ft3/sec

* USGS Pacific Islands Water Center Web Site

Table 7: Summary of Freshwater and Estuarine Habitats

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 local 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 BTS	• Investigate feasible methods to minimize ungulate damage. • Employ BTS and feral cat control mechanisms to protect nesting pulattat
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	Apra Harbor and Southern Guam	0.14%	Stable, expected to decrease	• Address knowledge gaps in understanding potential impacts of invasive species, sea level rise, and other threats • Implement current management plans/ laws • Control invasive species vegetation • Prevent further removal or loss from clearing for development or other purposes • Prevent and monitor for oil spills in Apra Harbor area • Restore damaged areas as needed	• Check aerial imagery and update mangrove extent estimates regularly, assess species trends and ability to reproduce • Monitor at risk species with understudied populations • Prevent clearing and removal by addressing landowner needs and provide resources for stewardship of mangroves • Use sea level rise modeling and other research to determine potential impacts to mangroves and where they might • Establish collaborations, partnerships, and training programs to build capacity for mangrove research and management • Monitor for potential oil spills and work with partners to prevent oil spills • Obtain baseline database for mangrove habitat for adaptive management
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 several ways. They can be classified by the type of cover (e.g. coral, seagrass, unconsolidated sediment, macroalgae) or by reef 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. These marine ecosystems are ecologically and economically important and are directly influenced by land-based activities and watershed processes, further justifying the need for integrated coastal zone management across the island. The marine habitats, along with their relative condition and conservation actions, are summarized in Table 8.

In Guam, reef flats extend over a kilometer from the shoreline to the wave-washed reef margin. The seaward part of the reef, which is 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 tend to be 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 be composed of substrate including pavement, seagrass beds, thickets of *Acropora* (staghorn coral), microatolls of *Porites* (massive corals), sand/rubble fields, and macroalgae. Although all of these habitats are utilized by reef fish species, seagrass beds and staghorn coral thickets are perhaps the most important reef flat habitats for juvenile reef fish, including fish species of concern.

Seagrass beds cover approximately 3.7 km^2 (917 acres) of reef flats in numerous coastal bays around central and southern Guam (NOAA, 2005). Guam's sea grass beds are composed of three species: *Enhalus acoroides* (tape seagrass), *Halodule uninervis* (narrowleaf seagrass), and *Halophila nipponica* (Japanese Halophila) (Lobban & Tsuda, 2003). These sea grass beds range in size from small beds a few meters in diameter to continuous beds nearly one km^2 in size. Guam's 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 Marine Preserve. These seagrass beds are used as foraging grounds by haggan (*Chelonia mydas*, green sea turtle).

Other substantial seagrass resources are found in Inalåhan, East Agana Bay, West Agana Bay, Pago Bay, Piti Bomb Holes Marine Preserve, and Hågat areas. These sea grass beds are important nursery areas for many reef fish species including harvested species like emperors (Lethrinidae), rabbitfish (Siganidae), wrasses (Labridae), and goatfish (Mullidae). Seagrass extent in Guam has been declining, and threats include land-based sources of pollution, climate change, recreational misuse, and overuse from personal watercraft and trampling reef-users.

Lagoon zones are areas enclosed by the low tide line of the inner edge of barrier reef flats. Guam has two areas that can be considered true lagoon zones: Apra Harbor and Cocos Lagoon in Malesso'. The depth in these areas ranges from less than one meter to over 30 m. Apra Harbor has sandy and muddy seafloor habitats between scattered patch reefs and shoals. These patch reefs and shoals boast some of the highest coral cover in Guam, with many areas reaching 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 habitat for many important species, including tanguisson (*Cheilinus undulatus*, Napoleon wrasse/humphead wrasse), which is listed under the Convention of International Trade of Endangered Species (CITES). 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 haggan and haggan karai *(Eretmochelys imbricata*, hawksbill sea turtle).

Channels connect lagoons or reef flats to the outer reef slope. Some examples of this type of reef zone are the Manell and Mamoan Channels in Malesso' 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 many reef fish species. Manell Channel in Malesso' is an important congregating site for haggan and channels in Tumon and East Hagatña are known congregating sites for *Mobula birostris* (oceanic manta ray) and other filter feeders.

The area extending from the seaward edge of the reef flat to the submarine terrace is known as the reef front or fore reef slope. The type of coral communities and the structure of the substrate in this zone are directly tied to the level and frequency of wave action. 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 powerful wave action tend to be dominated by stout, lower-profile, 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 *Porites* species. In sheltered areas, large branching and tabular corals are common. These terraces are frequented by schools of Acanthuridae (surgeonfish) and Scaridae (parrotfish).

The outer reef slope extends down from the submarine terrace and into deep water. They are usually steep (greater than 30º) 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 in shallow waters down to 40-60 m depth, with plate forms dominating the seaward slopes as deep as 112 m. Beyond this depth, gorgonians and soft corals dominate the habitat.

Twilight reefs, also known as lemlem taotao mattingan, are a valuable, yet understudied, marine habitat in Guam's surrounding waters. The "twilight zone" includes both the mesophotic (moderate light) and rariphotic (low light) zones. The rariphotic zone was only recently described and spans the dimly lit depths below the mesophotic zone, but above the complete darkness of the aphotic zone. The mesophotic (~40–130 m; 10–0.1% of surface irradiance) and rariphotic (~130–309 m; 0.1–0.01% of surface irradiance) zones support distinct species assemblages. Biologically, the lower boundary of the mesophotic zone aligns with the deepest occurrence of zooxanthellate corals (corals hosting dinoflagellate symbionts), while the rariphotic zone extends to the maximum depth where calcifying red algae occurs. The four locations with the deepest recorded zooxanthellate corals are all located in the Pacific Ocean, one of which is the MarianaIslands. While specimen-validated records of calcifying red algae reach depths of up to 268 meters in the Caribbean, photographic evidence suggests that these algae may occur at depths exceeding 300 meters in the Pacific. Guam's rich history of deep-sea exploration has led to significant scientific discoveries. However, little attention is given to the twilight zone. To date, exploration of Guam's twilight reefs has been limited to baited remote underwater video station (BRUVS) studies and a few sporadic collections and surveys conducted via dredging and technical diving. While existing BRUVS footage primarily documents fish communities and lacks comprehensive spatial and bathymetric coverage, it reveals distinctive benthic communities, habitats, and previously undocumented organisms in the Mariana Islands.

Exploratory dives using an underwater drone have shown that the twilight zone harbors a diversity of habitats, many new for the Mariana Islands, that harbor a rich biodiversity in invertebrates and seaweeds. Many of the species in the twilight zone are new records or new species to science. Even those of commercial interest, like black corals, have been studied inadequately, and preliminary data indicates that initial species identifications are incorrect, and habitat maps are lacking. Further research is needed to produce accurate species accounts along a depth gradient. Additionally, accurate habitat maps are required for managing valuable natural resources like precious corals. Twilight reefs are threatened by marine heatwaves, water quality degradation, outbreaks of nuisance species, and the introduction and spread of invasive species. The extensiveness of these threats emphasizes the need for research in these understudied areas, along with proper conservation carried out once further management needs are identified.

Table 8: Summary of Marine Habitats

Marine Habitats	Location	Total Area	Relative Condition	Needs	Conservation Actions
Reef Flats	All around Guam, most extensive on the western and southern shores	5260 acres	Stable/ 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 databases 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
Seagrass beds	Largest beds are along the southwest and southern coasts	<900 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 seagrass 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 seagrass beds addressing recreational impacts
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

Marine Habitats	Location	Total Area	Relative Condition	Needs	Conservation Actions
Twilight reefs	Deep-water benthic communities	Unknown	Unknown	• Protection from physical disturbance to preserve habitats • Baseline data on environmental conditions	• Conduct biodiversity surveys across depth gradients to document species composition and identify key species • Assess ecological connectivity between shallow and twilight reefs • Use collected data to inform targeted management strategies for reef conservation and climate adaptation efforts

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 re-established the authority of the Department over Conservation Reserves having joint jurisdiction with the DPR. The development of a Master Plan for Park and Conservation Land (DOAG 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. The Government of Guam has identified four areas for conservation: Anao, Bolanos, Masso, and Cotal Conservation areas. The 2020-2023 Guam Forest System Plan also includes land parcels set aside for conservation purposes. These proposed areas contain habitat that is vital to restoration efforts proposed in the SWAP. Designation of the proposed lands would be beneficial to all species listed in Guam's SGCN.

The Government of Guam owns the Anao, Bolanos, and Cotal Conservation Areas. The land area covered by the three areas is 16.5 km2 (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 SGCN. Historic documents at the Department of Land Management identified a fifth Government of Guam Conservation land in Yigo Guam known as the Y-Piga Conservation area.

The Anao Conservation Area encompasses an area of 2.13km^2 (526 acres) and is located in northeastern Guam. This conservation area contains several habitat types to include limestone forest (75.2%), scrub forest (9.9%), coastal scrub (8.5%), Less than one percent of the area consists of bare rock/soil, developed land, developed vegetation, mixed grass/ herbaceous, and mixed introduced forest. Coastal scrub vegetation can be found in areas below the cliff line along the eastern edge bordering the coast. 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). Fanihi are likely to 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 outplanting by FSRD, partners and community groups, limestone forest could one day be restored within Anao, making it favorable for reintroducing native species. Eradication of the BTS is also necessary and vital to recovery in the area.

The Bolanos Conservation area, 10.33 km^2 (2,553 acres), is managed by DAWR for hunting and outdoor recreation. The area is composed of savanna complex (*Miscanthus floridulus* and other grassland species) (39.4%), native volcanic forest (37.1%), scrub forest (13.46%), mixed grass/herbaceous (6.2%), and mixed introduced forest (2%). Less than 1% of the area consists of bamboo thicket, bare soil, coconut forest, emergent wetland, tangantangan thicket, and open water. Historically, the area was predominantly a 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 re-introductions. All efforts to rehabilitate Bolanos would involve ungulate and BTS control.

The 2.54 km^2 (628 acres) of the Cotal Conservation Area is predominately covered by *Acacia* forest (53%), savanna complex (27.5%) with scrub forest (16.5%), mixed introduced forest (13.8%), and mixed grass/herbaceous (13.8%). Barren and badland habitats make up approximately 2 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 value and is not connected to the southern Refuge Overlay. This area is accessible to the public. Reforestation efforts combined with public education activities have been implemented in this area in order to restore SGCN. The Department's FSRD has begun efforts to restore native species that would make this area available to release the efforts of native birds and other animals in the future. However, the prevalence of grassland fires in this area makes reforestation challenging.

The Y-Piga Conservation area is a relatively small parcel of 0.19 km^2 (47 acres) located in Northern Guam. It consists of mainly mixed introduced forest (57.9%), mixed grass/herbaceous (26.3%), and scrub/ shrub (10.5%). Less than 1% of the area is developed or bare soil. It is situated near several residential communities.

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^2 (2.25 acres) of open water surrounded by *Phragmites* 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 *Acacia* became established, 5500 native trees were planted to continue to control sedimentation and improve the habitat for native animals. Some of the native trees planted in the Masso watershed are locally rare, including ifit. 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 an important habitat for certain bird species, such as the pulattat.

In addition to locally managed conservation lands, the federal government has identified conservation areas in Guam. On June 14, 1991, 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 km2 (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 the purpose of establishing the overlay units on lands administered by the USAF in 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 SWAP.

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, Andersen Air Force Base (AAFB), and COMNAVMAR to improve the habitat for the benefit of Guam's SGCN. Another critical conservation area is Islan Dåno' (Cocos Island), 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 the 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, DAWR, 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 Islan Dåno' in support of the establishment of ko'ko'. 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 case, the GDAWR was responsible for the management actions to establish a breeding population of ko'ko' on Islan Dåno'. The Cocos Resort provided shuttle services for management-

related activities until the resort closed in 2020.

In 2009, the DAWR partnered with APHIS Wildlife Services Guam Program to eradicate rodents from Islan Dåno' before the re-introduction of captive-bred ko'ko'. Removal of predatory monitorlizards was initiated to give the newly released birds the best chance for survival. Guam Forest and Soil Resources planted native trees and provided maintenance of invasive vines to enhance the forest on Dåno' for the benefit of native species.

On November 16, 2010, 16 captive-bred ko'ko' 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 six weeks, the first nest was located. In August 2012, another release of ten birds occurred. Subsequent monitoring observed a total of 29 nests, 56 eggs, and 23 chicks by the end of 2014, and unbanded ko'ko' were sighted in all parts of the island.

In addition to the success of the ko'ko' introduction, the revival of the *Emoia slevini* (Slevin's skink) population following the rodent eradication is a conservation success story, along with the increase in haggan nests that benefit from monitor lizard population reduction. Islan Dåno' is an important nesting area for haggan. DAWR has documented haggan nesting on the island starting in 1983 up to the present. Haggan 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 haggan nesting population.

Islan Dåno' is a demonstration of how GDAWR can collaborate with landowners and other agencies to manage natural resources for the benefit of SGCN. Ko'ko', såli *(Aplonis opaca guami*, Micronesian starling), native skinks and geckos, and nesting seabirds, most of which are species no longer found in Guam due to the BTS, are breeding successfully on Islan Dåno'.

In 2020, a breeding population of BTS was confirmed on Islan Dåno'. This startling news ignited action by local and federal government agencies, as well as the community of Guam. The U.S. Geological Survey (USGS) removed more than 60 BTS from Dåno' in the months following the report of BTS by local fishermen. A local group of volunteers, Friends of Islan Dåno', initiated removal efforts and established a regular search schedule. These searches have proven successful, and while BTS sightings on Dåno' have declined, the removal efforts continue to address the BTS population that remains active at some low, difficult-to-detect level.

Populations of locally and federally listed species remain on Islan Dåno'. BTS control, monitor lizard control, population monitoring, and other management actions to prevent the introduction of injurious species to Dåno' continue to be a priority for GDAWR for the preservation of these extant native populations. The eradication of BTS from Islan Dåno' is technically feasible if The Principles of Eradication are adhered to. The future of Dåno' species depends on it.

Freshwater Conservation Areas

There are few freshwater conservation areas in Guam. Within the Sasa Bay Marine Preserve, a wetland site has been designated as a pulattat foraging site. There is also Fena Lake, the largest reservoir in Guam, which is important for nesting pulattat. 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 most pristine river habitats in Guam.

Marine Preserves

Over 10% of Guam's coastline has been designated as five marine preserves: Tumon Bay, Piti Bomb Holes, Sasa Bay, Achang Reef Flat, and Pati Point. 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 four of the five areas.

The largest of the preserves, Pati Point Marine Preserve, contains 20 $km^{2,}$ or approximately 4900 acres of reef environment. The area was originally 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 haggan nesting areas. Limited access to the preserve provides some level of protection; however, this makes enforcement of regulations 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 of Guam. This 4.5 km2 (1117 acres) preserve features a broad reef flat (2.7 km2, 665 acres) and gently sloping fore reef slope (0.7 km2, 166 acres), and broad bank/shelf habitat (1.42 km2, 351

acres less than 100 feet deep). This preserve contains almost one km2 (253 acres) dominated by coral. On the fore reef slope, the dominant species are plate-and-pillar coral (*Porites* (*synarea*) *rus*), complemented by a wide variety of other species. The reef flat contains large *Acropora*, *Porites* (lobe), and *Pavona* (lettuce) coral stands. These coral stands provide rich habitat for a variety of fish species including the CITES listed tanguisson 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 talåya (cast net) from shore is allowed in this preserve for four types of fish: kichu (*Acanthurus triostegus*, convict tangs), manahac or sesjun (*Siganus* sp., juvenile and adult rabbitfish respectively), I'e (*Caranx* sp., juvenile jacks and trevallies), and ti'ao (*Mullidae* sp., juvenile goatfish). Talåya may be used for kichu and manahak or sesyun, along the reef margin.

Piti Bomb Hole Preserve (3.6 km2 or 896 acres) stretches from Asan Point to the outlet channel from the Cabras power plant. The broad reef flat (1.4 km2, 349 acres) in Piti Bay extends from 72 m near the mouth of Tepungan Channel to 978m east of Asan Point (Randall & Eldredge, 1976). The reef flat includes unique, natural features known as the "bomb holes" that provide deep water sheltered areas. The deepest of these sinkholes are 30-32 feet at mean lower low water (MLLW) (Tsuda & 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 are 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 atuhong (*Bolbometopon muricatum,* bumphead parrotfish*)* 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 large numbers of divers each day.

Sasa Bay Marine Preserve (3.1 km^2 or 770 acres) includes a significant subset (0.5 km^2 , 126 acres) of the largest mangrove forest in the Mariana Archipelago. 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 and habitats for Carangidae, Sphyraenidae (barracudas), Lutjanidae, and Serranidae (groupers) (Wiles & Ritter, 1993). Additionally, the *Urogymnus granulatus* (mangrove whipray), eels, birds, and various crab species are present. The bay also serves as a foraging ground for haggan and haggan karai. Coral habitat (0.02 km^2 , 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 Malesso' (4.8 km^2 , or 1199 acres), which extends from the Ajayan Channel to Achang Bay. This lies within the Manell-Geus habitat focus area and the Achang Marine Preserve. It includes a wide variety of habitats including the island's only shallow water lagoon, mangroves, seagrass, sand, coral, and channel. The seagrass, mangrove, and estuarine areas of this preserve are important nursery areas for a number of fish species. Three species of mangroves can be found at this site: *Rhizophora apiculata*, *Avicennia marina*, and mangle macho, with *R. apiculata* being the most common (Raymundo et al., 2018). Manell channel, the largest channel in the preserve, is an important habitat for haggan and haggan karai as the surrounding areas include rich foraging habitat including dense sea grass beds. Fringing mangroves line Achang Reef Flat Marine Preserve, including *R. mucronata,* mangle macho*, A. marina,* and lalanyok*.* The Manell-Geus watershed was selected as one of two places where NOAA could maximize habitat conservation investments to benefit marine resources and coastal communities. Traditional fishing methods (as defined in five GCA Chapter 63 §63101) are permitted in this preserve under GAR §12204, by special permit, for the harvest of lesso' (*Siganus argenteus*, juvenile forktail rabbitfish), achemson (*Pterocaesio tile*, juvenile fusiliers), and atulai (*Selar crumenophthalmus*, big eye scad).

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. 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 Hågat Bay. The 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 (*Leptoseris n.* sp. and *Favia rotundata*) were new records for Guam. A total of 339 fish species were recorded, representing approximately 37% of the knownspecies from Guam. Macroinvertebrates accounted for 657 species encountered during the qualitative 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 Hågat Bay, exhibiting high levels of diversity. In general, diversity declines from Orote Point southeastward and then increases again in the Hågat 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 a 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

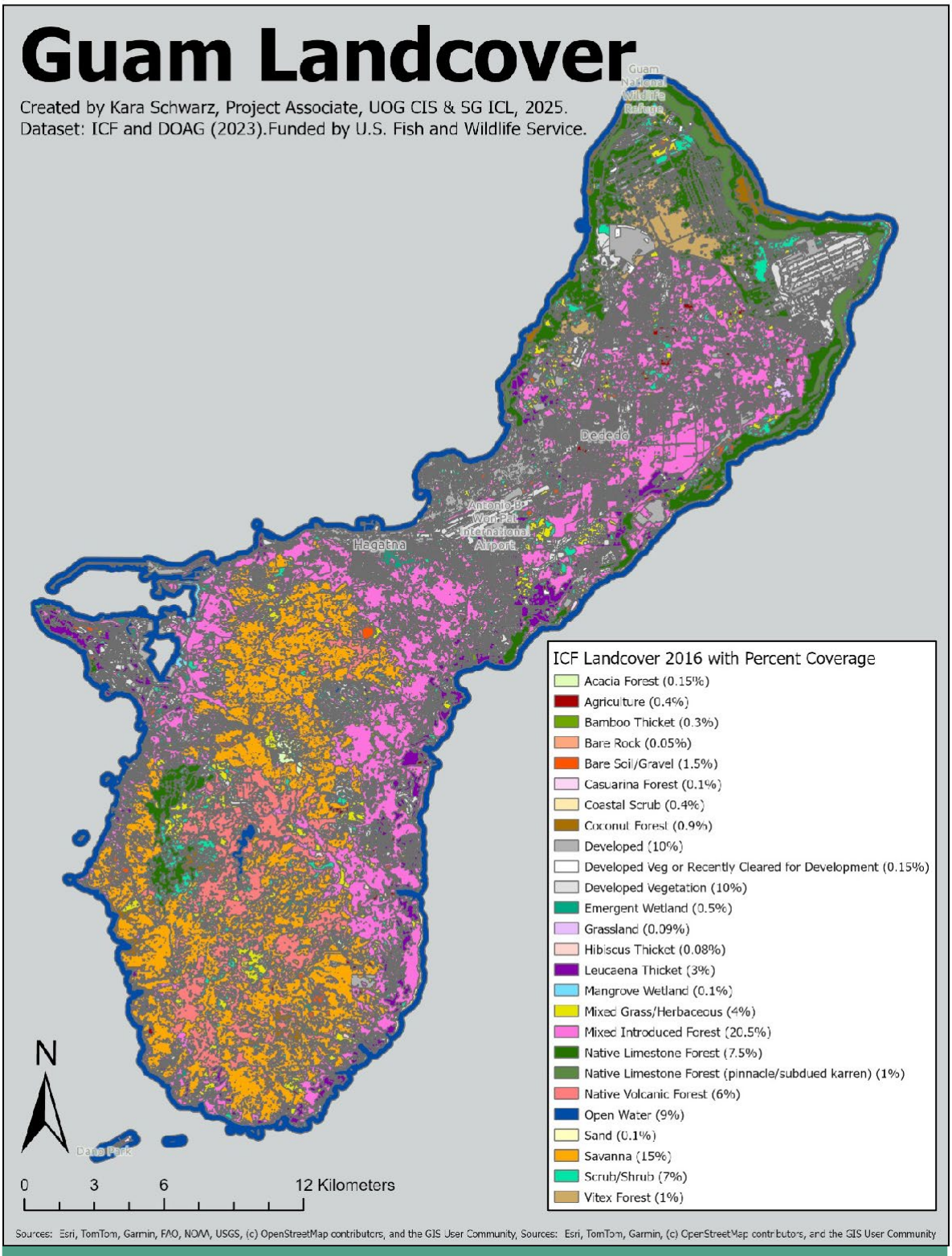


Figure 1: Landcover Types in Guam



Figure 2: Protected Areas in Guam

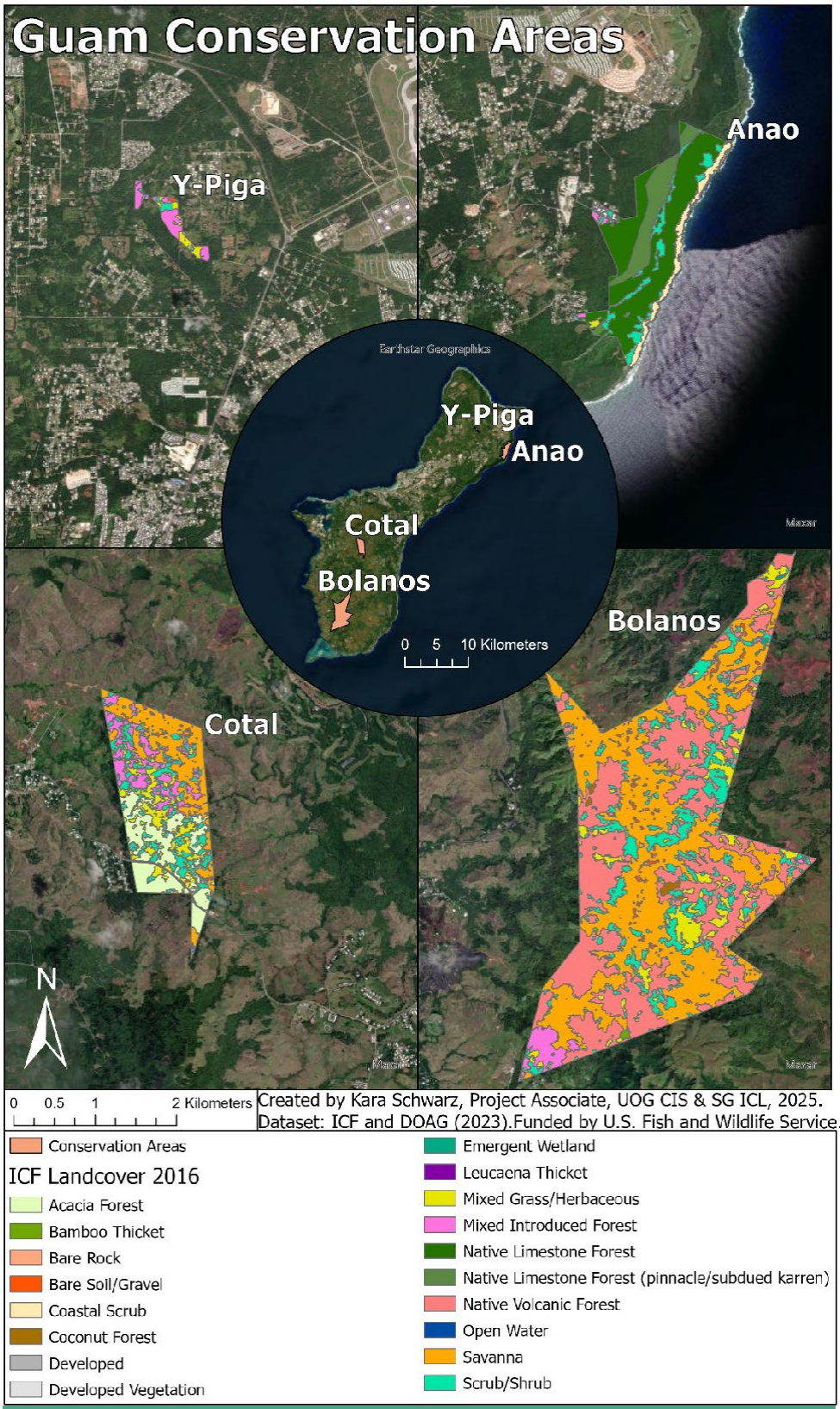


Figure 3: Landcover Types of Conservation Areas in Guam

Chapter 3: Species of Greatest Conservation Need (Elements 1 and 3)

SGCN Inclusion Criteria

The revised criteria for inclusion in the list of SGCN reflect a more comprehensive approach built upon the 2015 SWAP framework. These criteria incorporate legal, ecological, and cultural dimensions of conservation, ensuring that the SGCN list is scientifically grounded and locally relevant. The revised criteria identify species that are vulnerable to lack of management, data deficiencies, and ecological threats, and ensure that species significant to Guam's indigenous communities are not overlooked. A species may be considered a SGCN if it meets one or more of the established criteria. This allows for a precautionary and inclusive approach that accounts for various types of conservation concerns. Together, these revised criteria provide a transparent and justifiable foundation for prioritizing conservation needs for our SGCN.

Species experts were provided with portions of the SWAP relevant to their field of expertise. Using these materials, they reviewed the existing 2015 SGCN and recommend species for removal or inclusion. Experts also evaluated the existing species information, and their feedback was incorporated into the revision.

Note:

The full 2015 SWAP was provided to species experts upon request. Otherwise, experts received only the sections relevant to their field and were shown how to access the complete 2015 plan.

All candidate species made the SGCN list.

Inclusion Criteria for SGCN

1. **Listed as Threatened or Endangered:** The species is federally or locally listed as Threatened or Endangered under legal conservation frameworks.
2. **No Self-Sustaining Population:** The species lacks a self-sustaining breeding population in the wild or is extirpated from its native range.
3. **Population Status Uncertain/Unknown:** There is insufficient data to assess the population's size, trends, or viability.
4. **Restricted Range or Habitat:** The species occupies a limited geographic range or specialized habitat vulnerable to disturbance or habitat loss.
5. **Lack of Dedicated Conservation Program:** No targeted funding, plan, or management program exists for this species.
6. **Lack of Active Monitoring Program:** There is no ongoing, systematic monitoring of the population or key indicators (e.g., abundance, breeding success).
7. **Culturally Important:** This species holds cultural significance among indigenous groups in Guam for uses in traditional practices, such as fishing, weaving, medicine, etc.

Note:

- **Criterion 5 No Dedicated Conservation Program** refers to the lack of targeted conservation action, such as funded recovery plans, habitat restoration, or management programs.
- **Criterion 6 Lack of Active Monitoring Program** refers to the absence of data collection efforts, such as surveys or tracking of population trends.
- A species may meet one but not the other. For example, a species may be monitored regularly but still lack funded conservation initiatives.

Table 9: Inclusion Criteria for Species of Greatest Conservation Need

Species **CHamoru name** *Scientific name* Common name	Listed as threatened or endangered	No self-sustaining population	Population status uncertain/ unknown	Restricted range or habitat	Lack of Dedicated Conservation Program	Lack of Active Monitoring Program	Culturally important
Terrestrial Mammals							
Fanihi *Pteropus mariannus* Mariana fruit bat	X			X			X
Fanihi liyang *Emballonura semicaudata rotensis*,*** Pacific sheath-tailed bat	X	X	X	X	X	X	
Forest Birds							
Ko'ko' *Hypotaenidia owstoni*,*** Guam rail	X			X			X
Paluman åpaka'/fache' *Pampusana xanthonura*,*** White-throated ground dove	X	X		X	X	X	X
Totot *Ptilinopus roseicapilla*,*** Mariana fruit-dove	X	X		X	X	X	X
Yayaguak *Aerodramus bartschi*,*** Mariana swiftlet	X			X	X		X
Sihek *Todiramphus cinnamominus*,*** Guam kingfisher	X	X		X			X
Åga *Corvus kubaryi*,*** Mariana crow	X	X		X	X	X	X
Såli *Aplonis opaca guami*** Micronesian starling	X			X	X		X
Egigi *Myzomela rubratra saffordi*,*** Micronesian honeyeater	X	X		X	X	X	X
Wetland Birds							
Pulattat *Gallinula chloropus guami*,*** Mariana common moorhen	X			X	X		X
Gå'ga' karisu *Acrocephalus luscinius*,*** Nightingale reed warbler	X	X		X	X	X	X
Sea- and Shorebirds							
Utak/Fakpe *Phaethon lepturus* White-tailed tropicbird				X	X	X	X
CHuchuko' Åtilong (dark morph) **CHuchuko' Åpaka'** (pale morph) *Egretta sacra* Pacific reef heron				X	X	X	X

Species **CHamoru name** *Scientific name* Common name	Listed as threatened or endangered	No self-sustaining population	Population status uncertain/ unknown	Restricted range or habitat	Lack of Dedicated Conservation Program	Lack of Active Monitoring Program	Culturally important
Lu'ao *Sula leucogaster* Brown booby			X	X	X	X	X
Dulili/Kålalang Migratory shorebirds			X		X	X	X
Terrestrial Reptiles							
Guali'ek hålom tåno' *Cryptoblepharus poecilopleurus*,*** Snake-eyed skink			X	X	X	X	
Guali'ek hålom tåno' *Emoia slevini*,*** Slevin's skink	X	X	X	X	X	X	
Guali'ek hålom tåno' *Ornithuroscincus noctua*,*** Moth skink	X	X	X	X	X	X	
Guali'ek hålom tåno' *Perochirus ateles*,*** Micronesian gecko	X		X		X	X	
Guali'ek hålom tåno' *Emoia atrocostata*** *Littoral skink*	X		X	X	X	X	
Terrestrial Arthropods							
Ayuyu *Birgus latro* Coconut crab			X	X	X	X	X
Hypolimnas octocula marianensis Mariana eight-spot butterfly	X		X	X	X	X	X
Vagrans egistina *Marianas wandering butterfly*	X	X	X	X	X	X	
Terrestrial Gastropods							
Akaleha' *Partula gibba* Humped tree snail	X		X	X	X	X	X
Akaleha' *Partula radiolata* Guam tree snail	X		X	X	X	X	X
Akaleha' *Samoana fragilis* Fragile tree snail	X		X	X	X	X	X
Terrestrial Plants							
CHacha *Cyathea lunalata*** Tree fern	X			X	X	X	
Fadang *Cycas marianensis*** Federico nut	X			X	X	X	X

Species **CHamoru name** *Scientific name* Common name	Listed as threatened or endangered	No self-sustaining population	Population status uncertain/ unknown	Restricted range or habitat	Lack of Dedicated Conservation Program	Lack of Active Monitoring Program	Culturally important
Ufa hålom tåno' *Heritiera longipetiolata*,***	X		X	X	X	X	
Faniok *Merilliodendron megacarpum*	X		X	X	X	X	
Håyun lågu *Serianthes nelsonii*,*** Fire tree	X	X	X	X	X	X	X
*Tabernaemontana rotensis***	X		X		X	X	
*Bulbophyllum guamense **	X			X	X	X	
*Dendrobium guamense**	X			X	X	X	
*Eugenii bryanii **	X			X	X	X	
*Hedyotis megalantha**	X			X	X	X	
*Maesa walkeri**	X			X	X	X	
*Nerivilia jacksoniae**	X			X	X	X	
*Phyllanthus saffordii**	X			X	X	X	
Aplokating palao'an *Psychotria malaspinae**	X		X	X	X	X	
Berenghenas hålom tåno' *Solanum guamense**	X		X	X	X	X	
*Tinospora homosepala**	X	X	X	X	X		
*Tuberolabium guamense**	X			X	X	X	
Trongkon niyok *Cocos nucifera* Coconut			X		X	X	X
Åmot Native Medicinal Plants			X		X	X	X
Dokduk *Artocarpus mariannensis* Seeded Breadfruit			X		X	X	X
Bulbophyllum raulersoniae			X	X	X	X	
Claoxylon marianum			X	X	X	X	
Pe'echalan *Deeringia ameranthoides*			X	X	X	X	X
Drypetes dolichocarpa			X	X	X	X	
Tupun ayuyu *Elatostema calcareum*				X		X	X
Fagraea berteroana				X	X	X	X
Freshwater Fish							
Atot *Stiphodon sp.* Stream goby			X		X	X	
Atot *Sicyopus sp.* Redbellied goby			X		X	X	

Species **CHamoru name** *Scientific name* Common name	Listed as threatened or endangered	No self-sustaining population	Population status uncertain/ unknown	Restricted range or habitat	Lack of Dedicated Conservation Program	Lack of Active Monitoring Program	Culturally important
Atot *Stenogobius sp.* Marianas goby			X		X	X	
Umatan *Kuhlia rupestris* Flagtail			X		X	X	
Asuli *Anguilla marmorata* Giant marbled eel			X		X	X	
Freshwater Crustaceans							
Uhang *Atyidae spp.* Atyid shrimps			X		X	X	
Uhang *Macrobrachium spp.* Tahitian prawns			X		X	X	
Varunidae spp. Varunid crabs			X		X	X	
Freshwater Gastropods							
Akaleha' *Neritidae spp.* Nerite snails			X	X		X	
Akaleha' *Thiaridae spp.* Thiarid snails			X	X		X	
Freshwater Plants							
Guafak uhong/Umok sensonyan *Ceratopteris thalictroides subsp. gaudichaudii* Water fern			X	X	X	X	
Chaiguan gaddok *Potamongeton mariannense* Pond weed			X	X	X	X	
Nipa *Nypa fruticans* Mangrove palm or Nipa palm			X	X	X	X	X
Marine Mammals							
Bayena *Balaenoptera edeni***** Bryde's Whale	X		X		X	X	
Bayena *Balaenoptera borealis***** Sei Whale	X		X		X	X	
Bayena *Megaptera novaeangliae***** Humpback Whale	X		X		X	X	
Bayena *Ziphius cavirostris***** Cuvier's Beaked Whale	X		X		X	X	

Species **CHamoru name** *Scientific name* Common name	Listed as threatened or endangered	No self-sustaining population	Population status uncertain/ unknown	Restricted range or habitat	Lack of Dedicated Conservation Program	Lack of Active Monitoring Program	Culturally important
Bayena *Physeter macrocephalus***** Sperm Whale	X		X		X	X	
Bayena *Kogia sima***** Dwarf Sperm Whale	X		X		X	X	
Bayena *Kogia breviceps***** Pygmy Sperm Whale	X		X		X	X	
Bayena *Peponocephala electra***** Melonheaded Whale	X		X		X	X	
Bayena *Orcinus orca***** Killer Whale	X		X		X	X	
Bayena *Globicephala macrorhynchus***** Shortfinned Pilot Whale	X		X		X	X	
Tuninos *Grampus griseus***** Risso's Dolphin	X		X		X	X	
Tuninos *Stenella longirostris***** Spinner Dolphin	X		X		X	X	
Tuninos *Stenella coeruleoalba***** Striped Dolphin	X		X		X	X	
*Dugong dugon***** Dugong	X		X		X	X	
Marine Reptiles							
Haggan *Chelonia mydas**,** Green sea turtle	X			X			X
Haggan karai *Eretmochelys imbricata**,** Hawksbill turtle	X			X	X	X	X
Marine Fish							
Tanguisson *Cheilinus undulates**** *Humphead wrasse/ Napoleon wrasse*	X			X	X		
Atuhong *Bolbometopon muricatum**** Bumphead parrotfish	X	X		X	X		
Acanthuridae Surgeonfish				X		X	
Scaridae Parrotfish				X		X	

Species **CHamoru name** *Scientific name* Common name	Listed as threatened or endangered	No self-sustaining population	Population status uncertain/ unknown	Restricted range or habitat	Lack of Dedicated Conservation Program	Lack of Active Monitoring Program	Culturally important
Lethrinidae Emperors				X		X	
Serranidae Groupers				X		X	
Siganidae Rabbitfish				X		X	
Lutjanidae Snappers				X		X	
Mullidae Goatfish				X		X	
Chaetodontidae Butterflyfish				X		X	
Pomacanthidae Angelfish				X		X	
Cirrhitidae Hawkfish			X	X		X	
Labridae Wrasse			X			X	
Carangidae Jacks and Trevallies				X		X	
Skates and Rays							
Hafula' *Mobula alfredi* Reef Manta Ray			X	X	X		
Hafula' *Mobula birostris* Oceanic manta ray	X		X	X	X	X	
Hafula' *Mobula tarapacana* Sicklefin devil ray		X	X	X	X	X	
Corals							
Cho'cho' *Scleractinia* Hard Coral Subclass			X		X		
Octocorallia Soft Coral Subclass			X		X	X	
Cho'cho' *Acropora globiceps**	X		X		X	X	
Echinoderms							
Balåti *Actinopyga echinites* Deepwater red fish			X		X	X	
Balåti *Actinopyga varians* Surf red fish			X		X	X	
Balåti *Holothuria fuscogilva* Brown teatfish			X		X	X	

Species **CHamoru name** *Scientific name* Common name	Listed as threatened or endangered	No self-sustaining population	Population status uncertain/ unknown	Restricted range or habitat	Lack of Dedicated Conservation Program	Lack of Active Monitoring Program	Culturally important
Balåti *Holothuria whitmaei* Black teatfish			X		X	X	
Balåti *Thelenota ananas* Pineapple sea cucumber			X		X	X	
Balåti *Thelenota anax* Giant sea cucumber			X		X	X	
Marine Arthropods							
Mahonggang *Paniluris spp.* Spiny lobster			X		X	X	
Marine Gastropods							
Charonia tritonis Triton's trumpet	X		X		X	X	
Bivalves							
Hima *Tridacna derasa* *Tridacna maxima* *Tridacna squamosa* *Hippopus hippopus* Giant clams			X		X	X	
Marine Plants							
Lo'u/Chå'guan' tåsi *Enhalus acoroides* Tape seagrass			X		X	X	X
Lo'u/Chå'guan' tåsi *Halodule uninervis* Narrowleaf seagrass			X		X	X	X
Lo'u/Chå'guan' tåsi *Halophila nipponica* Japanese Halophila			X		X	X	X
Lo'u/ acho' tåsi *Rhodophyta: Corallinophycidae, Peyssonnneliales* Calcifying Red Algae			X	X	X	X	X
Lo'u/Chå'guan' tåsi *Rhodophyta* (red seaweeds), Ulvophyceae (green seaweeds), Phaeophyceae (brown seaweeds) Seaweed; Marine Macroalgae			X	X	X	X	X

* Federally Listed Threatened or Endangered Species
** Locally Listed Threatened or Endangered Species

Terrestrial SGCN

Mammals

Three native mammals are known to Guam including the fanihi, *Pteropus tokudae* and fanihi liyang. *Pteropus tokudae* has been extinct since the 1970s and the fanihi liyang is currently only found on the island of Aguiguan. The fanihi is the only extant bat in Guam. The fanihi and several forest bird species were added to the US Endangered Species List in 1984. Subsequently, recovery plans were developed for these species (USFWS, 1990b). Major causes for the decline of bat populations in Guam include hunting (poaching) for human consumption, habitat loss, and predation by invasive species, though some of these effects have not been explicitly investigated. Wiles (1987b) suggested that BTS predation of nonvolant pups while their mothers foraged 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.

Birds

There are over 100 species of birds documented in Guam including migrant, wetland, seabird, grassland, and forest birds (Reichel & Glass, 1991; Engbring & Fritts, 1988). The status of birds listed as SGCN 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 Native Forest Birds of Guam and Rota of the Commonwealth of the Northern Mariana Islands Recovery Plan covered the six federally listed native forest birds, (Beck & Savidge, 1990) including the ko'ko', Guam subspecies of sihek (*Todiramphus c. cinnamominus,* Guam kingfisher), åga (*Corvus kubaryi*, Mariana crow), *Myiagra freycineti* (Guam flycatcher), yayaguak, and the *Zosterops c. conspicillata* (Guam bridled white-eye). These species were grouped together for recovery purposes because they occupied similar habitats and faced similar threats. Åga has been extirpated in Guam but still remains on Rota. The USFWS has completed separate recovery plans for åga and sihek. Unfortunately, the population of *M. freycineti* and *Z. c. conspicillata* in Guam went extinct in the mid-1980s and were removed from the endangered species list (USFWS, 2004).

An amendment to the recovery plan was prepared for the yayaguak for the Mariana Islands in 2019 (USFWS, 2019). This species has been able to persist in spite of the BTS and continues to survive in the wild, in several small colonies totaling over 900 birds (Cruz et al., 2008). Most of the birds are found in one cave (Mahlac Cave) on the Naval Ordnance Annex in southern Guam. The yayaguak population is vulnerable to BTS predation, habitat destruction, and various stochastic factors affecting cave sites, including human disturbance, typhoons, and flooding. BTS trapping and video surveillance at Mahlac Cave suggests that BTS predation is a major factor limiting the size of the colony (Gorresen et al., 2024). Prior to Typhoon Pongsona (December 2002), the population numbered over 800 birds and dropped to 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 yayaguak to Tarague cave. The project has not yet moved forward as preliminary requirements by the military have not yet been addressed, as of July 2025.

The Guam subspecies, CHichirika/naabak, was not federally listed and went extinct in the mid-80s. The egigi, and totot (*Ptilinopus roseicapilla*, Mariana fruit-dove) are also no longer found on Guam. However, isolated observations of *Pampusana xanthonura* (white-throated ground dove) have been reported in Tarague Basin, Mangilao, Talo'fo'fo', and Yona. It is unknown whether these observations were all of one individual or multiple individuals. No recovery plan exists for these species; however, recovery efforts for other endangered birds should benefit them as well. Conservation efforts to establish these birds on Guam would require translocation of birds (eggs, chicks, or birds) from the CNMI where they still occur.

Seabirds, including the *Sula sula* (red-footed booby) and utak (*Phaethon lepturusi,* white-tailed tropicbirds), that inhabit Guam deserve further attention. Their seashore habitats need to be protected from development. Any offshore wind farm construction needs to take flight patterns into account.

Most of the major objectives outlined in the Native Forest Birds of Guam and Rota of the Northern Mariana Islands Recovery Plan (Beck & Savidge, 1990) for recovery of the ko'ko' have been implemented. DAWR maintains a captive population of over 100 ko'ko' and as many as 13 mainland zoos maintain and breed ko'ko' 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 re-introduction to

Guam, began in 1989. In December 1995, successful reproduction by captive ko'ko' released on Rota was documented. Population surveys on Rota last detected ko'ko' in 2023 but further releases are still warranted (DAWR, unpublished data). Since November 2010, a total of 26 ko'ko' has been released on the snake-free island of Islan Dåno' (Cocos Island) south of Guam, and reproduction was confirmed for the first time in 2011. DAWR conducted six population surveys in 2024–2025, confirming that the population is stable and reproducing. Chicks were observed in 2025, with the population estimated to be between 25 and 40 ko'ko'.

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 DAWR and USFWS and identifies critical objectives for recovery. One such objective is a captive population of 250 individuals. However, while breeding success in sihek has improved dramatically since the first publication of the SWAP, the captive population is currently at 127 birds as of March 2025. One limiting factor is the lack of available space for housing birds at mainland zoos, as well as the cost associated with holding birds until a release location is available. Other limitations include mate incompatibility and aggression, rising levels of infertility, a decline in the number of fertile eggs that hatch, young adult mortality, and continual exposure to avian tuberculosis at zoos. Unless expedient recovery actions are taken to reverse the decline of sihek in captivity and to repatriate the birds to Guam, this species may yet become extinct. However, the success of the translocation effort on Palmyra Atoll offers a reason for hope and marks a critical step toward the eventual return of the sihek to its native habitat on Guam (USFWS, 2024).

Extirpation of åga in Guam can be attributed to multiple factors; however, the primary factor is low reproductive success due to skewed sex ratios and predation pressure. DAWR worked throughout the 1990s and early 2000s to increase the success of wild pairs by collecting and hand-rearing chicks for release back into the wild. This method led to multiple successes, such as in 2003 when two captive-reared åga were released and later produced two clutches of fertile eggs in the wild. DAWR also developed, tested, and successfully deployed new techniques to protect nests of åga from BTS predation. The use of electrified barriers on tree trunks was found to be highly effective in preventing BTS intrusion into active nests (Aguon et al., 2002), and eight fertile åga eggs were protected via this method in the 1996 breeding season alone. These techniques could potentially also be used to protect the nests of other forest bird species.

Another of Guam's surviving native endemic bird species is the pulattat. Unfortunately, this species is poorly understood and has been neglected in terms of studies of life history and dispersal patterns. They are threatened by predation by BTS, feral cats, dogs, and habitat destruction by babuen hålom tåno'. The wetland habitat they depend upon is also under threat from human encroachment. Guam's limited landmass for development means there is an increasing number of conflicts between the need for wetland protection and the need for commercial and urban development. To make informed conservation decisions for this species, additional studies of pulattat life history are needed, identifying ways to increase pulattat reproductive rates, increase survivorship of young birds, and minimize negative impacts from the aforementioned threats.

Migratory shorebirds are also frequently observed in Guam and are covered in the SWAP as one group. Individuals of many migratory shorebird species overwinter on island. It is much more than a minor stopover for them, but rather a crucial part of the habitat needed to complete their life cycle as they spend significantly more time here than on their breeding grounds (Kastner, *pers. comm.*).

Reptiles

Guam has several skink and gecko species though their diversity is relatively limited. They are found across various habitat types such as forests, savannas, and altered environments. These species play key roles in helping regulate insect populations, dispersing seeds, and serving as prey for other wildlife species. Five species are of particular concern and are included as SGCN in the SWAP. *Cryptoblepharus poecilopleurus* (snake-eyed skink) is more widespread across the island, often found in sunny, open areas. *Emoia slevini*, *Ornithuroscincus noctua* (moth skink), and *Perochirus ateles* (Micronesian gecko) are considered nocturnal and display more elusive behaviors.

Arthropods

There are a limited number of terrestrial crustaceans in Guam with the ayuyu (*Birgus latro*, coconut crab) being the largest and most prominent. Previously widespread, ayuyu populations have sharply declined due to over-harvesting, habitat loss, and invasive

species. In particular, the invasive CRB has damaged Guam's trongkon niyok, ayuyu's main food source. Ayuyu are featured in many CHamoru legends and are hunted as a delicacy served at parties and local fiestas, highlighting their cultural significance. As a new addition to the SGCN list, this species' survival requires protecting remaining habitats, controlling invasive species, and enforcing harvest regulations to support population health and recovery.

Insects

There are two known endemic butterfly species in Guam, *Hypolimnas octocula marianensis* and *Vagrans egistina* (Mariana wandering butterfly). *Hypolimnas octocula marianensis* has faced significant decline in recent decades resulting in its endangered listing in 2015 under the Endangered Species Act. The species naturally occurs in limestone forests where its two host plants, *Procris pedunculata* and tupun ayuyu (*Elatostema calcareum*), are found. It is still observed in several locations in northern Guam, but population numbers have drastically reduced. The species is under pressure from several threats, such as habitat loss, invasive species and harsher climatic conditions, mainly affecting host plant health and abundance. *Vagrans egistina* was known to occur in limestone forests and has one known host plant, luluhut (*Maytenus thompsonii*). Though its host plant is still found in Guam, *V. egistina* is believed to be extirpated. There is not much known about this species.

Gastropods

Guam's terrestrial gastropods are part of the unique biodiversity of the Mariana Islands. These native land snails play important ecological roles in nutrient cycling, decomposition, and maintaining forest health. They also hold cultural significance as their shells were historically in traditional ornaments and crafts as part of the island's natural heritage. However, Guam's native snail populations have experienced significant declines, largely due to habitat loss, the introduction of invasive predators, such as *Euglandina rosea* (rosy wolf snail) and *Platydemus manokwari* (predatory flatworm), and other landscape changes. *Partula gibba* (humped tree snail), *partula radiolata* (Guam tree snail), and *samoana fragilis* (fragile tree snail) are three particular native snail species of concern and are included as SGCN. These snails are not only culturally significant but also serve as indicators of forest ecosystem health. Conservation of these SGCN requires targeted efforts to control invasive predators, protect remaining native forest habitat, and explore options for captive breeding and re-introduction to support recovery of these unique and highly threatened native gastropods.

Plants

There are 320 native plant species known to occur in Guam. These plants are part of many different plant communities that are a diverse assemblage of endemic, native, 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, the SWAP identified 33 terrestrial plant species/groups to be included as SGCN.

Two plant species deserve considerable and immediate attention. The first is the federally listed håyun lagu (*Serianthes nelsonii*). In 1994, the USFWS published a recovery 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 the fadang (*Cycas micronesica,* federico nut). This species was once the most abundant forest species. The accidental introduction of *Aulacaspis yasumatsui* (Asian cycad scale) in 2003 has decimated the population throughout the island. Unfortunately, there is little funding available to implement island-wide control of the pest. In 2015, this plant was listed under the Endangered Species Act, together with 13 other species. Some of the 2015 listed plants species remain understudied. Conducting additional surveys on public and private lands would increase our understanding of their habitat needs and distribution. All listed plants species are included as SGCN, with identified threats, and corresponding conservation needs.

Newly added SGCN include åmot (native medicinal plants) and other culturally significant species such as the trongkon niyok, nipa, and dokduk.

Presently, major threats to Guam's terrestrial plants include development, other anthropogenic threats, typhoons, insect pests, fire, and browsing by feral ungulates. The introduction of species and varieties of the same genera may result in new varieties through cross-pollination.

Freshwater SGCN

Guam has 101 named rivers and streams, all located in the volcanic southern half of the island (Best &

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. Each of the below sections describe/include all the native freshwater species and tables of those species, but they are included even IF not all those native species are included as SGCN.

Freshwater Vertebrates

Guam's native freshwater fish fauna consists of 11 species: two eels, one flagtail, one sleeper, and seven gobies. Gobies are the most abundant freshwater fish but all of Guam's native freshwater 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. Three of Guam's native fish species (*Stiphodon* sp., *Stenogobius* sp., and *Sicyopus* sp.) are found only in the southern Mariana Islands. *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. A study on the damming of Fena Lake in Guam found significant impacts on freshwater fauna, particularly amphidromous species both upstream and downstream (Conception, 1997; Conception & Nelson, 1999). Dams can act as barriers to migration, leading to reduced populations upstream. Additionally, damming alters the overall ecosystem by changing flow patterns and modifying habitat conditions (Conception & Nelson, 1999).

Freshwater Invertebrates

Guam has seventeen species of native snails, belonging to two families, the Neritidae (neritids) and Thiaridae (thiarids).

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 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. Neritids deposit their egg cases on solid substrates, including other neritids.

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.

Stenomelania plicaria (thiarid) and *Neritodryas subsulcata* (neritid) snails are the only freshwater invertebrates of concern in Guam. *Stenomelania plicaria* has a limited distribution in Guam, being found in a few rivers. *Neritodryas subsulcata* is very uncommon in Guam, though it is widespread throughout the Indo-Pacific.

Crustaceans

Guam has at least 12 species of freshwater crustaceans, including nine species of shrimp and at least three species of freshwater crab. All of these species are amphidromous, meaning they have a marine larval stage and a freshwater adult stage. *Macrobrachium* and atyid shrimp are the dominant crustaceans in Guam's freshwater systems.

Two families of shrimp are represented on the island: Atyidae (atyid) and Palaemonidae (Palaemonid). Atyid shrimp are small, generally less than 4 cm in length, and function as herbivores or detritivores, feeding on algae and organic matter using their brush-like chelae. The genera, *Atyoida* and *Atyopsis,* are typically found in shallow, fast-flowing waters, while *Caridina* prefers slower, deeper stream sections. *Halocaridina*, a cave-dwelling species with greatly reduced eyes, is found exclusively in caves and sinkholes along Guam's east coast. Atyid shrimp are an important food source for native fish and birds.

Palaemonid shrimp, which include the genus *Macrobrachium*, are larger omnivores, growing up to

15 cm. They feed using a prominent pair of chelipeds (pincers) and are widely distributed throughout Guam, inhabiting rivers, reservoirs, and caves. These shrimps are highly adaptable and often persist in intermittent headwater pools, where they are sometimes the only aquatic fauna present. Palaemonid shrimp are also harvested for food by local residents.

Guam's freshwater crabs are less well-known and represent a minor, often inconspicuous component of the island's freshwater fauna. Three species are currently known: *Ptychognathus* sp., *Sesarma* sp., and *Varuna cf. littorata*, all belonging to the Grapsidae family.

Native Aquatic Plants

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

Nipa is found in Guam only in the lower reaches of rivers that exhibit a true estuarine habitat. Nipa is found along only ten rivers in Guam (DAWR, unpublished data). Nipa was traditionally used for thatch, as the leaves are long lasting compared to coconut leaves. Dueto over-harvesting and habitat loss, nipa has become uncommon and is now protected under Guam law (Title 5 GCA, Chapter 63, §63302).

Marine SGCN

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 Appendix A. 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. No rigorous study of populations has been undertaken to date.

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 bycatch in nets and on longlines, oil spills, overzealous tour operators, in-water military training exercises, etc.

Reptiles

Three species of sea turtles inhabit the waters around Guam: haggan karai, haggan, and the leatherback (*Dermochelys coriacea*) (Eldredge, 2003b). Of these, haggan karai and haggan are known to nest on Guam's beaches and are included as SGCN.

All three species are protected under the U.S. Endangered Species Act (ESA) of 1973. Haggan karai was listed as endangered in 1973. Haggan was initially listed as threatened in 1978 but was later uplisted to endangered in 2016. In addition to federal protections, both haggan karai and haggan are protected under local law (5 GCA Chapter 63 §63101-63117), with haggan karai designated as endangered and haggan as threatened.

In 2015, NOAA and the USFWS conducted a global status review of haggan and proposed the listing of eleven Distinct Population Segments (DPSs) under the ESA (USFWS 2015a, 80 FR 15271). This proposal recommended replacing the existing global listing with individual DPS listings: eight DPSs as threatened and three as endangered. A public hearing was held in Guam on July 15, 2015, and the public comment period closed on September 25, 2015. The Central West Pacific DPS, which includes Guam, was proposed for uplisting to endangered. The final rule was published on April 6, 2016, formalizing these changes (USFWS 2015b, 81 FR 20057).

Haggan are herbivorous and widely distributed throughout tropical and sub-tropical oceans. On Guam, they are observed year-round, with peak sightings typically in December- February and May-June (NMFS-USFWS, 1998a).

Haggan karai, also circumtropical in distribution, primarily feed on sponges. Nesting is rare on Guam, with the first documented haggan karai nest reported in November 1991 (NMFS-USFWS, 1998b).

The sea turtle life cycle makes them especially vulnerable to a wide range of threats, both natural and human induced. As eggs, they are subject to predation

by invasive species such as fire ants, babuen hålom tåno', and monitor lizards, and occasionally harvested by humans. Hatchlings face predation from ghost crabs, birds, and fish upon reaching the ocean. Juveniles and adults may be preyed upon by sharks.

Anthropogenic threats include oil spills, entanglement in fishing nets, and being caught as bycatch on longlines. Marine debris, particularly plastic bags mistaken for jellyfish, can cause fatal ingestion. Poaching also remains a concern, with mating pairs and nesting females particularly at risk. Although illegal, turtle meat continues to be consumed locally and is often found in the back kitchens at parties and fiestas. Turtle meat holds cultural significance in the Pacific Islands and historically served as a key protein source during oceanic migrations (Amesbury & Hunter-Anderson, 2003).

Nesting beaches are also impacted by coastal development, including the loss of sand above the mean high tide and increased exposure to artificial lighting. Light pollution disorients hatchlings, which rely on visual cues to find the ocean, typically the brightest area on the horizon.

Fish

While many reef-associated species in Guam have shown declines in average size and abundance, two species are of particular concern: tanguisson, and the atuhong.

Tanguisson is one of the largest reef fishes, reaching a maximum size of over seven feet, and a weight of over four hundred pounds (Myers, 1999). It grows slowly, taking up to ten years to reach a weight of 70 pounds (Kang, 2023). This slow growth rate, coupled with its habit of sleeping in caves in relatively shallow water, leaves the tanguisson 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 must travel further and further into the Pacific to meet demand. In 2004, tanguisson 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 uncommon in Guam. Juveniles are seen more frequently on reef flats, especially in the Marine Preserves.

Atuhong is another large reef fish vulnerable to overfishing. This reef fish is also slow growing, and its habit of sleeping in large groups in shallow water makes it vulnerable to overfishing, particularly nighttime 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 where there is sufficient habitat of lagoonal and fore reef areas. This species is not used in the live reef fish trade and is not subjected to the intense foreign fishing pressure that the tanguisson faces. The atuhong has been almost completely absent from Guam's waters for decades. Other groups of reef fish that are a concern in Guam include Serranidae (groupers) and fish collected for the aquarium trade (Chaetodontidae, Pomacanthidae, Cirrhitidae). Serranidae life history makes them vulnerable to overfishing. They are slow growing with maturity coming after several years for most species (Myers, 1999). Serranidae are not migratory. Individuals usually find a cave or other structure to act as a home base and seldom venture far from it. This not only makes them easy to find, but the replacement of individuals caught for consumption is a slow process. Serranidae 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 in 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 *Centropyge shepardi* (rusty angelfish), *Neocirrhites armatus* (flame hawkfish), and *Chaetodontidae* (butterfly fish) (DAWR). 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. *Neocirrhites armatus* are common in areas without aquarium fish collecting (Myers, 1999). In Guam, however, this is not a common species.

Skates and Rays

Guam's marine environments host an array of manta ray species, including *Mobula alfredi* (reef manta ray), *Mobula birostris* (oceanic manta ray), *Mobula taracapana* (sicklefin devil ray), *Urogymnus granulatus* (mangrove whipray), and *Aetobatus ocellatus* (ocellated eagle ray). These species are found in various habitats around the island, from shallow lagoons and mangrove habitats to coral reefs and deep offshore waters. As key components of benthic food webs, rays play an important role in maintaining ecological balance and supporting local marine biodiversity.

Mobula alfredi, *M. birostris*, and *M. taracapana* are newly identified SGCN in this SWAP iteration. *Mobula alfredi* and *M. birostris* are slow-reproducing,

long-lived planktivores. *Mobula alfredi* make up a resident population in Guam's waters. Individuals are commonly spotted along coral reefs, bays, atolls, and productive coastlines. Guam's reef manta rays target Acanthuridae spawning aggregations to feed on fish spawn, marking the first recorded observation of this behavior (Hartup et al., 2013). They can reach wingspans of up to 11.5 feet and weigh up to 3,000 pounds. Each manta ray features a unique spot pattern on its ventral side, allowing for tracking through photogrammetry. It is listed as vulnerable to extinction on the IUCN Red List and CITES Appendix I and II. Although the species is found across Micronesia, research on local population size and trends remains limited.

Mobula birostris share similarities with *M. alfredi* and were previously considered a single species but were split into two distinct species in 2009. *Mobula birostris* are known for large migrations around open ocean areas of high productivity and often aggregate around underwater sea mounds, banks, and continental shelves. Snorkelers, divers and fishermen often confuse one species for the other, making it harder to determine sightings without photographs. Bycatch data from commercial fisheries document both species, as their habitats are located in tropical and sub-tropical regions. They have been documented in the CNMI and Guam, but very little is known. *Mobula birostris* is listed on the US endangered species list; the IUCN endangered and CITES Appendix I and II.

Mobula taracapana is listed as endangered on the IUCN red list, CITES Appendix I and II, with *M. alfredi*. *Mobula taracapana* shares similarities with *M. birostris* in its offshore habitat and life history traits. Although rarely photographed, several videos have documented nearshore encounters with this species around Guam. The use of offshore habitats by both *M. taracapana* and *M. birostris* limits our understanding of these species.

All three species face several threats throughout their range, including bycatch from commercial fishing nets, harassment or disturbance from irresponsible human activity, and altered feeding patterns caused by climate change. In Guam, rays are protected under Bill No. 44-31, which makes it unlawful for anyone to possess, sell, offer for sale, take, purchase, barter, transport, export, import, trade, or distribute ray parts.

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 50 years.

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). Of these, *A. globiceps* remains relatively common on Guam's reefs. *Acropora retusa* was initially believed to occur in Guam's waters based on a limited number of observations. However, NOAA's 2023 5-Year-Review concluded that these records likely represent different or undescribed species. As a result, *A. retusa* is no longer considered to occur in the Mariana Islands. *Seriatopora aculeata* was only recorded a handful of times between 1980 and 2010 and has not been observed since. NOAA concluded that available records do not support the species' current occurrence in the Mariana Islands (NOAA, 2023). While *A. retusa* and *A. Seriatopora* were SGCN in previous iterations of the SWAP, these findings have resulted in their removal from this revision.

In 2015, the NOAA proposed a potential 4(d) Rule for the ESA listed coral species in the Pacific Island Region, including Guam. Under the ESA, species listed as threatened are not protected from "take," which includes activities such as harming, harassing, or collecting individuals. A 4(d) Rule allows NOAA to enact specific prohibitions to support species conservation. However, a 4(d) has not been finalized for coral species and federal prohibitions will not apply until such rule is established. The absence of this regulation further threatens the health and safety of *A. globiceps* individuals in Guam.

Echinoderms

Echinoderms are a diverse group of marine invertebrates that include sea stars, sea urchins, brittle stars, and sea cucumbers. Found exclusively in marine environments, they are known for their radial symmetry, calcareous skeletons, and unique water vascular systems, which aid in locomotion, feeding, and respiration. Echinoderms play important ecological roles in maintaining the structure and function of benthic marine ecosystems.

Sea cucumbers (*Holothuroidea*), like other echinoderms, play a vital role in maintaining healthy reef ecosystems. They help recycle nutrients by breaking down organic matter in the sand, which enhances reef sediment quality (Lee et al., 2017; Keighan, 2023). Their digestive processes and excretion of fecal matter also help buffer ocean acidification by increasing the alkalinity of surrounding waters (Purcell et al., 2016). Protecting sea cucumbers

is not only critical for biodiversity, but also for the long-term resilience of coral reef systems.

Several species of sea cucumbers have been listed as endangered, vulnerable, or data deficient in the IUCN Red List of Threatened Species because of commercial over-harvesting. These are *Actinopyga echinites* (deepwater red fish), *Actinopyga varians* (surf red fish), *Holothuria fuscogilva* (brown teatfish), *Holothuria whitmaei* (black teatfish), *Thelenota ananas* (pineapple sea cucumber), and *Thelenota anax* (giant sea cucumber). Currently in Guam, individuals are permitted to harvest 100 animals per person per day. This level of harvest is unsustainable given their commercial value and their slow growth and recovery rates. Species specialists suggest working with policy makers and local communities to reduce take of these ecologically important species.

Arthropods

Marine arthropods in Guam include several culturally and economically important species, among which the spiny lobster (*Panulirus* spp.) is of particular concern. Spiny lobsters inhabit coral reefs and rocky coastal areas, where they shelter in crevices during the day and forage at night. They are highly valued for local consumption. Overfishing and habitat degradation pose ongoing threats to their populations.

Gastropods

Guam's marine gastropods are also of cultural and ecological importance. *Charonia tritonis* (Triton's trumpet) is a large snail, with an attractive shell highly prized by shell collectors. In areas of dense human population, these animals are quite rare (Smith, 2003). 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. *Charonia tritonis* feeds on echinoderms and is one of the few natural predators of *Acanthaster planci* (crown of thorns sea star).

Bivalves

Guam currently has four species of giant clam that are of concern: *Tridacna derasa*, *Tridacna maxima, Tridacna squamosa,* and *Hippopus hippopus*. Local law in 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 throughout 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 on many islands. The shells may be harvested for the shell trade or may be used to make jewelry by indigenous peoples, including the CHamoru 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.

In addition, NOAA Fisheries recently proposed listing several species of giant clams under the U.S. Endangered Species Act (ESA). Under this proposed rule, *T. derasa* and *H. hippopus*, both present in Guam, would be listed as endangered and threatened, respectively. This would add further federal protections but could restrict future harvest, possession, and trade of these culturally significant species.

Seagrasses

Seagrasses play a vital ecological role in Guam's nearshore waters by stabilizing sediments, supporting biodiversity, improving water quality, and sequestering carbon. Three species, *Enhalus acoroides*, *Halodule uninervis*, and *Halophila nipponica*, are commonly found in protected lagoons and reef flats across the island. Guam's seagrasses face a number of threats such as sedimentation, marine heatwaves, water quality degradation, outbreaks ofnuisance species, habitat loss, disease, and recreational impacts. These stressors can reduce coverage and degrade habitat quality. While none of these species are currently listed as globally threatened on the IUCN Red List, they are locally vulnerable due to limited distribution and increasing coastal pressures. Monitoring and protection of seagrass beds are important for maintaining reef resilience and ecosystem function.

Seaweeds; Marine Macroalgae

Seaweeds are primary producers on tropical reefs, forming the base of the food web and serving as an important resource for both marine herbivores and humans. Across the Pacific, seaweeds are named and used in diverse ways, often reflecting deep-rooted cultural traditions. In the CHamoru language, various names are used for different seaweed types based

on their appearance, use, or occurrence. Ado' refers to the edible *Caulerpa* "sea grapes," which are sold at markets and commonly eaten as a side dish of fresh sea vegetables. Chå'guan tåsi, literally meaning "grass of the sea," is a general term for seagrasses but also includes certain seaweeds like *Sargassum*, which is traditionally used as bait to catch Nasinae (unicornfish) using rod and reel. Other CHamoru names include cha'cha' (*Gracilaria tsudae*), take' uchan (*Nostoc*, terrestrial blue-green alga), lo'u (a general term for seaweeds), gulimån, and lumot tasi. In addition to long-standing traditional uses, newer practices involving seaweeds have emerged in response to ecological changes on Guam's reefs. For example, large blooms of the green seaweed *Chaetomorpha vieillardii* have led to its use as bait for Siganidae and as a fresh ingredient in salads.

Currently, all locally sourced seaweed in Guam is wild harvested. While the large-scale farming of agar- and carrageenan-producing seaweeds is not economically viable due to competition from regional producers such as Indonesia and the Philippines, mariculture of high-value species may hold promise. Because many tourists visiting Guam come from Asian countries where seaweed is a traditional and valued part of the diet, this creates a unique opportunity to develop niche markets for seaweed-based products. Additionally, emerging industries in pharmaceuticals and animal feed are increasingly interested in non-traditional, currently unfarmed seaweed species, presenting new avenues for aquaculture development.

Guam's fringing reefs are textbook examples of algal ridges, where calcifying red algae dominate reef crests exposed to intense wave action and desiccation. These algae form a thin, living veneer that consolidates and protects the reef structure. Beyond the crest, calcifying red algae are also abundant across other reef habitats, where healthy communities are essential for coral recovery following disturbance or mortality events. They are the preferred recruitment substrate for coral larvae, and species-specific interactions, mediated by chemical settlement cues, can significantly enhance larval settlement and recruitment success (Deinhart et al., 2022; Abdul Wahab et al., 2023).

Species of concern, such as *Rhodophyta* (red seaweeds), Ulvophyceae (green seaweeds), and Phaeophyceae (brown seaweeds), occur in marine and estuarine environments from shore to twilight zone. These species face many threats including marine heatwaves, water quality degradation, habitat loss, outbreaks of nuisance species, introduction and spread of invasive species, and over-harvesting. Calcifying red algae, *Rhodophyta:* Corallinophycidae, Peyssonneliales, face similar threats.

Large-scale outbreaks of nuisance seaweeds have become an increasing concern in the Mariana Islands. Additionally, studies indicate that several non-native seaweed species have become naturalized in Guam's waters. As the main entry point for maritime traffic, Apra Harbor is likely the primary site of introduction for many non-native species. Acomprehensive baseline survey of seaweed diversity and reef community composition in Apra Harbor is therefore strongly recommended to support early detection, monitoring, and prevention of further spread.

Fanihi

Pteropus mariannus

Mariana fruit bat



Photo by Scott Vogt

HISTORIC AND CURRENT STATUS: Earliest records of bats in Guam did not provide counts but simply noted that bats were "not uncommon" (Crampton, 1921; Wiles, 1987). It was not until the 1950s that an estimate of several thousand bats, mostly found near Fena Lake in Southern Guam, was recorded (D. H. Woodside 6 month visit in Guam) (Wiles, 1987). The fanihi population slowly continued to decline until intermittent, concerted population surveys were started in the 1990s and early-2000s. A significant increase to about 850-1000 fanihi in the population was noted in the 1980s, probably a result of the temporary migration from Rota to Guam. This is speculated to be the result of typhoon disturbance at a colony on Rota (Janeke, 2003). Between 1983 and 2008, Guam's fanihi population declined dramatically to 425–500 individuals (Wiles et al., 1989). By the early-2000s, the population had been reduced to a single colony with as little as 50 individuals at Pati Point on Andersen Air Force Base (AAFB) (Brooke, 2008; SWCA Environmental Consultants, 2013). This sharp decline was attributed to several threats, especially predation by BTS, which likely preys on non-flying young while their mothers forage, but also by illegal poaching, habitat degradation caused by feral ungulates, and human disturbances (USFWS, 2005). Regular, more consistent, and concerted survey and monitoring efforts did not begin in earnest until 2014 (on AAFB by the cooperative project of UOG and Naval Facilities Engineering Command Marianas [NAVFACMAR]). Guam's fanihi population remained small and fluctuating, ranging from about 15 individuals in 2014 to around 82 in 2020 (DAWR, 2020). Currently there are less than 200 fanihi throughout Guam with a few known roost colony sites.

THREATS: Fanihi face a host of threats, including native habitat loss by development and military training activities, habitat degradation by humans and non-native species, and illegal hunting. Habitat loss and declining forest health may have detrimental effects to food sources and roosting sites. Poaching of fanihi occurs as a result of the historical, cultural practice of consuming bats, which peaked during World War II and the years preceding, likely as a result of severe rationing imposed on the CHamoru peoples by the Japanese (Rogers, 1995). After the war, poaching events were less common, likely due to the protected location (within AAFB) and small population size.

HABITAT: Native mature limestone and ravine forest

GOAL: Implement Recovery Plan actions, restore/maintain healthy, manageable populations of fanihi, and fill ecological knowledge gaps for this species to improve future conservation management initiatives

OBJECTIVES: Establish safe foraging and roosting sites around the island that inhibit poaching and have predator monitoring and control measures in place. Further enhance the knowledge of fruit bat ecology and life history to better inform resource managers.

ACTION PLAN: (Recommendations provided from the 2017 Mariana Fruit Bat Management Plan)

- Indirect and direct threats: Eradicate BTS. Implement effective control measures such as enclosures to protect fruit bat roosting and foraging areas from BTS. Prohibit hunting with shotguns on AAFB. Investigate limiting factors on the remaining population at known roost sites and foraging areas.
- Habitat degradation and loss: Eradicate ungulates and invasive plants that degrade habitat and outplant native trees preferred by bats' diet. Limit degradation and destruction of natural limestone forest habitat and restore these areas.
- Small or extirpated population: Investigate current population through continued monitoring and the response to current weather trends.

- Monitoring: Continue quarterly surveys and annual base-wide counts. Continue follow-up surveys of opportunistic fruit bat sightings and preconstruction surveys.
- Adaptive management: Investigate fanihi response to aerial BTS suppression activities, interisland movement of individuals between Guam and Rota, and fruit bat habitat including habitat use and selection patterns, diet, and availability and distribution of preferred habitat.
- Planning and outreach: Support efforts among local and federal agencies in regular meetings and cooperative review of project plans and reports. Support educational outreach and awareness through media coverage and training in annual base-wide surveys.

Fanihi liyang

Emballonura semicaudata rotensis

Pacific sheath-tailed bat



HISTORIC AND CURRENT STATUS: Fanihi liyang is a subspecies endemic to Guam, Rota, Tinian, Saipan, and Aguiguan. This species previously occurred in Guam and was last seen in 1972 (Wiles et al., 1995). Little is known about its ecology and natural history. As of 2004, the cave dwelling mammal only existed on the island of Aguiguan, with an estimated population of 400-500 individuals (Esselstyn et al., 2004). Most recent surveys only found the species in Aguigan with a single population estimated at a minimum of 300 individuals (USFWS, 2023).

THREATS: Predation, competition, human disturbance, and pesticides may have caused this species to be extirpated in Guam.

HABITAT: Forages in forested areas, known to previously roost in caves in southern and northern Guam.

GOAL: Reduce BTS numbers at historic roosting caves. Research biology, ecology, and other pertinent natural history information to increase knowledge of the species (and similar species). Investigate and obtain information about current roost caves in the CNMI to compare with caves in Guam scheduled for enhancement and preparation for future species re-introduction.

OBJECTIVES: To establish a small population of fanihi liyang 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 and competition: Investigate BTS population at historic caves and plan for predator control measures to be implemented. Investigate black drongo (*Dicrurus macrocercus*) population near historic caves and bat foraging areas.
- Knowledge gaps: Explore partnerships with government agencies (Guam and CNMI), non-profit groups, NGOs, and other community groups to establish projects to study the natural history of fanihi liyang 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 fanihi liyang. Reduce ungulate numbers at the colony and adjacent areas, develop and implement reforestation techniques in Guam's local and federal conservation areas.
- Outreach and Awareness: Revitalize and expand the "Prutehi I Fanihi" campaign to address Sheath-tail bat. Establish partnerships with other agencies, organizations, and community groups in Guam and the CNMI to develop and implement the campaign.

Ko'ko'

Hypotaenidia owstoni

Guam rail



HISTORIC AND CURRENT STATUS: The ko'ko', endemic to Guam, was once found island wide with an estimated 60,000 in 1960 (Jenkins, 1979). By the early 1970s, it had disappeared from southern Guam but was still observed in central and northern areas (Beck & Savidge, 1990). By 1981, the population had declined to approximately 2,300 birds, concentrated on Andersen Air Force Base (AAFB) (Beck & Savidge, 1990) In response to this rapid decline, a captive breeding program was initiated in 1984 with the capture of 22 individuals (Newland, *pers. comm.*). Since then, over 2,000 ko'ko' have been bred in captivity from 12 ko'ko' in that founding population (DOAG, 2016).

An experimental release program began on Rota in 1989, and more than 1,000 birds have been released to date. Efforts to re-introduce ko'ko' to snake-controlled habitats on Guam began in 1998 and 2003, including releases in Area 50 on AAFB, where nesting and hatchlings were observed. However, the birds failed to establish due to the likely predation by feral cats. By 2019, the population on Rota was estimated at 200 individuals. The last release on Rota took place in 2020 but the current number is unknown as they have not been detected since 2023. The Department aims to conduct more surveys to determine population numbers and anticipates more releases later this year and 2026. As of June 2025, approximately 30 ko'ko' were held across 9 AZA-accredited zoos in the United States (Newland, *pers. comm.*). The Department's breeding facility currently houses 85 birds in the captive breeding program, and an additional 25-40 birds are found on Islan Dåno' where active nesting and chick sightings confirm successful reproduction.

THREATS: The principal cause of decline and extinction in the wild is BTS predation. Other causes that may have contributed to the decline may include habitat loss and modification, human exploitation, typhoons, pesticides, feral cat, feral dog, and monitor lizard predation. Populations on Rota are known to be threatened by wildfires and should be accounted for as a potential threat for re-introduction in Guam. Little fire ants could also threaten chick survival and reproductive success.

HABITAT: Ko'ko' has been observed in all habitats except wetlands.

GOAL: To re-establish a breeding population of ko'ko' in Guam and protect the currently established insurance population on Islan Dåno'.

OBJECTIVES: To maintain captive breeding population to provide for releases in the wild. To establish ko'ko' in designated predator-controlled sites in Guam.

ACTION PLAN:

- Introduced predators: Continue and expand BTS and feral cat control efforts at potential release sites and continue supporting efforts to improve BTS studies and measures.
- Small or extirpated populations: Continue captive breeding efforts and participation in Guam Rail Species Survival Plan to maintain a sustainable captive ko'ko' population that will enable both future ko'ko' introductions and supplemental releases of existing wild populations as needed. Conduct further surveys to determine population numbers in Rota. Continue support of existing wild populations on Rota and Islan Dåno' through control of introduced predators and supplemental releases of additional birds, if necessary. Identify additional suitable release sites for ko'ko' elsewhere on Guam and within the CNMI for new introductions.

Paluman Åpaka' (male) & Paluman Fache'(female)

Pampusana xanthonura

White-throated ground dove

Photo by Kalin Ocaña



HISTORIC AND CURRENT STATUS: This subspecies of white-throated ground dove is endemic to the Mariana Islands and Yap. Historically, this species was abundant throughout all habitats in Guam. By the 1980s, its population was limited to the northern part of the island with about 548 individuals (Engbring & Ramsey, 1984) but was considered extirpated from Guam by 1986 due to BTS predation. However, at least 20 confirmed sightings have occurred between 1998 and 2021, and these individuals are presumed to be from populations in CNMI (Wiles et al. *in prep)*. Most records are from northern Guam, specifically AAFB, with sightings also in Yigo, Agana Heights, Talo'fo'fo', and Mangilao. Most recent sightings include a male repeatedly seen at the DOAG compound in Mangilao from late 2018 through 2019, a male observed flying south of AAFB's back gate in February 2021, and another male photographed in that same area later that year.

THREATS: The principal cause of decline and extinction in the wild is BTS predation. Other causes may include habitat loss and modification, human exploitation, typhoons, pesticides, disease, feral cats, and monitor lizard predation.

HABITAT: 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 re-introduce 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 of this species. To determine if individuals observed in Guam are migrating or established individuals.

ACTION PLAN:

- Introduced predators: Implement and expand area-wide BTS control at potential release sites.
- Habitat degradation and loss: Reduce ungulate 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 of capturing and banding individuals observed in Guam and Rota.

Totot

Ptilinopus roseicapilla

Mariana fruit dove



Photo by Kalin Ocaña

HISTORIC AND CURRENT STATUS: Endemic to Guam and the Northern Mariana Islands, the totot was found throughout Guam, excluding coastal strand and grassland. Surveys conducted in the 1970s indicated that the totot population in southern Guam no longer existed and a population in northern Guam was severely reduced (DAWR, 1970-1999). This forest bird was extirpated in Guam in 1985 (Wiles et al., 1995). Although they are not currently found in Guam, the totot still occurs in neighboring islands. A local resident reported a sighting in 2012 in the Anao area. A former conservation officer observed a totot in Yigo across Mobil gas station.

THREATS: The principal cause of decline and extinction in the wild is BTS predation. Other causes may include habitat loss and modification, human exploitation, typhoons, pesticides, competition, disease, and feral cat, feral dog, monitor lizard predation.

HABITAT: Totot were observed in all forested habitats including native limestone and ravine forest, except savanna complex and beach strands.

GOAL: To restore a population of totot in northern and southern Guam.

OBJECTIVES: To re-introduce 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 of this species.

ACTION PLAN:

- Introduced predators: Implement and expand area-wide BTS control at potential release sites.
- Habitat degradation and loss: Reduce ungulate numbers at potential release sites and adjacent areas, develop and implement reforestation techniques in 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 totot eggs and chicks from Rota to Guam.

Yayaguak

Aerodramus bartschi

Mariana swiftlet



Photo by Kalin Ocaña

HISTORIC AND CURRENT STATUS: The yayaguak is endemic to the islands of Guam, Rota, Aguigan, Tinian, and Saipan. Historically, this species was widely distributed and was described as the most common bird in Guam in surveys as far back as 1945 (Jenkins, 1983). Unfortunately, the population underwent a drastic decline during the late 1960s through the 1970s (Jenkins, 1983). In early 2000, DAWR received a report of a small number (less than 20 birds) in Janum Point, northern Guam (USFWS, 2020j). Overall population numbers were greatly reduced due to various threats described below and are still in decline. Most recently, a study from 2019 to 2023 observed yayaguak populations at Mahlac, Maemong, and Fachi caves with 500-600, 140-200, and 30 birds, respectively (Gorresen et al., 2024).

THREATS: Habitat loss and degradation (loss of foraging habitat and cave disturbance), predation by the BTS in Guam, nest damage by insects, and climate change are ongoing threats. Pesticide use may be a potential threat, but research is currently limited.

HABITAT: Yayaguak nest and roost on cave walls and ceilings and forage for insects across various habitats in southern Guam. They have also been observed clinging to walls of limestone cliffs.

GOAL: To restore and protect yayaguak populations in known caves.

OBJECTIVES: To expand the distribution of this population by recolonizing a cave in northern Guam by translocating yayaguak from the south colony. To maintain and enhance the population in the southern colony. To continue monitoring the population of yayaguak.

ACTION PLAN:

- Introduced predators and competition: Continue BTS control measures at the Mahlac, Maemong, and Fachi caves, and implement and expand area-wide BTS and other predator control to potential release sites. Research potential use of artificial caves for yayaguak translocation.
- Habitat degradation and loss: Prevent caves historically used by yayaguak from disturbance or degradation and reduce ungulate numbers around potential release sites. Develop and implement reforestation measures on Guam conservation areas and national wildlife refuge overlay lands.
- Small or extirpated population: Monitor population abundance and distribution. Identify potential release sites in northern Guam. Translocate individuals from the southern population and re-introduce to historical caves in the north. Utilize acoustic monitoring to determine presence at suspected new locations.
- Climate change: Research climate change impacts on yayaguak colony at the Fachicave during prolonged rain events (flooding) and other limiting factors of climate change that may affect the yayaguak.

Sihek

Todiramphus cinnamominus

Guam kingfisher



Photo by Martin Kastner

HISTORIC AND CURRENT STATUS: Endemic to Guam, sihek historically occurred throughout the island but were less abundant in ravine and coastal forests of southern Guam (Jenkins, 1983). The species was last recorded in southern Guam by mid-1960 (Jenkins, 1983). In 1981, a population occurred only in northern Guam with an estimated 3,023 individuals (American Zoo & Aquarium Association). In 1984, around 20 individuals were captured for captive breeding. By 1988, this species was no longer found in the wild in Guam (Wiles et al., 1995). Currently, 5 birds are in captivity in Guam and about 130 exist in various U.S mainland zoos.

THREATS: The principal cause of decline and extinction in the wild is BTS 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, and monitor lizard predation.

HABITAT: This species once occupied all habitats throughout Guam, except savanna complex and wetlands. As this species nests in cavities, forests with umumu (*Pisonia grandis)* trees are particularly important as it is a favored tree in which sihek excavates nest cavities.

GOAL: To restore a wild population in Guam.

OBJECTIVES: To continue captive breeding efforts to maintain a sufficient supply of birds for upcoming releases.

ACTION PLAN:

- Introduced predators: Implement and expand area-wide BTS and predator control at potential release sites.
- Habitat degradation and loss: Reduce ungulate numbers at potential release sites and adjacent areas, develop and implement reforestation measures in Guam's conservation areas and national wildlife refuge overlay lands.
- Small or extirpated populations: Continue participation in Micronesian kingfisher SSP, continue captive breeding in Guam, and determine potential sites for kingfisher re-introduction in Guam.

Åga

Corvus kubaryi

Mariana crow



Photo by Martin Kastner

HISTORIC AND CURRENT STATUS: Åga is endemic to Guam and Rota but no longer exists on Guam. In 1981, the population was restricted to parts of the northern plateau with an estimated 350 birds (Engbring & Ramsey, 1984). By 1999, fewer than 7 wild individuals remained strictly on AAFB property (Jenkins, 1983). The last åga in Guam died in captivity in 2013. At present, the only remaining wild population exists on Rota.

THREATS: The principal cause of population decline was BTS predation. Other factors may include habitat loss and modification, human exploitation, typhoons, pesticides, competition, disease, predation, food resources, inbreeding, and senescence[3] . Restoration of the åga could be hampered by the loss of forest habitat required by this species.

HABITAT: Åga was found in most habitats in Guam, except the savanna. They were commonly observed in mature native forests, areas with secondary growth and mixed-woodlands.

GOAL: To restore the åga population to historic levels in Guam of about 300 birds. To collaborate efforts with CNMI-DFW to restore åga population on Rota.

OBJECTIVES: Work with the CNMI Fish and Wildlife to 1) translocate eggs or chicks from Rota to start a breeding program and 2) conduct research into implementing artificial incubation and hand rearing during breeding season on Rota.

ACTION PLAN:

- Introduced predators: Continue and expand area-wide BTS control at release site and adjacent areas and assess BTS threshold for åga re-introduction efforts.
- Habitat degradation and loss: To manage ungulate numbers on AAFB, develop and implement reforestation measures on conservation areas in Guam.
- Small or extirpated populations: Work with CNMI to translocate åga eggs and chicks from Rota to Guam for potential re-introduction.

Såli

Aplonis opaca guami

Micronesian starling



Photo by Martin Kastner

HISTORIC AND CURRENT STATUS: A subspecies endemic to Guam, Rota, Tinian, and Saipan, the såli is a cavity nester. Historically, the species was found across all habitats in Guam but most commonly in forested areas (Jenkins, 1983). A 1981 survey determined that the såli was one of the most abundant bird species in Guam at that time (Engbring & Ramsey, 1984). Såli are predominantly found in the AAFB housing area and nearby on Mount Santa Rosa. As of 2019, the island-wide population was estimated at 1,400 individuals, with 93-96% residing at AAFB (Pollock et al., 2022). The såli population at AAFB had increased approximately by 15-fold since the early 1990s. The species has highly adapted to urban environments and has been found to successfully nest and reproduce in buildings and other man-made structures. Outside of AAFB, small populations have been observed in northern and central Guam with 30-40 individuals near Yigo and Dededo, 20-30 individuals in Hagåtna, 10-20 individuals in Tamuning-Tumon-Harmon, and up to 10 individuals in other areas. In addition, an isolated resident population of approximately 30-40 individuals lives on Islan Dåno' (Cocos Island).

THREATS: The principal cause of decline in the wild is BTS predation. Other sources of mortality may include human exploitation, typhoons, pesticides, competition, disease, ungulates, feral cats and dogs, monitor lizard predation.

HABITAT: The såli utilizes all habitat types, and although they were once most common in forested areas, today they are most frequently found in Guam's urban areas.

GOAL: To increase population numbers and distribution in Guam.

OBJECTIVES: To promote successful nesting in AAFB and Islan Dåno', and other designated sites. To translocate såli from Andersen Air Force Base and Islan Dåno' to BTS-free areas.

ACTION PLAN:

- Small and extirpated populations: Explore the feasibility in implementing nest boxes across central Guam to support increasing reproductive success and population health.
- Introduced predators and competition: Implement and expand area-wide BTS control at potential release sites.
- Habitat degradation and loss: Reduce ungulate numbers impacting såli foraging areas.

Egigi

Myzomela rubratra saffordi

Micronesian honeyeater



Photo by Kalin Ocaña

HISTORIC AND CURRENT STATUS: This subspecies of honeyeater is endemic to the Mariana Islands. Historically, egigi was abundant throughout Guam occupying all habitats including urban areas (Jenkins, 1983). In 1980, the declining population was found only in the Northwest field in AAFB (Engbring & Ramsey, 1984). By 1986, the bird was extirpated in Guam (Wiles et al., 1995). Currently, the egigi is found in neighboring islands of Rota, Saipan, and Tinian where healthy populations exist.

THREATS: The principal cause of decline and extinction in the wild is BTS predation. Other causes may include habitat loss and modification, human exploitation, typhoons, pesticides, competition, disease, and predation by feral cats, dogs, rats and monitor lizards.

HABITAT: A versatile species, egigi was found in various habitat types in Guam including strand forest, scrub forest, limestone forest, urban and agroforest areas.

GOAL: To restore the egigi population in Guam.

OBJECTIVES: Obtain information to better understand the biology of the species. Enhance habitat in Guam to allow for re-introduction. Translocate egigi from Rota or Saipan.

ACTION PLAN:

- Introduced predators: Implement and expand area-wide BTS 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 egigi to encourage research opportunities and increase monitoring efforts of the current population in Mariana Islands.
- Small or extirpated populations: Conduct research into translocation to Islan Dåno'. Partner with CNMI to increase efforts to survey and monitor populations in Rota and/or Saipan.

Pulattat

Gallinula chloropus guami

Mariana common moorhen



Photo by Martin Kastner

HISTORIC AND CURRENT STATUS: The pulattat is an endemic subspecies to Guam, Saipan, Tinian and Pagan. Before 1951, the population was noticeably abundant in freshwater areas (Baker, 1951). The species has experienced population declines in recent years. Results from a 1981 survey showed that the pulattat was rare, with only 2 birds accounted for during the survey (Engbring & Ramsey, 1984). By 1999, pulattat were found throughout the southern and central parts of Guam, with population estimated at 100-125 birds (DAWR, 1999). The population numbered about 90 birds in the early 2000s (Takano, 2003). Sightings of adult pairs with chicks are being made in wetland habitats throughout the island.

THREATS: Major causes of decline are habitat loss and modification. Other causes include competition, human disturbance, development and encroachment of invasive vegetation, and predation by BTS and stray animals.

HABITAT: Pulattat is abundant in both natural and man-made freshwater habitats throughout Guam.

GOAL: To restore and maintain a population throughout Guam's wetlands.

OBJECTIVES: To maintain wetland habitat and prevent encroachment by development and invasive species.

ACTION PLAN:

- Introduced predators: Implement and expand area-wide BTS control at potential sites, as well as control for other predators.
- Habitat degradation and loss: 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 *Phragmites karka*. To assess the status of mitigation wetland areas and take appropriate management actions. Strengthen protection of wetlands throughout Guam. To continue work on building nest platforms to provide habitat in areas with deep waters.
- Small or extirpated populations: Partner with CNMI to establish a project to determine current population status and explore techniques to improve breeding habitats.
- Climate change: Investigate impacts of prolonged droughts and increased rain events on pulattat populations.

Gå'ga' Karisu/ Ga' kaliso/Ga'karriso

Acrocephalus hiwae

Nightingale reed warbler



HISTORIC AND CURRENT STATUS: Gå'ga' karisu is an endemic subspecies to Guam, Saipan, and Almagan. Historically, this bird was believed to be rare in Guam and restricted to wetlands (Baker, 1951). By the 1960s, the species was known to occur in four locales: Agana Swamp, Atantåno River Marsh, Masso River Mouth, and an undescribed location in Hågat (Reichel et al., 1992). After 1969, this bird species was no longer found in these areas (Reichel et al., 1992). Presently, the gå'ga' karisu is considered extinct in Guam.

THREATS: The principal cause of decline and extinction in the wild is BTS predation. Other causes may include habitat degradation and loss due to human disturbance and development and ungulate damage, along with wildfires, typhoons, pesticides, competition, and disease.

HABITAT: Restricted to adjacent areas in and near fresh and brackish water marshes.

GOAL: To introduce a viable population of gå'ga' karisu in Guam as a replacement species.

OBJECTIVES: Obtain information to better understand the biology of the species. Enhance habitat in Guam to allow for re-introduction. Translocate gå'ga' karisu from CNMI to Guam.

ACTION PLAN:

- Introduced predators: Implement area-wide BTS control in the wetlands in Guam.
- Habitat degradation and loss: Reduce ungulate numbers, develop and implement habitat restoration techniques on wetlands, and strengthen and enforce regulations on development and usage of the wetlands.
- Knowledge gaps: Explore partnership with CNMI to design an introduction and monitoring plan to bring gå'ga' karisu to Guam.
- Climate change: Research climate change impacts affecting nesting sites during prolonged raining and flooding events and other limiting factors influenced by climate change that may alter the species.

Utak or Fakpe

Phaethon lepturus

White-tailed tropicbird



Photo by Martin Kastner

HISTORIC AND CURRENT STATUS: The utak is found throughout most of the Pacific Ocean, except for its easternmost areas, and is also present in the Atlantic Ocean. 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 cliff line at Two Lover's Point. 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.

THREATS: Predation by the BTS is the most likely reason for the loss of the resident population in Guam.

HABITAT: Foraging from reef flat to open deep sea, nest in crevices located on cliff walls.

GOAL: To restore a nesting population to northern Guam.

OBJECTIVES: To maintain BTS-free habitats along northern cliff walls.

ACTION PLAN:

- Introduced predators: Implement and expand area-wide BTS control at potential roost and nest sites.
- Habitat degradation and loss: To prevent loss of historic cliffline roost sites.
- Small or extirpated populations: Collect information on this species distribution and abundance. Identify potential nest and roosting sites in Guam and respond appropriately to promote nest success in these areas.

CHúchuko' Átilong (dark morph)
CHúchuko' Ápaka' (pale morph)

Egretta sacra

Pacific reef heron

Photo by Kalin Ocaña



HISTORIC AND CURRENT STATUS: The Pacific reef heron occurs in many areas of the tropical Pacific. This species is an endemic shorebird to Guam. Historically, a breeding population occurred throughout the western coast (Orote Peninsula) to Islan Dåno' (Baker, 1951). In 1981, sightings were common in northern Guam and several individuals were seen along the Islan Dåno' coast (Engbring & Ramsey, 1984). Sightings of individuals still occur around a large portion of the island, on offshore islets, and on Islan Dåno' (Thompson, *pers. comm.)*.

THREATS: Probable causes affecting this species include BTS and rat predation and habitat loss and modification.

HABITAT: 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 in 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 in 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.

Lu'ao

Sula leucogaster

Brown booby



Photo by Kalin Ocaña

HISTORIC AND CURRENT STATUS: Lu'ao occurs throughout the tropical Western Pacific, south to Australia, and throughout the Atlantic. Historically, this species was not seen abundantly throughout Micronesia (Baker, 1951). Twenty-five birds were seen roosting on Orote Point from June to August 1997 (DAWR, 1997). Incidental sightings of individuals ranging from the Orote peninsula to the north, extending to the eastern and southeastern shores of Guam have been made. A breeding population was known from Guam but was extirpated (Wiles et al., 2003), most likely due to BTS.

THREATS: Predation by the BTS and rats may have caused this species to be extirpated from Guam.

HABITAT: Lu'ao nests 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 in Guam.

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

ACTION PLAN:

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

Dulili/Kåålalang

Migratory Shorebirds



Photo by Martin Kastner

HISTORIC AND CURRENT STATUS: Over 40 species of migratory shorebirds representing Charadriidae and Scolopacidae are known to winter in Guam (Reichel & Glass, 1991; Wiles et al., 2000; Engilis & Naughton, 2004). While a great majority of migrants fly over Guam (Williams & Williams, 1988), many individuals overwinter here as the island provides critical habitat essential to their survival.

THREATS: Predators and loss of habitat remain significant factors in reducing the number of migrants in Guam.

HABITAT: Wetland, estuaries, tidal flats, grasslands, and uplands are important habitats for migrant shorebirds and resident shorebirds (Engilis & Naughton, 2004).

GOAL: Restore and maintain habitat for dulili.

OBJECTIVES: Determine the abundance and distribution of shorebirds. Reduce BTS and rats in areas used by the different species. Prevent habitat loss.

ACTION PLAN:

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

Guali'ek hålom tåno'

Cryptoblepharus poecilopleurus

Snake-eyed skink

Photo by Jonathan Richmond



HISTORIC AND CURRENT STATUS: The snake-eyed skink was historically widespread throughout Guam and the Marianas Islands (Rodda et al., 1991). The last recorded specimen in Guam was in 1969 (Rodda et al., 1995), where it is believed to be extirpated; however, the species still occurs in Islan Dåno'. Anecdotal observations indicate that the abundance of *C. poecilopleurus* has increased in Islan Dåno' after a successful rat eradication effort in 2009.

THREATS: Possible causes of decline may include predation by introduced species and competition with introduced skink species.

HABITAT: Observed near coastal strands, often found in loose, sandy soil and on the trunks of coconut palms.

GOAL: To restore populations to coastal areas of Guam.

OBJECTIVES: To determine the status of this species in Guam and Islan Dåno'. To identify causes of decline and mitigate threats.

ACTION PLAN:

- Introduced predators: Implement and expand control measures for BTS, musk shrew, feral cat, and rats in areas with preferred habitat for *C. poecilopleurus.*
- Habitat degradation and loss: Prevent loss of habitat in areas deemed important to the skinks.
- Small or extirpated populations: Identify lizard population abundance where they occur and consider the potential of captive propagation for future releases in protected areas in Guam.

Guali'ek hålom tåno'

Emoia slevini

Slevin's skink



Photo by Jonathan Richmond

HISTORIC AND CURRENT STATUS: An endemic species to Guam, Islan Dåno', Rota, Tinian, Guguan, Alamagan, Asuncion, and Maug (Rodda et al., 1991; McCoid, 1995; Vogt & Williams, 2004). The species has not been recorded in Guam since 1945 and there was some concern that it was extirpated from Islan Dåno' following two cyclones in the early 1990s; however, it was rediscovered in Dåno' after a successful rat eradication effort in 2009 and is now frequently observed in certain parts of the islet (Richmond et al., 2022). Additionally, successful ungulate eradication led to a dramatic rebound of *E. slevini* on Sarigan in the late 1990s (Kessler, 2002), which could inform future re-introduction efforts for this species onto Guam.

THREATS: Possible causes to the decline of this species include the following: predation by introduced species, habitat loss, competition with non-native skinks (e.g., curious skink (*Carlia ailanpalai*) in Guam), and habitat conversion due to the presence of ungulates.

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 Islan Dåno'.

OBJECTIVES: To supplement the current population in Guam and Islan Dåno' from other islands (CNMI).

ACTION PLAN:

- Introduced predators: Continue area-wide BTS control. Support the control of monitor lizard, musk shrew, feral cat, and rat on Islan Dåno' to increase abundance.
- Habitat degradation and loss: Prevent loss of habitats deemed important to the skinks.
- Small or extirpated population: Quantify population density and consider the potential of captive propagation for future releases in protected sites in Guam. Explore possible ways of habitat expansion on Islan Dåno'.

Guali'ek hålom tåno'

Ornithuroscincus noctua

Moth skink



Photo by Jonathan Richmond

HISTORIC AND CURRENT STATUS: The moth skink is found in much of the western Pacific. In the Mariana Islands, it is found only in Guam and possibly on Rota, as unverified sightings were reported (Vogt & Williams, 2004). A native species to the Marianas, this species was not common in Guam. However, four individuals were collected on a single day in 1986. In the early 1990s, the moth skink was known to occur at three areas: Hilaan Point, Haputo Beach, and Achae Point along the northwestern coast (Wiles et al., 1995). However, Vogt and Williams (2004) indicate it occurs in central parts of Guam and is abundant in the Naval Ordnance Annex area, but there is conflicting information on its status.

THREATS: Possible causes of the decline 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 in Guam.

ACTION PLAN:

- Introduced predators: Implement and expand area-wide introduced species control of curious skinks, shrew, BTS, 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 in Guam and implement a captive breeding program for future releases in protected areas in Guam.

Guali'ek hålom tåno'

Perochirus ateles

Micronesian gecko



Photo by Nathan Sablan

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 (Pregill, 1998). This gecko was present throughout the post-war period in Guam and in other southern Mariana Islands (Rodda et al., 1991). Currently, the Micronesian gecko is considered rare and information on this species is lacking.

THREATS: Predation by BTS, Oceanic gecko (*Gehyra 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 BTS.
- Small and extirpated population: Work closely with private organizations and community groups 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 in Guam.

Guali'ek hålom tåno'

Emoia atrocostata

Littoral skink



Photo by G. Curt Fiedler

HISTORIC AND CURRENT STATUS: The littoral skink, also known as the tide-pool skink or mangrove skink, is a Mariana's endemic species that occurs on Guam, Islan Dåno', Aguiguan, Rota, Tinian, Saipan, and possibly Guguan (Vogt & Williams, 2004). This species was first recorded in Guam in the village of Inalåhan in September of 2006 and was quite common on Islan Dåno' along with some of the small fringing islets (Reed et al., 2007). There is a possibility that this species may be present on more of the northern islands (Vogt & Williams, 2004).

A limited genetic dataset indicates that *Emoia atrocostata* in the Mariana Islands is more closely related to the endemic *E. slevini* than to *E. atrocostata* in other parts of its range (Richmond et al., 2021; Richmond et al., 2022). Adult body size in the Marianas is also notably smaller than elsewhere in the range of *E. atrocostata.* This preliminary evidence suggests that the currently recognized *E. atrocostata* in the Marianas may represent an endemic, undescribed species, but additional genomic data are needed to more thoroughly test this hypothesis.

THREATS: Coastal development, habitat degradation, and invasive species.

HABITAT: Observed in limestone/rocky foreshore areas (i.e., the littoral zone), particularly those marked by the shrub *Pemphis acidulous* (Perry et al., 1998; Reed et al., 2007)c. The tide-pool skink is saltwater-tolerant and will jump into seawater pools to escape predators (Vogt & Williams, 2004).

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

OBJECTIVES: Conduct population assessments, monitor habitat quality, and confirm taxonomic identity using genomic data.

ACTION PLAN:

- Introduced predators: Implement and expand area-wide control for predatory species, such as rodents, shrews, cats, ants, and BTS.
- Small and extirpated population: Work closely with private organizations and community groups to explore the feasibility of captive propagation for this species.
- Habitat degradation and loss: Prevent loss of key habitats for this species.

Ayuyu

Birgus latro

Coconut crab



Photo by Else Demeulenaere

HISTORIC AND CURRENT STATUS: The ayuyu (*Birgus latro*, coconut crab) is an arthropod with varied significance in the Marianas. The species is a primarily nocturnal animal due to human harvesting. However, as observed on the uninhabited islands of Guguan and Asuncion, they are active both day and night due to the absence of human activity (Amesbury, 1980). Currently there is no data for population numbers of ayuyu in Guam.

THREATS: The primary threat to ayuyu is human activity, including over-harvesting, coastal developments altering their habitats, and climate change effects decreasing habitat availability (Cumberlidge et al., 2022, p. 11). In Guam, another threat is the invasive coconut rhinoceros beetle (*Oryctes rhinoceros)* (CRB) which damages the coconut, a major food source for the crab, affecting the species' survivability and overall population health.

HABITAT: Limestone forests and beaches

GOAL: Protect and restore sustainable populations of ayuyu

OBJECTIVES: Increase the abundance and distribution of ayuyu by reducing human harvesting pressure, protecting critical habitats, and addressing decline of the species' main food source

ACTION PLAN:

- Protect populations and habitats: Enforce no-take regulations and establish protected areas in key coastal and limestone habitats.
- Safeguard food resources: Support efforts to control CRB to maintain healthy coconut groves.
- Monitor and manage threats: Track population trends and reduce predators.
- Community engagement: Raise awareness and promote culturally grounded stewardship to reduce over-harvesting.

Hypolimnas octocula marianensis

Mariana eight-spot butterfly

Photo by Matthew Putnam



HISTORIC AND CURRENT STATUS: The Mariana eight-spot butterfly likely once occurred throughout the Southern Mariana Islands, as suitable limestone forest habitat and host plants are present on Guam, Rota, Saipan, and Tinian (Rubinoff & Holland, 2018). Although this species was historically recorded in Saipan (Sampson, 1986), it has not been observed there for decades. Despite the presence of its host plants, *Procris pedunculata* and tupun ayuyu (*Elatostema calcareum)*, on Rota and Tinian, the butterfly has not been seen on those islands either. Today, the Mariana eight-spot butterfly is known to survive in small numbers in Guam. Swezey collected one single female from a *Hibiscus* flower on October 17, 1936 (Moore, 2013). Of the fourteen species of butterfly recorded by Swezey (1942), *Hypolimnas octocula marianensis* appears to be the rarest. Muniappan collected three specimens on a limestone plant, *Procris pedunculata,* at Hila'an Point, on August 1975, one specimen from the AAFB in April 1982 and two specimens at Hila'an Point in 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), Hila'an, Asiga, Tanguisson Beach, and Guam racetrack (C. Fiedler, *pers. comm.*). The species' status is in decline and was listed as endangered under the U.S. Endangered Species Act on October 1, 2015 (USFWS, 2015c). Currently, the butterfly has been recorded from 6 to 19 locations (USFWS, 2021).

THREATS: Degradation and loss of limestone habitat due to development, ungulates, competitive invasive plant species, and predation. Feral ungulates are identified as the most significant threat because they graze on, trample, and uproot the butterfly's host plants. In addition, they alter the structure of the limestone forests and introduce invasive plant species. Invasive plant species also further contribute to the degradation of limestone forests. Several species have been documented as threats to the Mariana eight-spot butterfly or its host plants. Non-native ants and predatory wasps prey on butterfly eggs, while slugs feed on host plants, potentially reducing suitable habitat (USFWS, 2021). Some of these predators are native, suggesting the butterfly may have evolved with certain natural threats (Moore, 2013), while others are introduced and may pose new pressures.

HABITAT: Limestone forests where the two host plants, *Procris pedunculata* and tupun ayuyu, occur.

GOAL: Conserve viable host plant habitat and areas where *H. o. marianensis* has been recorded and establish a nursery population for rearing.

OBJECTIVES: Establish long-term routine population surveys at select locations. Survey viable host plant habitats. Study the biology and seasonal population dynamics of *H. o. marianensis*, rear *H. o. marianensis* in captivity, identify natural predators, and release captive reared adults in host plant habitats. Study the populations in Guam to determine existing population dynamics.

ACTION PLAN:

- Identify occurrences of butterflies and host plants. Reduce impacts of ungulates and invasive plants in limestone forests areas where host plants occur.
- Monitor the current populations by conducting surveys at known populations such as Hila'an Point.
- Increase the number of Mariana eight-spot butterfly individuals and population.
  - Collect wild caterpillars and rear them to adults in a predator free enclosure.
  - Release nursery bred adults in host plant dense habitats, especially in Guam's conservation areas.

- Increase the number of host plants and restore the natural forest structure and composition.
  - Collect propagules
  - Propagate plants in the nursery
  - Outplant and maintain seedlings in conservation areas
- Protect populations
  - Install natural buffers, exclusion fences, eradicate non-native ungulates from inside the enclosures, and remove invasive plant species.
  - Conduct research on predator control (ants and parasitoid wasps)

Vagrans egistina

Marianas wandering butterfly

HISTORIC AND CURRENT STATUS: This butterfly species was described from Guam and is endemic to the Marianas. In 1932, Swezey found this species rare but widespread in Guam (Schreiner & Nafus, 1997). In the 1970s, several specimens were collected from luluhut trees (*Maytenus thompsonii)*. Not much is known about the status in Guam.

THREATS: Causes for this species' rarity includes habitat loss of the host plants by introduced plant species, and predation of caterpillars by an ichneumonid wasp.

HABITAT: Limestone forests where the host plant, luluhut, occurs.

GOAL: To establish a viable population of *Vagrans egistina* in Guam.

OBJECTIVES: To survey luluhut habitats in Guam, determine seasonal population dynamics of *V. egistina,* and in the laboratory, culture *V. egistina*. To survey for natural enemies of *Vagrans* and study its biology. To release laboratory reared butterflies in habitats containing luluhut.

ACTION PLAN:

- Habitat degradation and loss: Identify and map localities with luluhut, reduce and prevent the development of limestone forest, and possible encroachment of invasive plants in these areas.
- Small or extirpated population: Conduct monthly surveys to determine its seasonality. To cultivate caterpillars of this species and rear them to the 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.
- Caterpillar predation: Investigate efficacy of controlling ichneumonid wasp in areas caterpillars occur.

Akaleha'

Partula gibba

Humped tree snail



Photo by G. Curt Fiedler

HISTORIC AND CURRENT STATUS: The humped tree snail is endemic to Guam and the Northern Mariana Islands. It was discovered and collected in 1819 during the Freycinet Uranie expedition in 1817-1819 (Crampton, 1925). Upon its discovery, this tree snail was considered to be the most abundant in Guam. In 1920, Crampton collected 3,204 individuals to determine geographic differences in shell patterns in 33 of his 39 sites studied (Crampton, 1925). No significant studies occurred until the late 1980s and early 1990s. 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 sites visited in 1989 supported no snails and one of the 13 new sites supported a small population (Hopper & Smith, 1992; Kanehira, 1936). In a 1995 survey, two humped tree snail populations were found in coastal areas (Smith, 1995). 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 (Smith, 1995). Currently, there are only about 100 individuals at the southern basin and slope of Haputo (NCTS, HERA) (C. Fiedler, *pers. comm.*). In 2025, the humped tree snail was awarded protection under the U.S. Endangered Species Act.

THREATS: The primary cause of decline for this species was from the predation by the introduced triclad flatworm, *Platydemus manokwari* and the invasive rosy predator snail (*Euglanina rosea*). 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, ungulates, typhoon disturbance, and climate change.

HABITAT: 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.

GOAL: To conserve and restore the population of humped tree snails in Guam.

OBJECTIVES: To determine the status of the species and if feasible, implement a captive breeding program. To determine the feasibility of captive propagation and implement a program.

ACTION PLAN:

- Conduct survey for snails: Conduct survey of areas previously known to harbor snails. Closely monitor the remaining population at Haputo for changes and presence of flatworm predators.
- Introduced predators: In selected sites, control predatory snails and flatworms.
- Habitat degradation and loss: Reduce ungulate numbers around known colonies, develop and implement reforestation techniques in Guam's conservation areas andnational wildlife refuge overlay lands.
- Small or extirpated population: Work closely with conservation organizations to monitor populations within the Mariana Islands and possibly translocate snails to Guam to supplement the existing population. Explore the feasibility of captive propagation of this snail. Examine the 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.

Akaleha'

Partula radiolata

Guam tree snail



Photo by G. Curt Fiedler

HISTORIC AND CURRENT STATUS: 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 (Crampton, 1925). During a return visit in 1828, zoologists collected samples of partulids but did not indicate population density (Crampton, 1925). 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 (Fiedler, 2015). Currently, the Guam tree snail is known to be the most abundant representation of native tree snails in Guam, occurring in habitats along the western and southeastern coasts of Guam. In 2015, when only 26 populations were known, the Guam tree snail was awarded protection under the U.S. Endangered Species Act. Since then, over 50 populations, some with thousands of individuals (Fielder, Demeulenaere, & Putnam, 2019; Fiedler, 2015), have been identified across the island, though local numbers fluctuate, and total population size remains unquantified (USFWS, 2020b).

THREATS: The primary cause of decline for this species was from the predation by the introduced triclad flatworm (*Platydemus manokwari)* and the invasive rosy predator snail (*Euglanina rosea*). 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, ungulates, typhoon disturbance, and climate change.

HABITAT: 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.

GOAL: To conserve and restore the Guam tree snail population in Guam.

OBJECTIVES: To determine the status of the Guam 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 a program.

ACTION PLAN:

- Introduced predators: To implement an area wide control for *P. manokwari* 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.
- Habitat degradation and loss: To control and monitor land clearing and prevent wildfires to preserve the native forest habitat for this species. Reforest with native flora and control ungulates in the habitat where snails are found will allow the required preservation of this species.
- Small or extirpated population: To conduct surveys in 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 the species since it is the most common and widespread native tree snail in 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.

Akaleha'

Samoana fragilis

Fragile tree snail

Photo by G. Curt Fiedler



HISTORIC AND CURRENT STATUS: In the Mariana Islands, the fragile tree snail is found in Guam and Rota. Historically, it was considered rare when discovered in 1819 during the Freycinet Uranie expedition of 1817-1819 (Crampton, 1925). Smith et al. (2008) 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.*). In 2015, the fragile tree snail was awarded protection under the U.S. Endangered Species Act. Currently, Guam has seven known populations. They are however small and narrowly dispersed populations, typically under 100 individuals, except at Haputo Ecological Reserve (USFWS, 2020c). A newly discovered population was estimated to have around 1,900 individuals (Mizerek, *pers. comm.*).

THREATS: The primary cause of decline for this species was from the predation by the introduced triclad flatworm, *Platydemus manokwari,* and the invasive rosy predator snail, *Euglanina rosea.* 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, ungulates, typhoon disturbance, and climate change.

HABITAT: Fragile tree snails prefer 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.

GOAL: To implement a Species Survival Plan for all native snails in Guam and continue annual surveys.

OBJECTIVES: To determine the status of the fragile 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 a program.

ACTION PLAN:

- Introduced predators: Implement and expand area-wide control of *P. manokwari*.
- Habitat degradation and loss: Reduce ungulate populations at colony and adjacent areas, develop and implement reforestation techniques in Guam's conservation areas and national wildlife refuge overlay lands.
- Small or extirpated population:Conduct surveys in Guam to determine currentpopulation size, structure, and locales of this species. To develop a captive breeding program for this snail to restore the population and eliminate anypossibleextinctiontoGuam.Work closely with conservation organizationsand CNMI Fish and WildlifeService to monitor populations within the Mariana Islands. To determine if the populations in Guam and Rota are the same species. To translocate the species from Guam to Rota dependent on whether the populations are the same.

CHacha

Cyathea lunalata

Tree fern



Photo by Else Demeulenaere

HISTORIC AND CURRENT STATUS: CHacha has always been considered rare and is found in southern Guam (Stone, 1970) in ravines and savanna habitats where they are especially vulnerable to wildfires and habitat degradation because of the introduction of invasive species.

THREATS: Presently, major threats include typhoons and wildland fires reducing the habitat in which this species lives. Habitat degradation is caused by invasive plant species outcompeting native plants.

HABITAT: Southern hills of Guam, wet ravines and muddy drainage slopes.

GOAL: To restore chacha populations.

OBJECTIVES: To survey the island and determine the density and distribution of the fern. To protect remaining areas harboring chacha. 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 those 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.

Fadang

Cycas micronesica

Federico nut

Photo by Jacob Concepcion



HISTORIC AND CURRENT STATUS: Fadang s a culturally and ecologically important species (Demeulenaere et al., 2021). It was one of the most abundant trees, mostly found throughout undisturbed native limestone forests and coastal strands (USFWS, 2023). The species also occurs in ravine forests and savannas. Fadang is endemic to Guam, Rota, Palau, and Yap. The 2003 introduction of the invasive *Aulacaspis yasumatsui* (Asian cycad scale) caused significant mortality of the species. As a result, in 2015, fadang was listed as endangered under the ESA. Currently, there are an estimated 11 populations with 290,000 wild individuals in Guam (USFWS, 2023).

THREATS: Invasive *Aulacaspis* scale, habitat loss, fire destruction, predation by ungulates, inadequate regulatory mechanisms.

HABITAT: Limestone areas, coastal areas, ravine forests, and savanna summits.

GOAL: To prevent extirpation of the fadang population.

OBJECTIVES: To prevent further loss of fadang due to the *Aulacaspis yasumatsui* infestation by the application of appropriate treatments and propagate seedlings in a scale-free enclosure.

ACTION PLAN:

- Surveying: Survey historical range of fadang. Monitor current populations to assess health and stability. Determine suitable locations for re-introductions.
- Captive propagation: Continue and maintain collection and propagation efforts for maintenance of genetic stock and for re-introduction.
- Predator control: Implement biological control treatment program to protect remaining fadang trees against the Asian scale and other insect pests especially in conservation areas. Reduce ungulate numbers in areas where the species is most abundant by maintaining existing fenced closures and constructing new fences.
- Small or extirpated population: Collect seeds and propagate at least 100-300 bi-annually for distribution.
- Genetic research: Conduct genetic studies to determine genetic variation within and between populations to promulgate an effective breeding program. Continue research on various methods of hand pollination, seed harvest, and propagation protocols.

Ufa hålom tåno'

Heritiera longipetiolata



Photo by Else Demeulenaere

HISTORIC AND CURRENT STATUS: This species is endemic to Guam, Rota, and Saipan (Stone, 1970). Historically restricted to limestone cliffs and plateaus (Stone, 1970; Moore & McMakin, 1979). As of 2023, there were approximately 2,000 or more wild individuals of ufa hålom tåno' from 19 populations in Guam (USFWS, 2024b).

THREATS: Loss of habitat, habitat degradation by BTS and rodents, ecosystem alteration, ungulate and insect predation, and leaf spot disease

HABITAT: Limestone cliffs and plateaus in Guam

GOAL: To maintain a viable population throughout the island

OBJECTIVES: To collect seeds from fruiting trees and develop a nursery of seedlings for outplanting. 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.

ACTION PLAN:

- Surveys and population assessment: Continue surveying historical and suitable habitats to assess population size, distribution, and threats
- Threat control: Maintain fenced areas to protect populations from feral ungulates. Monitor and control invasive species such as competing plants or diseases (leaf spot disease)
- Propagation and re-introduction: Maintain genetic stock through propagation and re-introduce to suitable habitats. Continue seed collection and propagation in nurseries.

Faniok

Merrilliodendron megacarpum

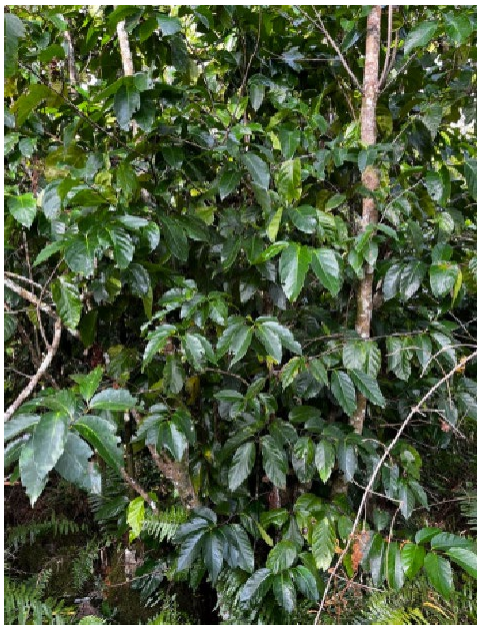


Photo by CJ Paulino

HISTORIC AND CURRENT STATUS: Faniok is considered rare in Guam's limestone forest (Stone, 1970). This species has been found only in a few locations including Hilaan Point, Haputo, Mount Lam Lam, Mount Tenjo, and Pugua point.

THREATS: Threats to the species include ungulate damage, typhoons, development, and possible insect infestation.

HABITAT: Limestone forest

GOAL: To restore population throughout the island

OBJECTIVES: 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 ungulate.

ACTION PLAN:

- Surveys and population assessments: Survey historical and suitable habitats to assess population size, distribution, and threats.
- Threat control: Maintain fenced areas to protect populations from feral ungulates. Monitor and control invasive species such as competitive plants or diseases.
- Captive propagation: Begin collection of individuals and propagation efforts for genetic stock and distribution.

Håyun lågu

Serianthes nelsonii

Fire Tree



Photo by Vince Fabian

HISTORIC AND CURRENT STATUS: Håyun lågu is endemic to Guam and Rota (Stone, 1970). Historic records of this tree are mostly known from the north of Guam (Stone, 1970; USFWS, 1994). Wiles et al. (1996) documented a few trees growing in southern Guam on volcanic soils. This species was federally listed as endangered on February 18, 1987 (52 CFR 4907-4910). The only adult tree known in Guam was severely damaged from Typhoon Mawar in 2023 and died soon after. There are over 40 adult trees on Rota. In Guam, only outplanted juvenile trees remain with some that have flowered, but none have fruited. Efforts to outplant håyun lågu are ongoing with GNWR staff and other partners with about 50 seedlings and about 200 on DoD lands in Guam. A genetic study by Demeulenaere revealed that the Guam and Rota populations possess unique genotypes. One of the recovery goals is to preserve genetic variation within each population. A second goal is to experimentally establish gene flow between the two genotypes to enhance overall genetic diversity. This research is being conducted by the University of Guam's CIS and SG ICL.

THREATS: Threats to the species include habitat loss, herbivory by ungulates, typhoons, and insect damage caused by mealy bugs and *Eurema blanda*.

HABITAT: Limestone and ravine forests

GOAL: To increase population throughout the island.

OBJECTIVES: To propagate seedlings.

ACTION PLAN:

- Habitat loss: To prevent further damage to the remaining naturally occurring seedlings where the last adult tree was.
- Small populations: 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. To establish a mixed population of Guam and Rota trees in a conservation area in Guam.
- Partnerships: Continue planning and implementation of ecosystem-level restoration to benefit this species.

Tabernaemontana rotensis



Photo by Else Demeulenaere

HISTORIC AND CURRENT STATUS: *Tabernaemontana rotensis* is endemic to Guam and Rota. The species was first recorded in 1936. At one point, the population in Guam was believed to be composed of only one adult tree. Recent observations have expanded that number to well over thousands of individual plants found in various parts of northern and southern Guam (DAWR). The population on the northeast portion of Guam is the largest possibly because of the presence of the såli (*Aplonis opaca guami,* Micronesian starling), an important seed disperser. As of 2020, there were a total of approximately 15,300 wild individuals from 8 populations in Guam and 6 populations in Rota (USFWS, 2020d). This number was an estimated decline of 5,000 individuals from the species' listing in 2015.

THREATS: Herbivory, insect infestations, and lack of seed dispersal are major factors limiting its abundance.

HABITAT: Native limestone forests

GOAL: To maintain a healthy population of *T. rotensis.*

OBJECTIVES: To determine the status and distribution of this species.

ACTION PLAN:

- Population Assessment: Continue surveys for *T. rotensis* in historical locations and potential suitable habitats.
- Threat control: Develop appropriate mitigation strategies to limit effects of wildlife, ungulates, and other invasive species.
- Pollination needs: Facilitate the return and translocation of suitable pollinators to populations of *T. rotensis* in effort to maintain self-sustaining populations.
- Propagation and translocation: Collect seeds and continue efforts to propagate, translocate, and monitor outplanted individuals. Create seed banks to prevent extirpation from catastrophic natural events, such as typhoons.
- Regulatory mechanisms: Recognize *T. rotensis* in Guam and CNMI's ESAs. Implement more protective measures and policies regarding the safeguarding of the species.
- Partnerships: Continue planning and implementation of ecosystem-level restoration to benefit this species.

Bulbophyllum guamense



Photo by Else Demeulenaere

HISTORIC AND CURRENT STATUS: Historically widely distributed in Guam and Rota. In 1992, this species was reported to occur in large mat-like formations on trees all over the island of Guam (Raulerson & Rinehart, 1992). In 2020, there were approximately 420 individuals in Guam from five populations. As of 2024, there were an estimated 10,000 individuals in Guam (USFWS, 2024c)

THREATS: Major threats include habitat loss, destruction from agriculture, urban development, non-native animals and plants, typhoons, wildland fires, and predation by non-native slugs.

HABITAT: This species is found on trees mostly in limestone and ravine habitats.

GOAL: To restore *B. guamense* populations and minimize threats to the species.

OBJECTIVES: 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 Guam.

ACTION PLAN:

- Surveys and inventory: Continue surveys in historical locations and potentially suitable habitats that have yet to be surveyed. Regularly monitor.
- Small or extirpated population: 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. Propagating this species for outplanting.

Dendrobium guamense



Photo by Else Demeulenaere

HISTORIC AND CURRENT STATUS: An epiphyte orchid known from Guam, Rota, and Tinian. *Dendrobium guamense* is thought to have once been widely distributed across Guam's native forests (U.S. Fish and Wildlife, 2015). As of 2022, 26 populations inhabit the Mariana Islands, approximating more than 13,000 individuals (USFWS, 2024b). Within the islands, Guam has 14 populations, Rota has 9 populations, and Saipan, Tinian, and Aguiguan each have 1 population (USFWS, 2024b).

THREATS: Presently, major threats include habitat loss, destruction from agriculture, urban development, non-native animals and plants, typhoons, wildland fires, and predation by non-native slugs.

HABITAT: Grow on trees in moist areas

GOAL: To restore *Dendrobium* populations and minimize threats to the species.

OBJECTIVES: To survey the island and determine the density and distribution of *D. guamense*. To protect remaining areas harboring the orchid. To propagate this species and outplant in conservation areas in southern and northern Guam.

ACTION PLAN:

- Surveys and inventories: Continue to survey for *Dendrobium guamense* in historical locations and potentially suitable habitat that has not been surveyed. Regularly monitor known populations in order to determine population trends.
- Ungulate monitoring and control: Maintain existing fenced enclosures and complete and maintain ungulate removal. Construct new ungulate enclosures, or erect strategic fencing, around naturally occurring *D. guamense* populations to protect this species and associated habitat from feral ungulates.
- Invasive non-native plant monitoring and control: Control established ecosystem-altering non-native plant species and those that compete with *D. guamense* or modify their habitat.
- Captive propagation for genetic storage and re-introduction: Collect and maintain seedsand other propagules for storage and propagation efforts for maintenance of genetic stock.

Eugenia bryanii



Photo by Lauren Gutierrez

HISTORIC AND CURRENT STATUS: Endemic to Guam, *E. bryanii*, occurrs on windy, exposed cliff lines along the west and east coasts of the island in abundance (Stone 1970). In 2015, there were less than 420 individuals in Guam (USFWS, 2020e). Between 2015 and 2018, 929 to 2,311 individuals in 8 populations were found in Guam through increased survey efforts (USFWS, 2020e).

THREATS: Presently, major threats include habitat loss, destruction from agriculture, urban development, non-native animals and plants, typhoons, combined with ungulate browsing.

HABITAT: Windy, exposed cliff lines

GOAL: To restore *E. bryanii* populations and minimize threats to the species.

OBJECTIVES: To survey the island and determine the density and distribution of *E. bryanii*. To protect remaining areas harboring the species. To propagate this species and outplant in conservation areas in southern and northern Guam.

ACTION PLAN:

- Surveys and inventories: Continue to assess the status of known occurrences of *E. bryanii* in historical locations and potentially suitable habitat including an island wide survey.
- Ungulate monitoring and control: Continue to construct and maintain fenced enclosures to protect individuals from the negative impacts of feral ungulates.
- Predation and herbivory by rodents: Implement effective control methods for rats at all populations.
- Disease prevention from myrtle rust: Implement effective prevention and plans for control methods for rust at all populations.
- Protect all remaining extant populations by controlling threats leading to habitat degradation.
- Captive propagation for genetic storage and re-introduction: Continue to collect seeds for storage and propagation efforts for maintenance of genetic stock and keep track of individual founders. Conduct genetic testing to resolve taxonomic questions, and ensure the best practices in cultivation, out planting, and genetic diversity measures.

Hedyotis megalantha



Photo by Tom Schils

HISTORIC AND CURRENT STATUS: Endemic to Guam, *Hedyotis megalantha* is a perennial herb known only to occur in the savanna ecosystem. Historically, this species ranged from the mid-central mountains and west coast of Guam and south to Mt. Lamlam (Bishop Museum, 2013). As of 2022, there are about 800 individuals reported on Guam (USFWS, 2024c).

THREATS: Presently, major threats include habitat loss, destruction from agriculture, urban development, non-native animals and plants, fires, and typhoons, combined with direct damage by recreational vehicles.

HABITAT: Savanna areas

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:

- Determine population status and current distribution: Determine the distribution and number of all individuals on each island. Identify priority sites for species conservation. Assess the status and threats to each population to inform prioritization of conservation effort.
- Conduct thorough surveys of the areas located on Cross Island Road inward towards the mountains of the Talo'fo'fo' Watershed, Nimitz Hill, Mount Lamlam, and the Sånta Rita-Sumai area near Mount Alifan to obtain population estimates and document the different plant life stages.
- Ungulate monitoring and control: Construct new or continue to maintain fences to protect individuals from the negative impacts of browsing by ungulates.
- Invasive non-native plant monitoring and control: Continue control of established ecosystem-altering non-native invasive plant species, and those that compete with *H. megalantha*.
- Site and habitat protection: Develop and implement effective control measures to reduce the impact of illegal collection or over-visitation.

Maesa walkeri



Photo by Else Demeulenaere

HISTORIC AND CURRENT STATUS: Endemic to the Mariana Islands, *M. walkeri* occurs at edges or in open sunny sites on limestone (Raulerson & Rinehart, 1991). Historically, *M. walkeri* was known from at least 13 occurrences in Guam and 9 occurrences on Rota (Bishop Museum, 2014). More recently, there were less than 30 known individuals in Guam and upwards of a thousand individuals on Rota (USFWS, 2015c).

THREATS: Major threats include habitat loss, destruction from agriculture, urban development, non-native animals and plants, fires, and typhoons.

HABITAT: Edges or open sunny sites on limestone.

GOAL: To restore *M. walkeri* populations and minimize threats to the species.

OBJECTIVES: To survey limestone forests and determine the density and distribution of *M. walkeri*. To protect remaining areas harboring the species. To propagate this species and out plant in conservation areas in Guam.

ACTION PLAN:

- Determine population status and current distribution: Determine the distribution and number of individuals on each island. Identify priority sites for species conservation. Assess the status and threats to each population to inform prioritization of conservation effort.
- Ungulate monitoring and control: Continue to construct and maintain fenced enclosures to protect wild populations and limit the negative impacts of feral ungulates.
- Invasive plant monitoring and control: Continue to control non-native invasive plant species and those that compete with *M. walkeri* at all populations.
- Captive propagation for genetic storage and re-introduction: Continue to collect seeds and other propagative materials for storage and re-introduction.
- Re-introduction and translocation: Augment populations and increase numbers of populations and individuals in suitable habitat to build resiliency and redundancy and reduce the impacts of predation and typhoons, and climate change.

Nervilia jacksoniae



Photo by Jacob Concepcion

HISTORIC AND CURRENT STATUS: Historically known to occur in central to northern Guam and the southwestern point of Rota in the forest ecosystem (Federal Register, 2014). In 2015, there were fewer than 200 individuals in Guam (Federal Register, 2014). As of 2020, there were approximately 388 individuals from 3 populations (USFWS, 2020a).

THREATS: Major threats include habitat loss, destruction from agriculture, urban development, non-native animals and plants, fires, typhoons and predation by invasive slugs.

HABITAT: Shady places on sandy soil

GOAL: To restore *N. jacksoniae* populations and minimize threats to the species.

OBJECTIVES: To survey forests and determine the density and distribution of *N. jacksoniae*. To protect remaining areas harboring the species. To propagate this species and out plant in conservation areas in Guam.

ACTION PLAN:

- Surveys and monitoring: Conduct surveys to determine population status, current distributions, and availability of sites. Assess the status and threats of potential sites for long-term conservation. Collect research to clarify life history information and inform conservation effort priorities.
- Ungulate monitoring and control: Use ungulate exclusion fences and continue eradication efforts to protect habitats.
- Invasive non-native plant monitoring and control: Continue control of invasive plant species.
- Captive propagation: Begin collection of individuals and propagation efforts for genetic stock maintenance and re-introduction.

Phyllanthus saffordii



Photo by Else Demeulenaere

HISTORIC AND CURRENT STATUS: Endemic to Guam, *P. saffordii* was historically known in southern and south-central Guam within the savanna habitat (Stone, 1970). The species has also been observed in rocky stream banks. Currently, its range is restricted to southern Guam with several thousand individuals (USFWS, 2024d).

THREATS: Major threats include habitat loss, destruction from agriculture, urban development, non-native animals and plants, fires, typhoons and direct damage by recreational vehicles.

HABITAT: Savanna areas

GOAL: 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 species. To propagate this species and out plant in conservation areas in Guam.

ACTION PLAN:

- Status and distribution: Determine the distribution and number of all individuals in Guam.
- Identify priority sites for species conservation: Assess the status and threats to each population to inform prioritization of conservation effort.
- Ungulate monitoring and control: Construct and maintain fenced enclosures to protect wild and introduced individuals from the negative impacts of browsing by ungulates.
- Invasive non-native plant monitoring and control: Continue control of established ecosystem-altering non-native invasive plant species, and those that compete with *P. saffordii* at all populations.
- Captive propagation for genetic storage and re-introduction: Continue to collect seeds and other propagative materials for storage and re-introduction.
- Re-introduction and translocation: Augment populations and increase numbers of populations and individuals in suitable habitat to build resiliency and redundancy and reduce the impacts of predation and typhoons, and climate change.

Aplokating palao'an

Psychotria malaspinae

No Photo Available

HISTORIC AND CURRENT STATUS: Endemic to the Mariana Islands (Raulerson & Rinehart, 1991), Aplokating palao'an was only known from Guam in the northeastern and southwestern sides of Guam in the forest ecosystem (Raulerson & Rinehart, 1991). As of 2020, there were 8-12 individuals in Guam (USFWS, 2020g).

THREATS: Major threats include habitat loss, destruction from agriculture, urban development, non-native animals and plants, and typhoons.

HABITAT: Limestone soils, forest edges and perhaps understories

GOAL: To restore Aplokating palao'an populations and minimize threats to the species.

OBJECTIVES: To survey savanna habitats and determine the density and distribution of Aplokating palao'an. To protect remaining areas harboring the species. To propagate this species and outplant in conservation areas in Guam.

ACTION PLAN:

- Determine population status and current distribution: Determine the distribution and number of individuals on each island. Assess the status and threats to each population to inform prioritization of conservation effort.
- Conduct research to clarify life history information and threats to the populations and their habitat: Conduct research to determine the best way to control BTS, rodents, and invasive invertebrates. Assess development and land designation and zoning threats to conservation of habitat needed for recovery.
- Ungulate monitoring and control: Continue to construct and maintain fenced enclosures to protect wild and re-introduced individuals from the negative impacts of feral ungulates.
- Invasive plant monitoring and control: Continue to control established ecosystem altering non-native invasive plant species and those that compete with Aplokating palao'an at all populations. Implement measures such as fire danger assessments, fire suppression responses, fuel treatments, regulations, and public outreach to prevent fire from burning native limestone forest.
- Captive propagation for genetic storage and re-introduction: Continue to collect seeds and other propagative materials for storage and re-introduction.
- Re-introduction and translocation: Augment population and increase numbers of populations and individuals in suitable habitat to build resiliency and redundancy and reduce the impacts of predation and typhoons, and climate change.

Berenghenas hålom tåno'

Solanum guamense

No Photo Available

HISTORIC AND CURRENT STATUS: Endemic in the Mariana Islands, Berenghenas hålom tåno' was historically abundant in its range across multiple islands (Stone, 1970). Currently, there are no known occurrences in Guam (USFWS, 2020).

THREATS: Major threats include habitat loss, destruction from agriculture, urban development, non-native animals and plants, typhoons and herbivory by ungulates.

HABITAT: Limestone cliffs and terraces near the sea.

GOAL: Restore Berenghenas hålom tåno' populations and minimize threats to the species.

OBJECTIVES: Locate species habitat and determine the density and survey for presence of Berenghenas hålom tåno'. Protect the last known habitats with historical occurrences of the species. Once the species is rediscovered, propagate this species and outplant in conservation areas in Guam.

ACTION PLAN:

- Surveys and inventory: Assess historical locations for rediscovery of populations.
- Captive propagation: If individuals are found, collect seeds or propagules to establish and maintain in *ex situ* facilities.

Tinospora homosepala



HISTORIC AND CURRENT STATUS: An endemic climbing vine, *T. homosepala* was historically known to be very rare (Stone, 1970). As of 2024, there were an estimated 150 wild individuals (USFWS, 2024e).

THREATS: Major threats include habitat loss, non-native animals and plants, typhoons and genetic limitations because of the possible loss of potential sexual reproduction.

HABITAT: Native forests

GOAL: Restore *T. homosepala* populations and minimize threats to the species.

OBJECTIVES: To locate species habitat and determine the density and distribution of *T. homosepala*. To protect remaining areas harboring the species. To propagate this species and outplant in conservation areas in Guam.

ACTION PLAN:

- Surveys and monitoring: Survey historical range of *T. homosepala*. Survey all sites with suitable habitat. Determine potential locations for re-introductions. Monitor extant populations for reproduction to determine sex ratio.
- Ungulate monitoring and control: Use ungulate exclusion fences and continue eradication efforts to protect habitats.
- Invasive non-native plant monitoring and control: Continue control of invasive plant species.
- Captive propagation: Continue and maintain collection of individuals and propagation efforts for genetic stock maintenance and re-introduction.
- Research: Conduct genetic studies to determine genetic variation within and between populations to plan an effective breeding program.

Tuberolabium guamense



Photo by Matthew Putnam

HISTORIC AND CURRENT STATUS: Endemic to the Mariana Islands, *T. guamense* was historically found in very low, shady positions on trees and shrubs all over the island (Raulerson & Rinehart, 1992). The species was also reported in Rota, Tinian, and Aguiguan. In 2015, the species was listed as threatened under the Endangered Species Act. Currently, there are nearly 75,000 individuals in Guam and approximately 5,000 individuals documented in Rota (USFWS, 2025).

THREATS: Major threats include habitat loss, destruction from agriculture, urban development, non-native animals and plants, typhoons, fires, herbivory by slugs, and low genetic representation.

HABITAT: Shady forest ecosystem

GOAL: Rediscover and restore *T. guamense* populations and minimize threats to the species.

OBJECTIVES: To locate species habitat and determine the density and distribution of *T. guamense*. To protect remaining areas harboring species. To propagate this species and out plant in conservation areas in Guam.

ACTION PLAN:

- Surveys and inventory: Continue surveys for *T. guamense* in historical locations and potentially suitable habitats.
- Invasive plant monitoring and control: Maintain control of established ecosystem-altering non-native invasive plant species and those competing with *T. guamense*. Develop approaches to control *Vitex parviflora*.
- Local protection: Add T. guamense to the Guam and CNMI ESAs. Create management plans and enforcement to protect *T. guamense*.
- Captive propagation: Collect seeds for storage and propagation efforts to maintain genetic stock. Determine translocation protocols to ensure long-term persistence.
- Predators and other threats: Use ungulate enclosures to protect the species. Research the effects of potential slug herbivory. Research methods to address predators and threats.

Trongkon niyok

Cocos nucifera

Coconut Tree

Photo by Lauren Gutierrez



HISTORIC AND CURRENT STATUS: Native to the Mariana Islands, the trongkon niyok is found nearly everywhere in Guam (Stone, 1970). Historically, the species earned the title of the "Tree of Life" as every part of the tree was used for food, shelter, building materials, and other needs. Leaves were used as material for thatched roofs and for various tools such as rick sacks, fans, brooms, and more. The meat and water of the nuts are used as a major food source and ingredient in many dishes. Today, the leaves are primarily used for artistic weaving purposes and as a way for CHamoru people to preserve with their indigenous heritage. A 2013 survey estimated 1.46 million coconut trees throughout the island (USDA, 2013). Another survey was conducted in 2024 (UOG) but the data is not yet publicly available.

THREATS: Large numbers of trongon niyok on Guam are being killed by the coconut rhinoceros beetle (*Oryctes rhinoceros*) (CRB). This invasive species was first detected in Guam during 2007.

HABITAT: Trongkon niyok grow in the majority of habitats in Guam, including limestone forests, savannas, coastal, ravines.

GOAL: Protect and sustain healthy trongkon niyok in Guam

OBJECTIVES: Conserve and restore key coconut strands, reduce impacts from pests, and promote community stewardship and traditional uses.

ACTION PLAN:

- Establish sustainable, long-term monitoring approaches to track health, pest presence, and regeneration success.
- Implement integrated pest management (IPM) strategies, including a self-sustaining biological control agent (Paudel et al., 2021) removal of dead coconut palms, and sanitation to reduce breeding sites
- Conduct targeted surveys to identify healthy coconut strands and prioritize conservation of restoration areas
- Replant healthy coconut trees in areas such as parks and village recreation sites
- Collaborate with cultural practitioners to promote traditional uses and knowledge related to the coconut.
- Develop and share outreach and research materials relating to conservation of the coconut tree and impacts of the CRB and other coconut pests

Åmot

Native Medicinal Plants

Photo by Else Demeulenaere



HISTORIC AND CURRENT STATUS: Åmot was historically abundant throughout Guam in all habitats. Over time, the health of these plants has been significantly reduced due to various threats such as land conversion and invasive species. Many species that were once widely distributed are now locally rare or fragmented in distribution. Comprehensive population assessments are limited or completely lacking and generally lack formal monitoring data. However, anecdotal reports and field observations suggest continuing declines in both wild abundance and regeneration potential for key species. Particular species of concern include, but are not limited to:

THREATS: Habitat loss and degradation, development, invasive species, ungulates, disease, over-harvesting without sustainable management, loss of traditional knowledge and lack of exposure to practices

Species	CHamoru Name
Erythrina variegata	Gaogao dangkolu
Peperomia mariannensis	Potpupot
Elatostema calcareum	Tupun ayuyu
Deeringia amaranthoides	Pe'echalan
Piper guahamense	Pupulun aniti
Maytenus thompsonii	Luluhut
Triumfetta procumbens	Ka'mang tåsi
Hedyotis foetida	Pao de'do'

HABITAT: Åmot can be found in a range of ecosystems across Guam, including limestone forests, ravine areas, coastal strand, wetlands, and savannas. Some are maintained in home gardens or small farm settings.

GOAL: Conserve and restore åmot and associated traditional knowledge to support ecological resilience, cultural revitalization, and sustainable use.

OBJECTIVES: Identify and document priority åmot and their current distributions. Collaborate with cultural practitioners to record traditional uses and stewardship practices. Promote community-based conservation and restoration of habitats where åmot occur. Integrate traditional ecological knowledge with science-based conservation approaches.

ACTION PLAN:

- Survey and mapping: Survey and map åmot populations in the wild and cultivated settings.
- Community involvement: Develop and support community-led conservation gardens or nurseries for priority species.
- Safeguard TEK: Record and safeguard traditional ecological knowledge (TEK) through culturally appropriate documentation in collaboration with yo'åmte siha and local elders.
- Educational engagement: Engage schools, youth, and the general public in planting and learning about åmot through place-based education.
- Habitat restoration: Protect and restore habitats critical to åmot, in especially vulnerable habitats such as forests and coastal areas.
- Sustainable use: Work with landowners and local and federal agencies to encourage propagation, sustainable harvest, and integration of åmot into landscaping and reforestation efforts.
- Legislative advocacy: Collaborate with lawmakers to recognize and protect åmot and traditional healing knowledge through legislation, including support for preservation areas, knowledge holders, and sustainable harvest guidelines.

Dokduk

Artocarpus mariannensis

Seeded Breadfruit



Photo by Else Demeulenaere

HISTORIC AND CURRENT STATUS: Dokduk is endemic to the Mariana Islands. It is a historically dominant tree in Guam's forest (Fosberg, 1960). A census conducted during 1989-1999 showed a decline due to introduced ungulates (Wiles, 2005). The fruits, known as hutu in CHamoru, are an important highly nutritious food source for the fanihi and people (Ragone, 1997; Safford, 1905; & Demeulenaere et al., 2021).

THREATS: Dokduk faces difficulty reproducing as fallen fruits are consumed by introduced ungulates.

HABITAT: Commonly found in both limestone and volcanic substrate (Wiles, 2005).

GOAL: Monitor the species' population trends. Increase natural recruitment.

OBJECTIVES: Establish a monitoring program. Control ungulates to increase natural recruitment.

ACTION PLAN:

- Education: Include dokduk as a high value tree for fauna and people in reforestation programs and community outreach.
- Invasive species: Ungulate control to increase natural recruitment.
- Cultivation: Grow seedlings in nursery and outplant in the wild.

Bulbophyllum raulersoniae



Photo by Nathan Sablan

HISTORIC AND CURRENT STATUS: *Bulbophyllum raulersoniae* is an orchid endemic to Guam and Rota. Long known to Guam botanists but only formally described in July 2022 by Deloso, Paulino & Cootes, based on plants from limestone forests of Guam and Rota. The authors note its historic range appears to have contracted, with Lamlam-Alifan ridge likely serving as a current refugium for remaining Guam plants.

THREATS: Major threats include habitat loss, non-native animals and plants, typhoons, and predation by non-native slugs.

HABITAT: This epiphytic orchid occurs in limestone forests.

GOAL: To restore *B. raulersoniae* populations and minimize threats to the species.

OBJECTIVES: To survey the island and determine the density and distribution of the orchid. To protect remaining areas harboring the species. To propagate this species and outplant in conservation areas in southern Guam.

ACTION PLAN:

- Surveys and inventory: Continue surveys in historical locations and potentially suitable habitats that have yet to be surveyed. Regularly monitor these areas.
- Small or extirpated population: Identify locations of species and collaborate with the University of Guam or other organizations knowledgeable of orchid propagation. Protect existing populations from threats such as invasive species. Conduct studies into the ecology and biology of this species. Propagate the species for outplanting.

Claoxylon marianum



Photo by Nathan Sablan

HISTORIC AND CURRENT STATUS: *Claoxylon marianum* was first collected in 1792 on Guam by Tadeáš Haenke during the Malaspina expedition and formally described in 1866 from specimens collected in 1819 (Kerr, 2023). It is endemic to the several Mariana Islands, including Guam, Rota, Saipan, and Anatahan (Kerr, 2023). Today, *C. marianum* is regarded as a rare plant by several botanists.

THREATS: Limestone forests have suffered fragmentation and loss over time, reducing habitat quality and connectivity. Habitat degradation from development and invasive species, such as ungulates and invasive insect pests, but also invasive plant species.

HABITAT: Limestone forest, at the edge of limestone ridges

GOAL: Ensure the long-term persistence of *C. marianum* in its native range, maintain or improve wild population size and distribution, preserve habitat integrity, achieve a stable or increasing population trend.

OBJECTIVES:

- Assess current population size and distribution across Guam, Rota, Saipan, and Anatahan.
- Protect and restore limestone forest edge habitat, preventing further degradation.
- Propagate plants *ex situ* using seeds and cuttings to create a living collection for conservation and restoration.
- Reintroduce propagated individuals into suitable habitat and monitor survival
- Engage communities, traditional practitioners, and agencies in awareness-building and stewardship.

ACTION PLAN:

- Surveys and inventory: Continue surveys in historical locations and potentially suitable habitats that have yet to be surveyed. Regularly monitor.
- Protect current populations through conducting surveys in areas with known suitable habitat and managing pests and other threats.
- Propagate seedlings in nurseries to establish new wild population

Pe'echalan

Deeringia amaranthoides



Photo by Lauren Gutierrez

HISTORIC AND CURRENT STATUS: Pe'echalan is a shrub whose long branches can hang down or climb over nearby plants. It has medicinal value and is often seen along forest edges and cliffs. The species is sparsely found in northern Guam and is relatively abundant is certain areas. Formal surveys are needed to obtain approximate population numbers.

THREATS: Limestone forests have suffered fragmentation and loss over time, reducing habitat quality and connectivity. Habitat degradation from development and invasive species, such as ungulates and invasive insect pests, but also invasive plant species.

HABITAT: Limestone forest, forest edges, cliffs

GOAL: Ensure the long-term persistence of pe'echalan in its native range, maintain or improve wild population size and distribution, preserve habitat integrity, achieve a stable or increasing population trend.

OBJECTIVES:

- Assess current population size and distribution across Guam.
- Protect and restore limestone forest edge habitat, preventing further degradation.
- Propagate plants *ex situ* using seeds and cuttings to create a living collection for conservation and restoration..
- Reintroduce propagated individuals into suitable habitat and monitor survival.
- Engage communities, traditional practitioners, and agencies in awareness-building and stewardship.

ACTION PLAN:

- Surveys and inventory: Continue surveys in historical locations and potentially suitable habitats that have yet to be surveyed. Regularly monitor.
- Protect current populations through conducting surveys in areas with known suitable habitat and managing pests and other threats.
- Propagate seedlings in nurseries to establish new wild populations

Drypetes dolichocarpa



Photo by Lauren Gutierrez

HISTORIC AND CURRENT STATUS: *Drypetes dolichocarpa* is native to the Mariana Island. Small with populations occur in southern and northern limestone forests.Morton et al. (2000) described the species as "somewhat rare in northern Guam."

THREATS: Limestone forests have suffered fragmentation and loss over time, reducing habitat quality and connectivity. Habitat degradation from development and invasive species, such as ungulates and invasive insect pests, but also invasive plant species.

HABITAT: Limestone forests in northern Guam and southern Guam (Mount Alifan-Mount LamLam ridgeline). Found mostly in open clearings and forest edges.

GOAL: Survey current populations, ensure long-term persistence of *D. dolichocarpa* in its native range, maintain or improve wild population size and distrubution, presreve habitat integrity, and achieve a stable or increasing population in limestone forests

OBJECTIVES:

- Assess current population size and distribution across Guam
- Protect and restore limestone forest edge habitat, preventing further degradation.
- Propagate plants ex situ using seeds and cuttings to create a living collection for conservation and restoration.
- Reintroduce propagated individuals into suitable habitat and monitor survival
- Engage communities, traditional practitioners, and agencies in awareness-building and stewardship.

ACTION PLAN:

- Surveys and inventory: Continue surveys in historical locations and potentially suitable habitats that have yet to be surveyed. Regularly monitor.
- Protect current populations through conducting surveys in areas with known suitable habitat and managing pests and other threats.
- Propagate seedlings in nurseries to establish new wild populations.

Tupun ayuyu

Elatostema calcareum



Photo by Else Demeulenaere

HISTORIC AND CURRENT STATUS: Tupun ayuyu was historically more abundant and likely occupied both subdued karren and pinnacle karren limestone formations. However, the introduction of ungulates reduced its presence in subdued karren, where these animals could more easily access and disturb the vegetation. As a result, the species is now found primarily in the less accessible pinnacle karren. Tupun ayuyu is also one of the two known host plants of the eight-spot butterfly, making its conservation especially important for sustaining this native species.

THREATS: Limestone forests have suffered fragmentation and loss over time, reducing habitat quality and connectivity. Habitat degradation has been driven by development and invasive species, including ungulates that browse and trample vegetation, invasive insect pests that damage native plants, and invasive plant species that outcompete native flora. The sustained pressure from ungulates in particular has altered forest structure and regeneration, and species such as tupun ayuyu are especially vulnerable because they are directly browsed on, further limiting their recovery and abundance.

HABITAT: Limestone forests

GOAL: Assess current population size and distribution across Guam, restore populations of tupun ayuyu, protect limestone forests from ungulate pressure, and prevent further habitat loss and degradation

OBJECTIVES:

- Assess current population size and distribution across Guam.
- Increase the number of healthy, reproducing individuals across limestone forest habitats.
- Reduce browsing and trampling impacts on *tupun ayuyu* and other native plants.
- Improve habitat quality and connectivity for native species.

ACTION PLAN:

- Assess current population size and distribution across Guam.
- Install exclusion fencing in priority forest areas.
- Engage landowners and communities in forest protection and ungulate management.
- Remove or control invasive plant species that outcompete native flora.
- Prevent new introductions of invasive pests and plants.
- Identify and protect remaining intact limestone forest through conservation easements, community conservation, or legal protection.

Fagraea berteroana



Photo by Else Demeulenaere

HISTORIC AND CURRENT STATUS: Historically only known from Guam's southern hills. Still today, the species mostly grows on limestone patches on Mt. Lamlam, Mt. Alifan, and Mt. Almagosa.

THREATS: Invasive species and fires

HABITAT: Limestone forests in southern Guam

GOAL: Survey current populations, ensure the long-term persistence of the species in its native range. maintain or improve wild population size and distribution. preserve habitat integrity. achieve a stable or increasing population the southern limestone forests.

OBJECTIVES:

- Assess current population size and distribution across southern Guam.
- Protect and restore limestone forest on the southern mountain ridges preventing further degradation.
- Propagate plants ex situ using seeds to create a living collection for conservation and restoration.
- Reintroduce propagated individuals into suitable habitat and monitor survival
- Engage communities, traditional practitioners, and agencies in awareness-building and stewardship.

ACTION PLAN:

- Surveys and inventory: Continue surveys in historical locations and potentially suitable habitats that have yet to be surveyed.
- Protect current populations through conducting surveys in areas with known suitable habitat and managing pests and other threats.
- Propagate seedlings in nurseries to establish new wild populations

Lesser-known plants

HISTORIC AND CURRENT STATUS: Particular species of concern include, but are not limited to:

- *Korthasella spp. (mistletoe)*
- *Phreatia thompsonii*
- *Pogostemon guamensis*
- *Rhaphidophora guamensis*
- *Strongylodon lucidus*
- *Tristiropsis obtusangula (Faia)*

THREATS: Specific threats for each species must be assessed (e.g., habitat loss, invasive species, climate change, development pressure).

HABITAT: Research habitat preferences using historical documents, herbarium records, and traditional ecological knowledge. Identify key ecological requirements (e.g., soil type, elevation, associated species).

GOAL: Gather and compile comprehensive information on the historic and current status, habitat requirements, and threats for each target species.

OBJECTIVES:

- Identify and review available literature, herbarium specimens, and archival materials related to each species.
- Consult with local experts, botanists, and traditional knowledge holders to gather ecological and historical insights.
- Conduct targeted field surveys to locate remnant populations and document current distribution.
- Develop a standardized data collection protocol to record life history traits and habitat conditions.
- Prioritize species for conservation action based on rarity, threat level, and ecological and cultural importance.

ACTION PLAN: To be developed based on data gathered through the objectives. The action plan could include habitat protection, propagation research, exsitu conservation, or restoration strategies.

Atot

Stiphodon sp.

Stream Goby

Photo by DAWR



HISTORIC AND CURRENT STATUS: Only known from the southern Mariana islands. The most abundant fish in almost all freshwater habitats in Guam. Has a marine larval stage and must reach salt water during early life history.

THREATS: Introduced fish and plants, degradation of water quality

HABITAT: Generally found on hard substrates, most common in medium to fast flowing water. Herbivorous, mainly feeds on algae attached to rocks and clay.

GOAL: To maintain current population status.

OBJECTIVES: To control introduced predators, maintain water quality.

ACTION PLAN:

- Assess current population structure and size: To maintain information on its status in Guam.
- Protect habitat: 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.

Atot

Sicyopus sp.

Redbellied Goby

Photo by DAWR



HISTORIC AND CURRENT STATUS: Only known from the southern Mariana islands. Widespread, but relatively uncommon. This species has a marine larval stage and must reach salt water during early life history.

THREATS: Introduced species, degradation of water quality.

HABITAT: Generally found on hard substrates, most common in medium to fast flowing water. Omnivorous, feeds on small aquatic invertebrates as well as some algae.

GOAL: To maintain current population status.

OBJECTIVES: To control introduced predators, maintain water quality.

ACTION PLAN:

- Assess current population structure and size: To determine the status of this species in Guam.
- Protect habitat: 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.

Atot

Stenogobius sp.

Marianas Goby

Photo by DAWR



HISTORIC AND CURRENT STATUS: Discovered in 1994. Widespread in Guam and relatively common. Omnivorous, feeding on plants and animals, and sifts from the sand. This species has a marine larval stage and must reach salt water during early life history. As very few endemics seem to fare well, its placement in SGCN is warranted.

THREATS: Loss of habitat, degradation of water quality.

HABITAT: Lower reaches of rivers on soft sandy or muddy substrates.

GOAL: To maintain current population status.

OBJECTIVES: To control loss of habitat, maintain water quality.

ACTION PLAN:

- Assess current population structure and size: To determine the status of this species in Guam.
- Protect habitat: To control loss of riparian vegetation and 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.

Umatan

Kuhlia rupestris

Flagtail



HISTORIC AND CURRENT STATUS: Indigenous to the western and southern Pacific. Found in freshwater lentic habitats. The species has a marine larval stage and must reach salt water during its early life history.

THREATS: Introduced fish and diseases.

HABITAT: Rivers and streams across the western and southern Pacific.

GOAL: To maintain current population.

OBJECTIVES: To protect from habitat loss and introduced competitors and diseases.

ACTION PLAN:

- Assess current population structure and size: To determine the status of this species in Guam.
- Protect habitat: Ensure water quality is maintained and passage to the ocean is maintained to allow for spawning to be successfully completed.
- Invasive species control: removal of freshwater invasive species that may have a negative impact to umatan island-wide.

Asuli

Anguilla marmorata

Giant Marbled Eel



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: 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.

Uhang

Atyidae spp.

Atyid shrimp (at least 6 species)



HISTORIC AND CURRENT STATUS: Common and widespread in 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.

THREATS: Introduced predators

HABITAT: Rocky and hard substrates in rivers throughout the Pacific.

GOAL: Maintain current population.

OBJECTIVES: To maintain substrate and water quality.

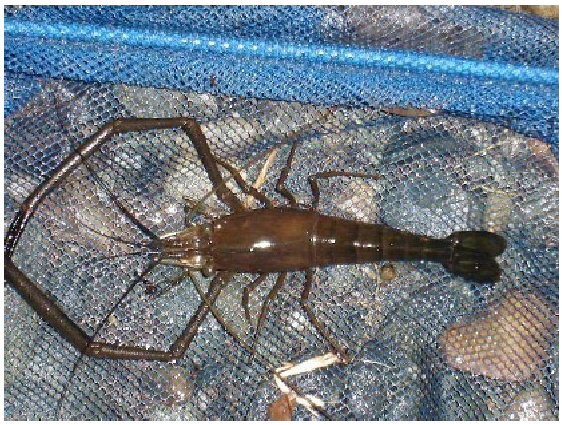
ACTION PLAN:

- Assess current population structure and size: To determine the status of each of the species in Guam.
- Protect habitat: Ensure water quality is maintained and passage to the ocean is maintained to allow for spawning to be successfully completed.

Uhang

Macrobrachium spp.

Tahitian prawns (2 species)



HISTORIC AND CURRENT STATUS: Common to abundant in rivers in Guam, especially in upper reaches. Omnivores, feeding on detritus, plant and animal material. All species have a marine larval stage. Commonly trapped for food by local anglers.

THREATS: Introduced predators, loss of habitat, overfishing, and destructive fishing methods.

HABITAT: Practically all freshwater habitats in Guam.

GOAL: To maintain current population.

OBJECTIVES: Maintain substrate and water quality.

ACTION PLAN:

- Assess current population structure and size: To maintain current information on the status of this species in Guam.
- Protect habitat: Ensure water quality is maintained and passage to the ocean is maintained to allow for spawning to be successfully completed.

Varunid crabs

Varunidae spp.

Freshwater crabs (> 3 species)



HISTORIC AND CURRENT STATUS: Common and widespread in 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.

THREATS: Introduced predators, loss of water quality.

HABITAT: Rocky and hard substrates in rivers throughout the Pacific.

GOAL: To maintain current population.

OBJECTIVES: Maintain substrate and water quality.

ACTION PLAN:

- Assess current population structure and size: To determine the status of this species in Guam.
- Protect habitat: Ensure water quality is maintained and passage to the ocean is maintained to allow for spawning to be successfully completed.

Akaleha'

Neritidae spp.

Nerite snails (12 species)



HISTORIC AND CURRENT STATUS: Nerite snails are common and widespread in Guam, especially in the upper reaches of rivers. This snail has a marine larval stage and must reach salt water during early life history. Feeds on algae and other benthic material.

THREATS: Introduced predators.

HABITAT: Rocky and hard substrates in rivers throughout the Pacific.

GOAL: To maintain current population.

OBJECTIVES: To maintain substrate and water quality.

ACTION PLAN:

- Assess current population structure and size: To determine the current size and distribution of the 12 species of snails.
- Protect habitat: Ensure water quality is maintained and passage to the ocean is maintained to allow for spawning to be successfully completed.

Akaleha'

Thiaridae spp.

Thiarid snails (5 species)



HISTORIC AND CURRENT STATUS: Some species of this snail are common to abundant in rivers in 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: 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 in 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.

Guafak uhong/ Umok sensonyan

Ceratopteris thalictroides subsp. gaudichaudii

Water Fern



HISTORIC AND CURRENT STATUS: Guafak uhong is common in Fena Lake. Elsewhere, it is widespread, but nowhere common in Guam. Further research is needed to confirm if it may be an endemic species.

THREATS: Introduced predators and loss of habitat.

HABITAT: Slow moving or stagnant water, ponds, lakes.

GOAL: Identify species and maintain current population.

OBJECTIVES: To protect species from habitat loss and predators. To determine the taxonomic status of this species.

ACTION PLAN:

- Assess current population structure and size: To determine the status of this species. Protect habitat: Ensure habitat is kept free of invasive plants and animals.

Chaiguan gaddok

Potamogeton mariannensis

Pond Weed



HISTORIC AND CURRENT STATUS: Chaiguan gaddok is endemic to Guam (Costion & Lorence, 2012). This species of pondweed is widespread but nowhere is common.

THREATS: Introduced plants and animals, loss of substrate

HABITAT: Usually found in slow moving stretches of rivers with soft sandy or muddy substrate.

GOAL: To preserve suitable habitat for this species.

OBJECTIVES: Remove and/or control potential threats

ACTION PLAN:

- Assess current population structure and size: To determine the status of this species.
- Protect habitat: Remove introduced predators, control loss of substrate.

Nipa

Nypa fruticans

Mangrove palm or Nipa palm

Photo by Caley Jay Chargualaf



HISTORIC AND CURRENT STATUS: Nipa is a palm species that was introduced from the Philippines (Safford, 1905) and became naturalized. The species is typically found in estuaries, especially along Guam's eastern coast (Fosberg, 1960). Nipa has been found in 13 of the island's rivers and the Department has also outplanted palms along Masso River. Nipa is culturally important as it is used as thatch for roofs (Safford, 1905) but individuals must first obtain a permit from the Department's Forestry Division to collect it.

THREATS: Introduced plants and animals. Over-harvesting.

HABITAT: Found in river mouths, where they are exposed to estuarine conditions.

GOAL: To preserve suitable habitat for this species. Prevent over-harvesting.

OBJECTIVES: Remove and/or control potential threats.

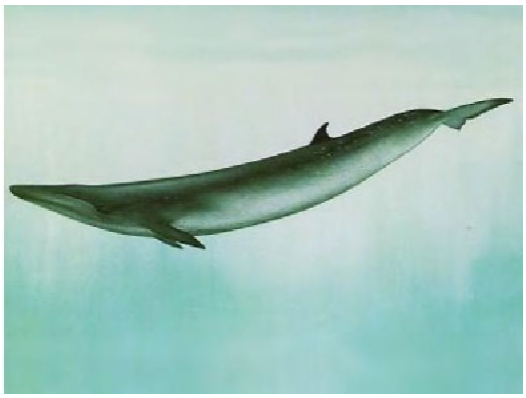
ACTION PLAN:

- Assess current population structure and size: To determine the status of this species.
- Protect habitat: Remove introduced species.

Bayena

Balaenoptera edeni

Bryde's Whale



HISTORIC AND CURRENT STATUS: Protected under the Marine Mammal Protection Act (1972); listed in Appendix 1 of CITES; population information not available. In the early 1980s, Bryde's whales' abundance in the Western North Pacific was estimated to be 22,000 to 24,000 (NOAA, 2015b). Bryde's whale pods ranging from one to four individuals were encountered in the Mariana Archipelago 18 times during small boat surveys from 2010 to 2019 (Hill et al., 2020).

THREATS: Seismic operations; collision with large vessels; entanglement in fishing gear (A female with a calf was observed approximately 250 km west of Guam with a line tightly wrapped overtop of her blow hole causing deep abrasions" (Hill et al., 2020)); 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; overfishing of prey species, particularly commercial species such as anchovy.

HABITAT: Temperate to tropical waters, both oceanic and inshore, bounded by latitudes 40°N and S, or the 20° isotherm. Sightings during most months suggest that Bryde's whales spend time in the Mariana Archipelago year-round (Hill et al., 2020).

GOAL: To determine the importance of Guam's waters to the conservation of marine mammals.

OBJECTIVES: To survey Guam's waters annually to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.

ACTION PLAN:

- Conduct quarterly aerial surveys around Guam's waters to determine the abundance and distribution of the marine mammal species in Guam's waters and seek technical assistance from federal partners to gain information about these species.

Bayena

Balaenoptera borealis

Sei Whale



HISTORIC AND CURRENT STATUS: Protected under the Marine Mammal Protection Act (1972); listed in Appendix 1 of CITES; and listed as endangered under the Endangered Species Act. All stocks of Sei whales within U.S. waters are estimated to be below 600 individuals (USNMFS, 2020).

THREATS: 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, inbreeding, and illegal whaling.

HABITAT: Oceanic, undertaking long migrations between warm water breeding grounds and colder water feeding grounds, between 40°N and S. While Sei whales have been spotted near Guam, their activities or behavior in these waters remain uncertain. They have an unpredictable distribution pattern, unlike other large whale species, in which they may be seen in one area and then not return for years or decades (NOAA, 2024).

GOAL: To determine the importance of Guam's waters to the conservation of marine mammals.

OBJECTIVES: To survey Guam's waters annually to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.

ACTION PLAN:

- Conduct quarterly aerial surveys around Guam's waters to determine the abundance and distribution of the marine mammal species in Guam's waters and seek technical assistance from federal partners to gain information about these species.

Bayena

Megaptera novaeangliae

Humpback Whale



HISTORIC AND CURRENT STATUS: Protected under the Marine Mammal Protection Act (1972); listed in Appendix 1 of CITES; population information not available. Humpback whales included in the Western Northern Pacific DPS are listed as endangered under the Endangered Species Act, but minimal data on these populations, especially around the Mariana archipelago, exists (Young et al., 2023). Preliminary abundance estimates between 2015 and 2019 report a yearly average of 61 (CV=0.21) individuals within the waters of Saipan, Tinian, and Aguijan (Hill et al., 2020).

THREATS: 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.

HABITAT: Antarctic pelagic, in summer; temperate–sub-tropical/tropical coastal in winter. The Western Northern Pacific DPS includes two units: the Philippines/Okinawa unit and the Marianas/Ogasawara unit. Sightings of newborn calves during small boat surveys confirm the Mariana Islands as a breeding location (USNMFS, 2020).

GOAL: To determine the importance of Guam's waters to the conservation of marine mammals and to advance the recovery of the global species and to protect its habitats.

OBJECTIVES: To survey Guam's waters annually to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations. To minimize human-caused injury and death.

ACTION PLAN:

- Conduct quarterly aerial surveys around Guam's waters to determine the abundance and distribution of the marine mammal species in Guam's waters and seek technical assistance from federal partners to gain information about these species.
- Monitor potential impacts from military training and exercises.

Bayena

Ziphius cavirostris

Cuvier's Beaked Whale



HISTORIC AND CURRENT STATUS: Protected under the Marine Mammal Protection Act (1972); listed in Appendix II of CITES; population information not available. Estimating population size is difficult due to similar appearances between species. Nine Cuvier's beaked whales have been found stranded in Guam, Rota, or Saipan since 2007 (Hill et al., 2020).

THREATS: 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, military operations including sonar.

HABITAT: Tropical (ca 22–32°C) to sub-polar (ca 1–8°C) deep oceanic waters.

GOAL: To determine the importance of Guam's waters to the conservation of marine mammals.

OBJECTIVES: To survey Guam's waters annually to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.

ACTION PLAN:

- Conduct quarterly aerial surveys around Guam's waters to determine the abundance and distribution of the marine mammal species in Guam's waters and seek technical assistance from federal partners to gain information about these species.

Bayena

Physeter macrocephalus

Sperm Whale



HISTORIC AND CURRENT STATUS: Protected under the Marine Mammal Protection Act (1972); listed in Appendix I of CITES; and listed as endangered under the Endangered Species Act. Due to their wide range and overlap with other stocks, population estimates are not reliable. However, there have been numerous sightings reported on Guam.

THREATS: Entanglement in fishing equipment, ship strikes, decline in prey populations, 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 (USNMFS, 2020).

HABITAT: 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).

GOAL: To determine the importance of Guam's waters to the conservation of marine mammals.

OBJECTIVES: To survey Guam's waters annually to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.

ACTION PLAN:

- Conduct quarterly aerial surveys around Guam's waters to determine the abundance and distribution of the marine mammal species in Guam's waters and seek technical assistance from federal partners to gain information about these species.

Bayena

Kogia sima

Dwarf Sperm Whale



HISTORIC AND CURRENT STATUS: Protected under the Marine Mammal Protection Act (1972); not listed in either Appendix I or II of CITES; population information not available due to their low sighting rate and difficulty to be identified.

THREATS: 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.

HABITAT: Oceanic, apart from colder waters, but more coastal than pygmy sperm whales.

GOAL: To determine the importance of Guam's waters to the conservation of marine mammals.

OBJECTIVES: To survey Guam's waters annually to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.

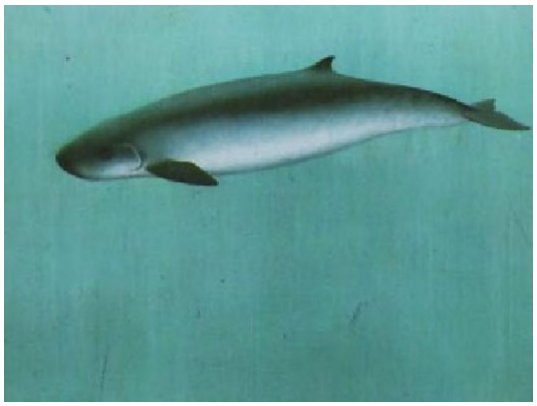
ACTION PLAN:

- Conduct quarterly aerial surveys around Guam's waters to determine the abundance and distribution of the marine mammal species in Guam's waters and seek technical assistance from federal partners to gain information about these species.

Bayena

Kogia breviceps

Pygmy Sperm Whale



HISTORIC AND CURRENT STATUS: Protected under the Marine Mammal Protection Act (1972); not listed in either Appendix I or II of CITES; population information not available due to their low sighting rate and difficulty to be identified.

THREATS: 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.

HABITAT: Oceanic, apart from colder waters.

GOAL: To determine the importance of Guam's waters to the conservation of marine mammals.

OBJECTIVES: To survey Guam's waters annually to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.

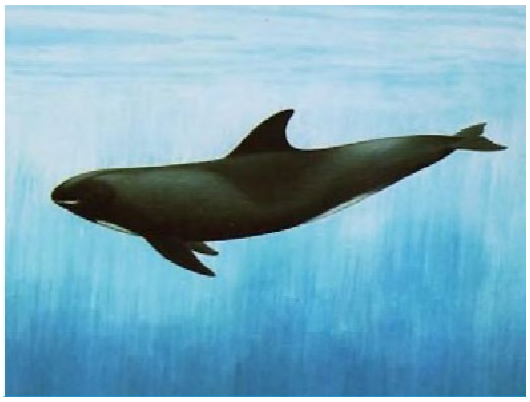
ACTION PLAN:

- Conduct quarterly aerial surveys around Guam's waters to determine the abundance and distribution of the marine mammal species in Guam's waters and seek technical assistance from federal partners to gain information about these species.

Bayena

Peponocephala electra

Melonheaded Whale



HISTORIC AND CURRENT STATUS: Protected under the Marine Mammal Protection Act (1972) and listed in Appendix II of CITES. Surveys conducted from 2010 to 2019 have catalogued 401 individuals encountered across the Mariana Islands archipelago, including Guam (Hill et al., 2020).

THREATS: 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.

HABITAT: Pelagic and oceanic. Primarily tropical and sub-tropical areas but can be found in temperate waters. Inhabits warm waters (usually >25°C), mainly equatorial. Generally in upwelling areas.

GOAL: To determine the importance of Guam's waters to the conservation of marine mammals.

OBJECTIVES: To survey Guam's waters annually to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.

ACTION PLAN:

- Conduct quarterly aerial surveys around Guam's waters to determine the abundance and distribution of the marine mammal species in Guam's waters and seek technical assistance from federal partners to gain information about these species.

Bayena

Orcinus orca

Killer Whale



HISTORIC AND CURRENT STATUS: Protected under the Marine Mammal Protection Act (1972); listed in Appendix II of CITES. Periodic sightings have occurred over the past five decades but there are no current population estimations for Guam or the Marianas (Uyeyama, 2014).

THREATS: The species is a long-lived and top predator, making it highly susceptible to accumulating high levels of heavy metals and organo-chlorines. Also threatened by the reduction of food resources by overfishing of prey specie and entanglement in drift-nets or discarded netting.

HABITAT: Oceanic, pelagic and neritic, in warm and cold waters; may be more common in cold, deep waters; often seen near seal colonies. Annual long-distance migration to the tropics for breeding/molting (Pitman et al., 2020).

GOAL: To determine the importance of Guam's waters to the conservation of marine mammals.

OBJECTIVES: To survey Guam's waters annually to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.

ACTION PLAN:

- Conduct quarterly aerial surveys around Guam's waters to determine the abundance and distribution of the marine mammal species in Guam's waters and seek technical assistance from federal partners to gain information about these species.

Bayena

Globicephala macrorhynchus

Shortfinned Pilot Whale



HISTORIC AND CURRENT STATUS: Protected under the Marine Mammal Protection Act (1972) and listed in Appendix II of CITES. Surveys conducted from 2010 to 2019 have catalogued 209 individuals encountered across the Mariana Islands archipelago, including Guam (Hill et al., 2020).

THREATS: 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. Individuals may be exposed to naval training, underwater U.S. Navy explosive sites, fisheries interactions, and tourism activities.

HABITAT: Tropical (ca 22–32°C) to temperate (ca 10–22°C) oceanic waters, approaching coastal seas. Most found in northwest Guam in waters extending towards and past Rota.

GOAL: To determine the importance of Guam's waters to the conservation of marine mammals.

OBJECTIVES: To survey Guam's waters annually to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.

ACTION PLAN:

- Conduct quarterly aerial surveys around Guam's waters to determine the abundance and distribution of the marine mammal species in Guam's waters and seek technical assistance from federal partners to gain information about these species.

Tuninos

Grampus griseus

Risso's Dolphin



HISTORIC AND CURRENT STATUS: Protected under the Marine Mammal Protection Act (1972) and listed in Appendix II of CITES. Periodic sightings have occurred but no current population estimations for Guam or the Marianas (Hill et al., 2020).

THREATS: 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 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.

HABITAT: Tropical, sub-tropical, 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. Encounters were on offshore waters with depths of more than 2500 m.

GOAL: To determine the importance of Guam's waters to the conservation of marine mammals.

OBJECTIVES: To survey Guam's waters annually to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.

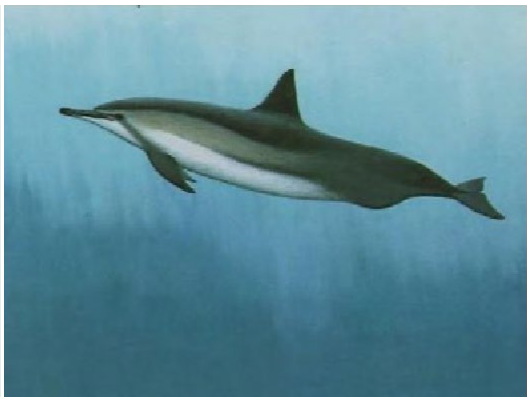
ACTION PLAN:

- Conduct quarterly aerial surveys around Guam's waters to determine the abundance and distribution of the marine mammal species in Guam's waters and seek technical assistance from federal partners to gain information about these species.

Tuninos

Stenella longirostris

Spinner Dolphin



HISTORIC AND CURRENT STATUS: Protected under the Marine Mammal Protection Act (1972) and listed in Appendix II of CITES. Most sighted species in Guam with group sizes of up to 135 individuals. Surveys conducted from 2010 to 2013 have catalogued 307 individuals encountered across the Mariana Islands archipelago, including Guam (Hill et al., 2020).

THREATS: 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 areas such as the 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. Potential exposure to US Navy detonation sites and proximity to tourism activities.

HABITAT: Primarily pelagic but can be neritic in some regions; tropical, sub-tropical 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). Encountered within 1km from shore.

GOAL: To determine the importance of Guam's waters to the conservation of marine mammals.

OBJECTIVES: To survey Guam's waters annually to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.

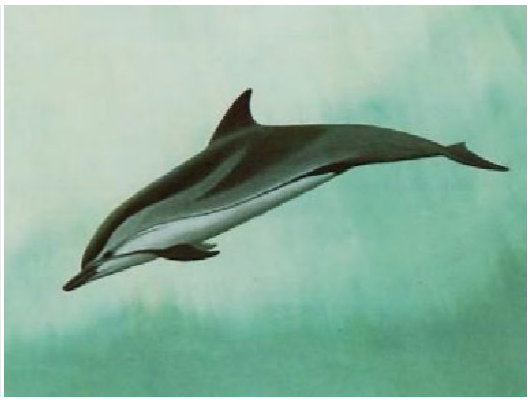
ACTION PLAN:

- Conduct quarterly aerial surveys around Guam's waters to determine the abundance and distribution of the marine mammal species in Guam's waters and seek technical assistance from federal partners to gain information about these species.

Tuninos

Stenella coeruleoalba

Striped Dolphin



HISTORIC AND CURRENT STATUS: Protected under the Marine Mammal Protection Act (1972) and listed in Appendix II of CITES. Periodic sightings have occurred but no current population estimations for Guam or the Marianas.

THREATS: 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.

HABITAT: Pelagic. Deep water and outer edge of the continental slope. Tropical, sub-tropical and warm temperate waters. Possible vagrants recorded in colder waters. Encounters were primarily 54-342 km offshore with depths greater than 2,300 m.

GOAL: To determine the importance of Guam's waters to the conservation of marine mammals.

OBJECTIVES: To survey Guam's waters annually to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.

ACTION PLAN:

- Conduct quarterly aerial surveys around Guam's waters to determine the abundance and distribution of the marine mammal species in Guam's waters and seek technical assistance from federal partners to gain information about these species.

Dugong dugon

Dugong



HISTORIC AND CURRENT STATUS: Protected under the Marine Mammal Protection Act (1972); population information not available. Isolated sighting in Guam; no current population estimations for Guam or the Marianas.

THREATS: Habitat loss, direct take, collisions with small vessels in shallow water

HABITAT: 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. Records of at least 521 individuals in Palau support the idea of a growing population in Micronesia although information is lacking at present to infer explicit population numbers.

GOAL: To determine the importance of Guam's waters to the conservation of marine mammals.

OBJECTIVES: To survey Guam's waters annually to determine the abundance and distribution of the various species of marine mammals and make appropriate management recommendations.

ACTION PLAN:

- Conduct quarterly aerial surveys around Guam's waters to determine the abundance and distribution of the marine mammal species in Guam's waters and seek technical assistance from federal partners to gain information about these species.

Haggan

Chelonia mydas

Green Sea Turtle



Photo by David Burdick

HISTORIC AND CURRENT STATUS: Haggan is the most common sea turtle species found in Guam's waters (Kolinski, 2005). It is listed both federally and locally as endangered. Estimated average abundance found approximately 22 nesting females from 2008 to 2010 (Seminoff et al., 2015) and 140 to 300 individuals from 2008 to 2012 (Van Houtan et al., 2016). Between 2013 to 2019, there were around 230 haggan recorded in Guam's waters (Gaos et al., 2020). 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 (NMFS-USFWS, 1998a). Nesting occurs year-round but may vary by season. Currently identified important nesting sites in Guam include Islan Dåno' and the Northwestern coastline from Falcona Beach to Tarague Basin, along with Dadi Beach and Spanish Steps in Naval Base Guam.

THREATS: Predation on eggs and hatchlings by introduced species, fibropapilloma disease (a recent threat documented by DAWR biologists in 2020), human take of eggs and adults (mainly for food), loss of marine and nesting habitat, taken as bycatch, oil spills, development, public use of beaches, light pollution, marine debris, and climate change.

HABITAT: Adult haggan can be seen throughout the island in all marine habitats as they feed on seagrass and algae.

GOAL: Restore population to a sustainable level to meet recovery thresholds under the Guam and US Endangered Species Act.

OBJECTIVES: Assess population structure and size, assess, monitor, and protect habitat, and reduce illegal take through outreach and enforcement.

ACTION PLAN:

- Data review and research design:
  - Review and compile existing data and literature on haggan nesting activities to determine nesting sites, population trends, and long-term conservation needs.
  - Define nesting monitoring research questions and standardize nesting beach monitoring activities by coordinating with partners to define key research questions and develop standardized survey protocols for consistent monitoringof nesting beaches throughout the island.
- Population and health assessment:
  - Collect and analyze data on species demography (age, sex), population size, genetics, movement patterns, and health status through mark-recapture surveys of foraging populations, nest excavations to determine clutch size, hatchling success, and emergence rate, and beach surveys during nesting season to track frequency and success.
- Habitat protection and threat mitigation:
  - Ensure nesting and foraging habitats are protected through inclusion in ACOE and Guam Seashore Clearance permit conditions, high level protection in the Guam seashore Reserve Plan, and designation on Environmental Sensitivity Index (ESI) maps

    - Continue biosecurity measures at historical nesting sites by implementing predator control and monitoring impacts of lizards on nests. Prevent predation by feral animals and rodents. Reduce impacts of light on known nesting beaches.
    - Evaluate nest success and implement appropriate nest protection measures as needed
- Outreach, education, and community engagement:
    - Continue engagement with schools and community groups using educational materials and presentations to reduce illegal take
    - Support the maintenance and expansion of the Haggan Huddle volunteer program to supplement staff surveys, increase public presence on beaches, and build location stewardship
    - Develop targeted messaging to reduce illegal harvest and promote community responsibility
    - Increase community awareness of light impacts on haggan, encourage private landowners to decrease light use in coastal properties, and support research on light mitigation methods
- Bycatch and mortality reduction
    - Monitor and reduce incidental mortality in fisheries by collaborating with fishers and partners to identify and mitigate sources of bycatch and respond rapidly to strandings or injuries
- Partnerships and cooperative agreements:
    - Initiate and maintain cooperative agreements with USFWS, AAFB, and Navy to support long-term nesting and in-water monitoring, protect critical habitat, track migration patterns, and coordinate conservation responsibilities among conservation organizations.

Haggan karai

Eretmochelys imbricata

Hawksbill turtle



Photo by David Burdick

HISTORIC AND CURRENT STATUS: Haggan karai are mainly found on coral reefs throughout tropical regions (USFWS, 2015e). The species is less common in the waters of Guam than haggan and nest on the island in much smaller numbers. They are listed both federally and locally as endangered. The first haggan karai nest was reported in Guam in November 1991 (USFWS, 1998). Estimated average abundance found approximately 100 to 200 individuals between 2008 to 2013, with estimates of nesting individuals being much lower (Van Houtan et al., 2016). Between 2013 to 2018, there were 11 individuals recorded in various locations throughout Guam (Gaos et al., 2020).

THREATS: Predation on eggs and hatchlings by introduced species, human take of eggs and adults (for food and shells), loss of habitat, taken as bycatch, oil spills, development, light pollution, and marine debris, and climate change.

HABITAT: Haggan karai feed primarily on sponges. They can be seen in all nearshore habitat types (NMFS-USFWS, 2013) with Apra Harbor as an important foraging area.

GOAL: Restore population to a sustainable level to meet recovery thresholds under the Guam and US Endangered Species Lists.

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

ACTION PLAN:

- Data review and research design:
  - Review and compile existing data and literature on haggan karai nesting activities to determine nesting sites, population trends, and long-term conservation needs.
  - Define nesting monitoring research questions and standardize nesting beach monitoring activities by coordinating with partners to define key research questions and develop standardized survey protocols for consistent monitoring of nesting beaches throughout the island.
- Population and health assessment:
  - Collect and analyze data on species demography (age, sex), population size, genetics, movement patterns, and health status through mark-recapture in surveysof foraging populations, nest excavations to determine clutch size, hatchling success, and emergence rate, and beach surveys during nesting season to track frequency and success.
- Habitat protection and threat mitigation:
  - Ensure nesting and foraging habitats are protected through inclusion in ACOE and Guam Seashore Clearance permit conditions, high level protection in the Guam seashore Reserve Plan, and designation on Environmental Sensitivity Index (ESI) maps
  - Continue biosecurity measures at historical nesting sites by implementing predator control and monitoring impacts of lizards on nests and prevent predation by feral animals and rodents. Reduce

impacts of light on known nesting beaches.
    - Evaluate nest success and implement appropriate nest protection measures as needed
- Outreach, education, and community engagement:
    - Continue engagement with schools and community groups using educational materials and presentations to reduce illegal take
    - Support the maintenance and expansion of the Haggan Watch volunteer program to supplement staff surveys, increase public presence on beaches, and build location stewardship
    - Develop targeted messaging to reduce illegal harvest and promote community responsibility
    - Increase community awareness of light impacts on haggan karai, encourage private landowners to decrease light use in coastal properties, and support research on light mitigation methods
- Bycatch and mortality reduction
    - Monitor and reduce incidental mortality in fisheries by collaborating with fishers and partners to identify and mitigate sources of bycatch and respond rapidly to strandings or injuries
- Partnerships and cooperative agreements:
    - Initiate and maintain cooperative agreements with USFWS, AAFB, and Navy to support long-term nesting and in-water monitoring, protect critical habitat, track migration patterns, and coordinate conservation responsibilities among conservation organizations.

Tanguisson

Cheilinus undulatus

Humphead Wrasse or Napoleon Wrasse



HISTORIC AND CURRENT STATUS: Heavily fished by SCUBA equipped spear fishers, nighttime spear fishers. Adults are rarely seen. Juveniles are more frequently seen, especially in the marine preserves.

THREATS: Human take of adults and juveniles, habitat degradation

HABITAT: Adults inhabit outer reef slopes and channel slopes. Juveniles occur in coralrich areas of lagoon reefs, particularly among thickets of staghorn *Acropora* (Myers, 1999). Juveniles are found in Cocos Lagoon, Tumon Bay Marine Preserve, and Piti Bomb Holes Preserve (DAWR, unpublished data).

GOAL: Sustain population to facilitate delisting from CITES and to prevent listing on Endangered Species List.

OBJECTIVES: Assess current population structure and size, protect habitat, manage take through outreach and education.

ACTION PLAN:

- Assess current population structure and size: To collect baseline population size, demography (age and sex), genetics, and distribution information for Guam's stocks.
- Protect habitat: To provide adequate protection of habitat in ACOE and Guam Seashore clearance permit conditions.
- Reduce take through outreach and education: To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting slow growth rate, to include in fisheries management plans.

Atuhong

Bolbometopon muricatum

Bumphead Parrotfish



HISTORIC AND CURRENT STATUS: Stocks have steadily declined in Guam. Sightings are exceptionally rare.

THREATS: 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.

HABITAT: Clear outer lagoon and seaward reefs at depths of 1 to at least 30m. In unfished areas may enter outer reef flats at low tide (Myers, 1999). Its life cycle is dependent on the availability of and connections between particular habitats.

GOAL: To recover the population to historic levels.

OBJECTIVES: Assess current population structure and size, protect habitat, and manage take through outreach and education.

ACTION PLAN:

- Assess current population structure and size: To collect baseline population size, demography (age and sex), genetics, and distribution information for Guam's stocks.
- Protect habitat: Provide adequate protection of habitat in ACOE and Guam Seashore clearance permit conditions.
- Reduce take through outreach and education: To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting slow growth rate. To include in fisheries management plans.

Hugupau, tataga, guasa', hangon, guagnas, hiyuk, kichu

Acanthuridae

Surgeonfish



Photo by Tatiana Talavera

HISTORIC AND CURRENT STATUS: Popular food fish representing up to 30% of the coastal fishery. This family is heavily fished using a number of techniques including gill nets and spearfishing.

THREATS: Overfishing, loss of habitat. Species of particular management need based on vulnerable life histories and patterns of decline are: *Naso unicornis*, *Naso lituratus*, *Acanthurus xanthopterus*, *Acanthurus blochii*.

HABITAT: Varied, adults generally found in lagoons and seaward reefs. Juveniles often in protected, turbid, inshore waters (Myers, 1999).

GOAL: To manage populations for sustainable fishing.

OBJECTIVES: Assess current population structure and size, protect habitat, and manage take through outreach and education.

ACTION PLAN:

- Assess current population structure and size: To collect baseline population size, genetics, and distribution information for Guam's stocks.
- Protect habitat: To provide adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions.
- Reduce take through outreach and education: To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting biology. To include in fisheries management plans.

Laggua, palaksi

Scaridae

Parrotfish



Photo by Tatiana Talavera

HISTORIC AND CURRENT STATUS: Popular food fish, can represent up to 30% of the coastal fishery. This family is heavily fished using a number of techniques including gill nets and spearfishing.

THREATS: Overfishing, loss of habitat. Species of particular management need based on vulnerable life histories and patterns of decline are: *Chlorurus microrhinos*, *Chlorurus frontalis*, *Cetoscarus ocellatus*, *Hipposcarus longiceps*, *Scarus altipinnis*, *Scarus rubroviolaceus*.

HABITAT: Varied, adults generally in lagoons and seaward reefs although some occur exclusively in reef flats and shallow lagoon areas dominated by seagrass or dense algae beds. Juveniles are often in protected, inshore waters including reef flats and lagoons, but may also be found on seaward reefs (Myers, 1999).

GOAL: To manage populations for sustainable fishing.

OBJECTIVES: Assess current population structure and size, protect habitat, and manage take through outreach and education.

ACTION PLAN:

- Assess current population structure and size: To collect baseline population size, genetics, and distribution information for Guam's stocks.
- Protect habitat: Provide adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions.
- Reduce take through outreach and education: To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting biology. To include in fisheries management plans.

Mafute, lililuk

Lethrinidae

Emperors



Photo by Tatiana Talavera

HISTORIC AND CURRENT STATUS: Popular food fish, this family is heavily fished using a number of techniques including gill nets, spearfishing, hook and line.

THREATS: Overfishing, loss of habitat. Species of particular management need based on vulnerable life histories and patterns of decline are: *Lethrinus rubrioperculatus*, *Lethrinus olivaceus*, *Lethrinus xanthochilus*, *Lethrinus obsoletus*, *Lethrinus harak*, *Monotaxis grandoculis*.

HABITAT: Varied, adults generally found in lagoons and seaward reefs although some occur in reef flats and shallow lagoon areas, including seagrass, mangroves, and shallow sandy areas. Juveniles are often in protected, inshore waters including reef flats and lagoons, but may also be found on seaward reefs (Myers, 1999).

GOAL: To manage populations for sustainable fishing.

OBJECTIVES: Assess current population structure and size, protect habitat, manage take through outreach and education.

ACTION PLAN:

- Assess current population structure and size: To collect baseline population size, demography (age and sex), genetics, and distribution information for Guam's stocks.
- Protect habitat: Provide adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions.
- Reduce take through outreach and education: To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting slow growth rate, to include in fisheries management plans.

Gadao, gadao pentu, gadao maluslus, gadao matingon, gadao mama'te, gadao alutong finu

Serranidae

Groupers



Photo by Tatiana Talavera

HISTORIC AND CURRENT STATUS: Popular food fish, this family is heavily fished using a number of techniques including gill nets, spearfishing, hook and line.

THREATS: Overfishing, loss of habitat

HABITAT: Varied, adults generally in lagoons and seaward reefs although some occur in reef flats and shallow lagoon areas, including seagrass, mangroves, and shallow sandy areas. Juveniles are often in protected, inshore waters including reef flats and lagoons, but may also be found on seaward reefs (Myers, 1999).

GOAL: To manage populations for sustainable fishing.

OBJECTIVES: Assess current population structure and size, protect habitat, manage take through outreach and education.

ACTION PLAN:

- Assess current population structure and size: To collect baseline population size, demography (age and sex), genetics, and distribution information for Guam's stocks.
- Protect habitat: Provide adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions.
- Reduce take through outreach and education: To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting slow growth rate. To include in fisheries management plans.

Sesyun, manahak, manahak ha'tang, manahak lesu, hiting fade

Siganidae

Rabbitfish



HISTORIC AND CURRENT STATUS: Popular food fish, this family is heavily fished using a number of techniques including talåya (throw net), hook and line, tekken (gill net), and spear. Juveniles recruit in large schools and form a culturally important fishery. Juveniles are taken with tekken and talåya, while adults are more frequently taken with hook and line or spear.

THREATS: Overfishing, loss of habitat. Most harvested species include *Siganus spinus*, *Siganus argenteus*, and *Siganus punctatus*.

HABITAT: Reef flats, lagoons and bays, and fore reefs (Myers, 1999).

GOAL: To manage populations for sustainable fishing.

OBJECTIVES: Assess current population structure and size, protect habitat, manage take through outreach and education.

ACTION PLAN:

- Assess current population structure and size: To collect baseline population size, demography (age and sex), genetics, and distribution information for Guam's stocks.
- Protect habitat: To provide adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions.
- Reduce take through outreach and education: To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting biology. To include in fisheries management plans.

Tagafi, fafaet, funai, kakaka, bua, lagu

Lutjanidae

Snappers



Photo by Tatiana Talavera

HISTORIC AND CURRENT STATUS: Popular food fish taken with hook and line, spear, and gill-net. Some species are shunned due to chronic incidence or perception of ciguatera toxin.

THREATS: Overfishing, loss of habitat

HABITAT: Varied, adults generally found in lagoons and seaward reefs although some occur in reef flats and shallow lagoon areas, including seagrass, mangroves, and shallow sandy areas. Some species are the principal fisheries species taken from deep reefs (>500 ft.). Juveniles often in protected, inshore waters including reef flats and lagoons. Some species are frequently found in brackish or freshwater habitats (Myers, 1999).

GOAL: To manage populations for sustainable fishing.

OBJECTIVES: Assess current population structure and size, protect habitat, manage take through outreach and education.

ACTION PLAN:

- Assess current population structure and size: To collect baseline population size, demography (age and sex), genetics, and distribution information for Guam's stocks.
- Protect habitat: To provide adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions.
- Reduce take through outreach and education: Teach fishers conservation by educating them not to catch fish below reproductive size. Develop educational materials highlighting slow growth rate. To include in fisheries management plans.

Samoneti, ti'ao, sakmoneten acho', sakmoneten amariyu, sakmoneten lasu lahi, sakmoneten le'ao

Mullidae

Goatfish



Photo by Tatiana Talavera

HISTORIC AND CURRENT STATUS: Popular food fish. Juveniles recruit in large schools and form a culturally important fishery. Juveniles are taken with tekken (gill net), and talåya (throw net), while adults are more frequently taken with hook and line or spear.

THREATS: Overfishing, loss of habitat

HABITAT: 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 (Myers, 1999).

GOAL: To manage populations for sustainable fishing.

OBJECTIVES: Assess current population structure and size, protect habitat, manage take through outreach and education.

ACTION PLAN:

- Assess current population structure and size: To collect baseline population size, demography (age and sex), genetics, and distribution information for Guam's stocks.
- Protect habitat: To provide adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions.
- Reduce take through outreach and education: To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting rapid growth rate. To include in fisheries management plans.

Ababang, ababang lonnat, ababang rayao, ababang pintado

Chaetodontidae

Butterflyfish

Photo by Tatiana Talavera



HISTORIC AND CURRENT STATUS: Not traditionally taken as a food fish by the CHamoru population but sometimes taken for food in other areas. These fish are some of the most popular species taken for the home aquarium trade, although many species do poorly in captivity.

THREATS: Overfishing by the aquarium trade, loss of habitat

HABITAT: 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 (> 200 feet) (Myers, 1999).

GOAL: To manage and maintain current population status.

OBJECTIVES: Assess current population structure and size, protect habitat, manage take through outreach and education.

ACTION PLAN:

- Assess current population structure and size: To collect baseline population size, demography (age and sex), genetics, and distribution information for Guam's stocks.
- Protect habitat: To provide adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions.
- Reduce take through outreach and education: To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting biology. To include in fisheries management plans.

Ababang

Pomacanthidae

Angelfish



HISTORIC AND CURRENT STATUS: Not traditionally taken as a food fish by the CHamoru population but sometimes taken for food in other areas. These fish are some of the most popular species taken for the home aquarium trade, although many species do poorly in captivity.

THREATS: Overfishing by the aquarium trade, loss of habitat

HABITAT: This family inhabits reef flats, clear lagoons, seaward reef slopes, and channels. Some species are found on deep reefs (Myers, 1999).

GOAL: To manage and maintain current population status.

OBJECTIVES: Assess current population structure and size, protect habitat, manage take through outreach and education.

ACTION PLAN:

- Assess current population structure and size: To collect baseline population size, demography (age and sex), genetics, and distribution information for Guam's stocks.
- Protect habitat: To provide adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions.
- Reduce take through outreach and education: To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting biology. To include in fisheries management plans.

Aluda

Cirrhitidae

Hawkfish



HISTORIC AND CURRENT STATUS: Within the Cirrhitidae family, the stocky hawkfish (*Cirrhitus pinnulatus*) is often fished for food. Other species in this family 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.

THREATS: Overfishing, aquarium collection, loss of habitat. Collection of these species for the aquarium trade often leads to the destruction of the corals they inhabit.

HABITAT: Aluda 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 (*Pocillopora eydouxi*) and *Acropora* species (Myers, 1999).

GOAL: To manage and maintain current population status.

OBJECTIVES: Assess current population structure and size, protect habitat, manage take through outreach and education.

ACTION PLAN:

- Assess current population structure and size: To collect baseline population size, demography (age and sex), genetics, and distribution information for Guam's stocks.
- Protect habitat: To provide adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions.
- Reduce take through outreach and education: To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting biology. To include in fisheries management plans.

Palaksi, a'aga, lalacha' mamate

Labridae

Wrasses



HISTORIC AND CURRENT STATUS: Wrasses are a popular food fish in Guam. They are frequently taken on hook and line, with tekken (gill nets), and with spear. Wrasses are carnivores, feeding on reef invertebrates and smaller fishes.

THREATS: Overfishing, loss of habitat

HABITAT: Wrasses are found in almost all coral reef habitats, from seagrass beds to sandy reef flats, to seaward reef slopes and deep reefs (> 500 feet). In some habitats, wrasses are among the most abundant species found.

GOAL: To manage populations for sustainable fishing.

OBJECTIVES: Assess current population structure and size, protect habitat, manage take through outreach and education.

ACTION PLAN:

- Assess current population structure and size: To collect baseline population size, demography (age and sex), genetics, and distribution information for Guam's stocks.
- Protect habitat: To provide adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions.
- Reduce take through outreach and education: To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting biology. To include in fisheries management plans.

I'e, tarakitu, mamulan

Carangidae

Jacks and Trevallies



Photo by Tatiana Talavera

HISTORIC AND CURRENT STATUS: Popular food fish. Juveniles recruit in large schools and form a culturally important fishery. Juveniles are taken with hook and line and talåya (throw net), while adults are more frequently taken with hook and line or spear.

THREATS: Overfishing, loss of habitat.

HABITAT: 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 (Myers, 1999).

GOAL: To manage populations for sustainable fishing.

OBJECTIVES: Assess current population structure and size, protect habitat, manage take through outreach and education.

ACTION PLAN:

- Assess current population structure and size: To collect baseline population size, demography (age and sex), genetics, and distribution information for Guam's stocks.
- Protect habitat: To provide adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions.
- Reduce take through outreach and education: To teach fishers conservation by educating them not to catch fish below reproductive size. To develop educational materials highlighting slow growth rate. To include in fisheries management plans.

Hafula'

Mobula alfredi

Reef Manta Ray



Photo by Julie Hartup

HISTORIC AND CURRENT STATUS: Manta rays are listed as vulnerable to extinction on the IUCN Red List and are included in Appendix II of both CITES and the Convention on Migratory Species (CMS). From 2008 to 2024, 64 individual manta rays have been documented in Guam, representing a small population compared to other groups, which are estimated to consist of about 300 individuals. Guam's reef manta rays target Acanthuridae (surgeonfish) spawning aggregations to feed on fish spawn, marking the first documentation of this behavior (Hartup et al., 2013). One juvenile manta ray was documented in August 2019 off Rota Harbor and then recorded in Guam in June 2020 suggesting a mixing of populations and need for shared management.

THREATS: Reef manta rays are targeted in Western Asia, where their gill rakers are commonly used in traditional medicine. They also get caught as bycatch in commercial fishing nets. The popularity of scuba diving spots that attract manta rays often leads to unmanaged and irresponsible behavior. Manta rays are ram-jet filter feeders and planktivorous, and both their feeding patterns and abundance are affected by climate change.

HABITAT: Reef manta rays are found in tropical and sub-tropical regions of the Indian and western Pacific Oceans. In Guam, these rays are found in coral reefs, sea banks, and epipelagic and mesopelagic zones with time-at-depth spent repetitively at 200-350 meters with deepest depths below 600 meters.

GOAL: Maintain population for delisting from CITES and to avoid listing on the Endangered Species List.

OBJECTIVE: To manage and increase population.

ACTION PLAN:

- Assess the current population structure and size.
- Gather baseline data on population size, demographics (age and sex), and growth rates.
- Understand the horizontal and vertical movements of reef manta rays, along with genetic and distribution information regarding Guam's population.
- Collaborate with CNMI on reef manta ray population.

Recommended section citation:
Hartup, J. 2025. Hafula' Species Accounts. In Guam Department of Agriculture, Division of Aquatic and Wildlife Resources. (2025). 2025 Guam State Wildlife Action Plan (p. 154).

Hafula'

Mobula birostris

Oceanic manta ray



Photo by Julie Hartup

HISTORIC AND CURRENT STATUS: The oceanic manta ray is currently listed as endangered due to declining populations from fishing and habitat loss. The oceanic manta ray has been recognized for its significant role in marine ecosystems, but its population is declining due to overfishing, bycatch, and environmental changes. The giant manta ray's status is "Endangered" due to a significant population decline (50-79% in the past three generations) and their continued threats potentially furthering the decline. Also known as the giant manta ray, the species is also protected by the Convention on Migratory Species (CMS) (2011) and the Convention on the International Trade in Endangered Species (CITES) (2013), which are global conservation treaties. In Guam, rays are protected under Bill No. 44-31, which makes it unlawful for anyone to possess, sell, offer for sale, take, purchase, barter, transport, export, import, trade, or distribute ray parts. Each manta ray features a unique spot pattern on its ventral side that allows for tracking through photogrammetry.

THREATS: Overfishing, bycatch, environmental impacts

HABITAT: Oceanic manta rays inhabit mostly warm, tropical and sub-tropical oceans and are often found in some coastal regions, seamounts and banks, and open ocean environments.

GOAL: Document and maintain population for delisting as an endangered species and from CITES.

OBJECTIVES: Document, manage and increase population. Increase awareness, reduce threats, and promote sustainable ecotourism diving practices.

ACTION PLAN:

- Develop and enforce regulations to minimize fishing impacts, promote ecotourism, and educate the public about manta ray conservation.
- Implement protective measures, conduct research, and engage local communities in conservation efforts.
- Gather baseline data on population size, demographics (age and sex), and growth rates.
- Understand the horizontal and vertical movements of oceanic manta rays, along with genetic and distribution information regarding Guam's population.
- Collaborate with CNMI on the oceanic manta ray population.
- Implement protective measures, conduct research, and engage local communities in conservation efforts.

Recommended section citation:
Hartup, J. 2025. Hafula' Species Accounts. In Guam Department of Agriculture, Division of Aquatic and Wildlife Resources. (2025). 2025 Guam State Wildlife Action Plan (p. 155).

Hafula'

Mobula tarapacana

Sicklefin devil ray or Chilean devil ray



Photo by Julie Hartup

HISTORIC AND CURRENT STATUS: *Mobula taracapana* has historically been an important species in tropical and sub-tropical marine ecosystems. It was once abundant in many coastal regions, where it played a crucial role in the marine food web. However, current populations are declining due to overfishing, particularly from targeted fisheries and bycatch in gill-nets and trawl nets. Additionally, habitat degradation and environmental changes, such as climate change and ocean acidification, pose significant threats to their survival. Conservation efforts are needed to protect this species and ensure its long-term viability in the wild. The sicklefin devil ray is listed as endangered on the IUCN and Appendix I and II of CITES.

THREATS: Primary threats are bycatch in commercial fisheries, where these rays are unintentionally caught in gill-nets and trawl nets, leading to injury or death. Additionally, targeted fishing for their gill plates, which are highly valued in traditional medicine and as a delicacy in some Asian cultures, exacerbates their vulnerability. Habitat degradation, including the destruction of coastal ecosystems such as coral reefs and mangroves, further impacts their feeding and breeding grounds. Climate change also poses a serious threat, as rising ocean temperatures and acidification can disrupt their migratory patterns and affect the availability of prey.

HABITAT: This species inhabits warm, tropical, and sub-tropical oceans, primarily residing in coastal and open ocean environments. These rays are often found in areas with abundant plankton, their primary food source, which they filter from the water using their specialized gill rakers. They tend to frequent continental shelves and can be seen near coral reefs, where they may engage in feeding and social behaviors. Sicklefin devil rays are known for their migratory patterns, traveling long distances in search of food and suitable breeding grounds. They are typically found at varying depths depending on the availability of prey and environmental conditions. The health of their habitat is crucial for their survival, as changes in water quality, temperature, and habitat structure can significantly impact their populations and overall ecosystem dynamics.

GOAL: Document and maintain population for delisting from CITES and to avoid listing on the United States Endangered Species List.

OBJECTIVES: Document, manage, and increase the population while increasing awareness and reducing threats.

ACTION PLAN:

- Develop and enforce regulations to minimize fishing impacts, promote ecotourism, and educate the public about *Mobula taracapan* conservation.
- Implement protective measures, conduct research, and engage local communities in conservation efforts.
- Gather baseline data on population size, demographics (age and sex), and growth rates of *Mobula taracapan*.
- Understand their horizontal and vertical movements, as well as genetic and distribution information, while collaborating with CNMI on implementing protective measures, conducting research, and engaging local communities in conservation efforts.

Recommended section citation:

Hartup, J. 2025. Hafula' Species Accounts. In Guam Department of Agriculture, Division of Aquatic and Wildlife Resources. (2025). 2025 Guam State Wildlife Action Plan (p. 156).

Cho'cho'

Scleractinia

Hard Coral



Photo by David Burdick

HISTORIC AND CURRENT STATUS: Coral cover, primarily composed of zooxanthellate Scleractinian species, on Guam's shallow coral reefs was historically estimated around 50-60% across the island's reef zones (NOAA, 2008). However, repeated disturbances, such as mass bleaching events, have led to drastic declines with average live coral cover at 25% or less (NOAA, 2021).

THREATS: Climate change, land-based sources of pollution (sedimentation, pollution), over-harvesting of herbivorous fish populations, crown-of-thorns outbreaks, recreational misuse, and disease.

HABITAT: Highly variable, reef flats up to 100m deep.

GOAL: To maintain or expand Guam's hard coral resources.

OBJECTIVES: Conduct assessments and monitoring of hard coral resources in Guam's waters. Take actions to limit impacts to coral resources (passive restoration) and continue active coral restoration for areas where removal of negative impacts is not sufficient to restore the ecosystem services of corals.

ACTION PLAN:

- Assess current population structure and size: Support the Guam Long-term Coral Reef Monitoring Program's (GLTMP) existing in situ monitoring of coral percent cover, species composition, and rugosity within the High Priority Reef Areas and at island-wide bleaching response and recovery sites. The GLTMP no longer conducts coral colony size and condition surveys due to capacity constraints, but the re-introduction of these surveys could occur if program capacity is expanded.
- Protect habitat: Implement a variety of watershed restoration actions aimed at improving the quality of water draining into coastal waters. Compile existing water quality data, conduct a gaps analysis, and support the development and implementation of nearshore coral reef-focused water quality monitoring efforts. Provide adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. Develop and effectively implement the regulation of the harvest of reef fishes, with particular attention on herbivorous fish species. Support the regular monitoring and control of *Acanthaster planci*.
- Reduce take through outreach and education: Educate residents on the need for re-vegetation, raise public awareness on the impacts of wildland arson, and educate recreational users.
- Active coral restoration: Outplant stony coral in areas where passive restoration is insufficient to restore ecosystem services provided by coral reefs. The University of Guam Marine Lab has active coral restoration for staghorn species including: *Acropora pulchra, A. muricata, A. acuminata, A. Aspera, A. teres, A. austera, A. virigata, A. vaughani.* The Department of Agriculture Guam Coral Reef Initiative also has begun coral restoration with six additional species: *Acropora latistella, Diploastrea heliopora, Acropora surculosa, Pocillopra grandis, Galaxea fascicularis, and Pavona decussata*.

Subclass Octocorallia
Soft Coral

Sclerophytum colony from the reef flat in Piti Bomb Holes MPA

Photo by David Burdick



HISTORIC AND CURRENT STATUS: Populations have expanded in some areas in the last thirty years but seem to be declining at present. These corals serve as an important habitat for a number of marine invertebrates.

THREATS: Land-based sources of pollution (sedimentation, chemicals), climate change, destruction by shell collectors, and disease.

HABITAT: Habitats vary greatly from reef flats to over 100m (330ft.) deep. Malalcyonacean soft corals, such as *Sclerophytum* (formerly *Sinularia*) spp. are conspicuous and abundant Guam's on shallow reef flats, while neptheids and "gorgonians" are typically found below 25 m Guam's seaward slopes.

GOAL: To maintain or expand Guam's soft coral resources.

OBJECTIVES: Take actions to limit impacts to coral resources and conduct assessments and monitoring of soft coral resources in Guam's waters.

ACTION PLAN:

- Assess current population structure and size: conduct in situ surveys of Guam's coral resources including percent cover, species composition, and disease.
- Protect habitat: Implement a variety of watershed restoration actions aimed at improving the quality of water draining into coastal waters. Compile existing water quality data, conduct a gaps analysis, and support the development and implementation of nearshore coral reef-focused water quality monitoring efforts. Provide adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions.
- Reduce take through outreach and education: Educate local residents on need for re- vegetation, raise public awareness of the impacts of wildland arson, and educate recreational users.

Cho'cho'

Acropora globiceps



Photo by David Burdick

HISTORIC AND CURRENT STATUS: Within U.S. waters, *Acropora globiceps* occurs 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 (NOAA, 2015). This species was listed as threatened under the U.S. Endangered Species Act in 2014.

THREATS: Ocean warming, disease, ocean acidification, sedimentation plumes, land-based source pollution, recreational misuse (anchoring, stepping on corals, etc.).

HABITAT: Upper reef slopes, reef flats, and adjacent habitats in depths ranging from 0 to 20m, with a preference for clear, exposed reef areas and depths <8 m.

GOAL: To determine locations and abundance in Guam. To develop and implement adaptive management actions to prevent further decline of species.

OBJECTIVES: Take actions to limit impacts to coral resources and conduct assessments and monitoring of hard coral resources in Guam's waters.

ACTION PLAN:

- Assess current population structure and size: Support the Guam Long-term Coral Reef Monitoring Program's (GLTMP) existing in situ monitoring of coral percent cover, species composition, and rugosity within the High Priority Reef Areas and at island-wide bleaching response and recovery sites. The GLTMP no longer conducts coral colony size and condition surveys due to capacity constraints, but the re-introduction of these surveys could occur if program capacity is expanded.
- Protect habitat: Implement a variety of watershed restoration actions aimed at improving the quality of water draining into coastal waters. Compile existing water quality data, conduct a gaps analysis, and support the development and implementation of nearshore coral reef-focused water quality monitoring efforts. Provide for adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions. Develop and effectively implement the regulation of the harvest of reef fishes, with particular attention on herbivorous fish species. Support the regular monitoring and control of *Acanthaster planci*.
- Reduce take through outreach and education: To educate residents on the need for re-vegetation, raise public awareness on the impacts of wildland arson, and educate recreational users.

Balåti

Actinopyga echinites

Deepwater red fish



HISTORIC AND CURRENT STATUS: *Actinopyga echinites*, also called the brown fish has been historically abundant in Guam (Kerr et al. 2017). It is also one of the most commercially valuable species (Purcell et al. 2012) and may be disappearing from Guam's waters as a result, just as it is elsewhere in its range. In the IUCN Red List of Threatened Species, it is currently listed as vulnerable to extinction globally.

THREATS: Overfishing

HABITAT: Sandy reef flats

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

OBJECTIVES: To manage and increase population to allow sustainable fishing

ACTION PLAN: Reduce take through change in regulations

Photo credit: https://www.inaturalist.org/observations/106308693 with permission © Marisa Agarwal CC BY-NC 4.0

Recommended section citation:
Kerr, A. 2025. Balåti Species Accounts. In Guam Department of Agriculture, Division of Aquatic and Wildlife Resources. (2025). 2025 Guam State Wildlife Action Plan (p. 160).

Balåti

Actinopyga varians

Surf red fish



HISTORIC AND CURRENT STATUS: *Actinopyga varians*, sometimes also called the Pacific white-spotted sea cucumber, has been historically abundant in Guam (Kerr et al. 2017). It is also one of the most commercially valuable species (Purcell et al. 2012) and may be disappearing from Guam's waters as a result, just as it is elsewhere in its range. In the IUCN Red List of Threatened Species, it is currently listed as Data Deficient and hence may be vulnerable or threatened globally.

THREATS: Overfishing

HABITAT: The wave-battered outer margins of reef flats

GOAL: Sustain population and prevent listing on Endangered Species List.

OBJECTIVES: To manage and increase population to allow sustainable fishing

ACTION PLAN: Reduce take through change in regulations.

Photo credit: https://www.inaturalist.org/observations/162875339 with permission © Olivia Bañez CC BY-NC 4.0

Recommended section citation:
Kerr, A. 2025. Balåti Species Accounts. In Guam Department of Agriculture, Division of Aquatic and Wildlife Resources. (2025). 2025 Guam State Wildlife Action Plan (p. 161).

Balåti

Holothuria fuscogilva

Brown teatfish



HISTORIC AND CURRENT STATUS: *Holothuria fuscogilva*, sometimes also called the white teatfish, has never been abundant in Guam (Kerr et al. 2017). However, it is one of the most commercially valuable species (Purcell et al. 2012) and may be disappearing from Guam's waters as a result, just as it is elsewhere in its range. In the IUCN Red List of Threatened Species, it is currently listed as vulnerable to extinction globally.

THREATS: Overfishing

HABITAT: The deep outer reef slope, usually below 20 m depth on sandy bottoms.

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

OBJECTIVES: To manage and increase population to allow sustainable fishing.

ACTION PLAN: Reduce take through change in regulations.

Photo credit: https://www.inaturalist.org/observations/193921046 with permission © Claire Goiran CC BY-NC 4.0

Recommended section citation:
Kerr, A. 2025. Balåti Species Accounts. In Guam Department of Agriculture, Division of Aquatic and Wildlife Resources. (2025). 2025 Guam State Wildlife Action Plan (p. 162).

Balåti

Holothuria whitmaei

Black teatfish



HISTORIC AND CURRENT STATUS: *Holothuria whitmaei*, sometimes also called the teated sea cucumber, has been fairly abundant in Guam (Kerr et al. 2017). However, it is also one of the most commercially valuable species (Purcell et al. 2012) and appears to be disappearing from Guam's waters as a result, just as it is elsewhere in its range. In the IUCN Red List of Threatened Species, it is currently listed as endangered.

THREATS: Overfishing

HABITAT: The shallow outer reef slope, usually above 20 m depth on sandy bottoms.

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

OBJECTIVES: To manage and increase population to allow sustainable fishing

ACTION PLAN: Reduce take through change in regulations.

Photo credit: https://www.inaturalist.org/observations/106469515 with permission © Marisa Agarwal CC BY-NC 4.0

Recommended section citation:
Kerr, A. 2025. Balåti Species Accounts. In Guam Department of Agriculture, Division of Aquatic and Wildlife Resources. (2025). 2025 Guam State Wildlife Action Plan (p. 163).

Balåti

Thelenota ananas

Pineapple sea cucumber



HISTORIC AND CURRENT STATUS: *Thelenota ananas*, sometimes also called the spiked sea cucumber, has been fairly abundant in Guam (Kerr et al. 2017). However, it is also one of the most commercially valuable species (Purcell et al. 2012) and appears to be disappearing from Guam's waters as a result, just as it is elsewhere in its range. In the IUCN Red List of Threatened Species, it is currently listed as endangered.

THREATS: Overfishing

HABITAT: The shallow outer reef slope, usually above 20 m depth on sandy bottoms.

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

OBJECTIVES: To manage and increase population to allow sustainable fishing

ACTION PLAN: Reduce take through change in regulations.

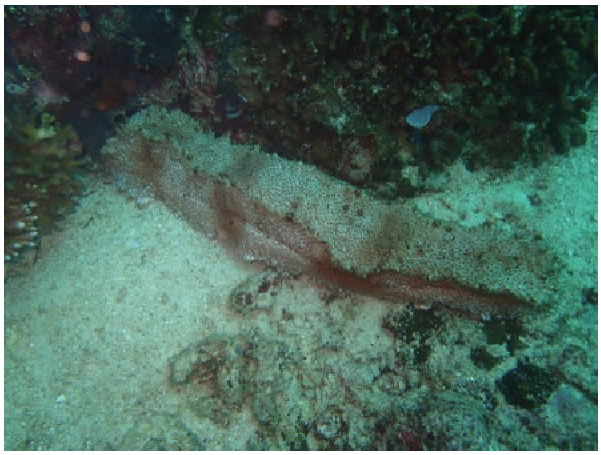
Photo credit: https://www.inaturalist.org/observations/107288184 with permission © Marisa Agarwal CC BY-NC 4.0

Recommended section citation:
Kerr, A. 2025. Balåti Species Accounts. In Guam Department of Agriculture, Division of Aquatic and Wildlife Resources. (2025). 2025 Guam State Wildlife Action Plan (p. 164).

Balåti

Thelenota anax

Giant sea cucumber



HISTORIC AND CURRENT STATUS: *Thelenota ananas*, sometimes also called the king sea cucumber, has never been abundant in Guam (Kerr et al. 2017). However, it is also one of the most commercially valuable species (Purcell et al. 2012) and appears to be disappearing from Guam's waters as a result, just as it is elsewhere in its range. In the IUCN Red List of Threatened Species, it is currently listed as data deficient and so may already be vulnerable or endangered.

THREATS: Overfishing

HABITAT: The deep outer reef slope, usually below 20 m depth on sandy bottoms.

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

OBJECTIVES: To manage and increase population to allow sustainable fishing

ACTION PLAN: Reduce take through change in regulations.

Photo credit: https://www.inaturalist.org/observations/256802560 with permission © Benoît Segerer CC BY-NC 4.0

Recommended section citation:
Kerr, A. 2025. Balåti Species Accounts. In Guam Department of Agriculture, Division of Aquatic and Wildlife Resources. (2025). 2025 Guam State Wildlife Action Plan (p. 165).

Mahonggang

Paniluris sp.

Spiny Lobster



HISTORIC AND CURRENT STATUS: This species has historically been harvested for food. Increased fishing pressure and habitat degradation have affected its population. In 2003, it was the top ranked crustacean harvested with over 2,200 kg (4,800 lbs.) collected in Guam (Gutierrez, 2003).

THREATS: Overfishing, loss of habitat

HABITAT: Surf zone, reef front, may feed in reef flats.

GOAL: To manage populations for sustainable fishing.

OBJECTIVES: Assess current population structure and size, protect habitat, and manage take through outreach and education.

ACTION PLAN:

- Assess current population structure and size: To collect baseline population size, demography (age and sex), genetics, and distribution information for Guam's stocks.
- Protect habitat: To provide 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. To include in fisheries management plans.

Charonia tritonis

Triton's Trumpet



HISTORIC AND CURRENT STATUS: Historically, *Charonia tritonis* was more common around Guam's reefs, but decades of collection for decorative shells and food have drastically reduced its abundance, particularly in densely populated areas. Today, the species is considered rare with its decline exacerbated by over-harvesting. The species is not locally or federally listed but is regulated internationally as a CITES Appendix II species.

THREATS: Overfishing, loss of habitat

HABITAT: Areas of rich coral cover

GOAL: Sustain population

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), genetics, and distribution information for Guam's stocks.
- Protect habitat: To provide 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. To include in fisheries management plans.

Hima

Tridacna derasa, Tridacna maxima, Tridacna squamosa, Hippopus hippopus

Giant Clam



HISTORIC AND CURRENT STATUS: Historically, giant clam populations were abundant throughout the Marianas and across Micronesia and the Indo-Pacific. Significant declines in populations were caused by decades of intense over-harvesting for food, aquarium trade, and use in carving for traditional adornment. By the late 20th century, wild populations were severely reduced or locally extirpated.

THREATS: Overfishing, loss of habitat

HABITAT: Reef flats and seaward reefs to a depth of at least 60 feet.

GOAL: Achieve long-term population stability to meet recovery thresholds under CITES and Endangered Species Act.

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), genetics, and distribution information for Guam's stocks.
- Protect habitat: To provide adequate protection of habitat in ACOE and Guam Seashore Clearance permit conditions.
- Reduce harvesting of giant clams through outreach and education: To develop educational materials highlighting slow growth rate. To include in fisheries management plans.

Lo'u/Chå'guan tåsi

Enhalus acoroides, Halodule uninervis, Halophila nipponica

Sea Grasses



HISTORIC AND CURRENT STATUS: Seagrass beds are widely distributed across Guam's reef flats, where they play an important ecological role. However, these resources have experienced significant declines due to disturbances such as dredging, increased sedimentation, and marine heatwave events. A satellite image analysis conducted by NOAA in 2005 estimated that seagrass covered approximately 3 km^2 of Guam's nearshore reef environment (NOAA, 2005). Since that assessment, the total seagrass area has decreased by an estimated 22% (LaRoche et al., 2018).

THREATS: Sedimentation, marine heatwaves, water quality degradation, outbreaks of nuisance species, habitat loss, disease, and recreational impacts.

HABITAT: Reef flats and lagoons

GOAL: Protect, maintain, and where possible, expand the extent and improve the health of Guam's seagrass resources.

OBJECTIVES: Evaluate seagrass density and monitor long-term trends in their distribution across Guam's nearshore marine environments.

ACTION PLAN:

- Assess population structure and distribution: Conduct field surveys of Guam's seagrass resources to document species composition, population structure, density, and spatial extent.
- Protect critical habitat: Restore vegetation in watersheds that drain into coastal bays with significant seagrass beds. Construct designated walkways to minimize physical disturbance in areas with high seagrass cover.
- Minimize anthropogenic impacts through outreach and education: Raise community awareness about the importance of watershed re-vegetation and the impacts of wildland arson on coastal ecosystems. Educate recreational users on the ecological value of seagrass beds, particularly their role in supporting fisheries.

Recommended section citation:
Schils, T. 2025. Lo'u Species Accounts. In Guam Department of Agriculture, Division of Aquatic and Wildlife Resources. (2025). 2025 Guam State Wildlife Action Plan (p. 169).

Lo'u/Ácho' tåsi

Rhodophyta:

Corallinophycidae, Peyssonneliales

Calcifying Red Algae



HISTORIC AND CURRENT STATUS: Rhodoliths are free-living, calcifying red algae that can form dense aggregations (beds). They are internationally recognized as unique habitats and biodiversity hotspots. Despite their ecological importance, rhodolith communities remain understudied in tropical regions, and little is known about their diversity and ecological roles in Guam. Under degraded water quality or following major disturbances, some species of calcifying red algae can outcompete corals and opportunistically overgrow reef surfaces. The documented species diversity of calcifying red algae in Guam is among the highest in the world, and the level of endemism for this group in the Mariana Islands is expected to be high (Mills et al., 2022). Species of calcifying red algae are the deepest recorded plant life on Earth. Guam's mesophotic and rariphotic communities support extensive cover of these algae. These algae play a key role in reef carbonate budgets, particularly in areas where coral cover is low or has declined (Schils, 2023).

THREATS: Marine heatwaves, water quality degradation, habitat loss, and disease.

HABITAT: Habitat builders across reef flats, crests, and forereefs, from shallow to mesophotic depths.

GOAL: Advance understanding of how the unique diversity of Guam's calcifying red algae contributes to the persistence of healthy, carbonate-accreting tropical reef systems.

OBJECTIVES: Investigating the species diversity and ecological function of calcifying red algae in relation to shifts in herbivore populations and coral cover.

ACTION PLAN:

- Characterize the species diversity of calcifying red algae across reef habitats and identify indicator species that reflect reef health. Use these indicators to monitor ecological condition and guide management efforts.
- Preserve healthy calcifying red algal communities to support reef resilience and recovery after disturbance.
- Prioritize the conservation of rare and potentially endemic calcifying red algal species unique to the Mariana Islands.
- Document the ecological and biological diversity of rhodolith communities, which remain largely unexplored in the region.

Recommended section citation:
Schils, T. 2025. Lo'u Species Accounts. In Guam Department of Agriculture, Division of Aquatic and Wildlife Resources. (2025). 2025 Guam State Wildlife Action Plan (p. 170).

Lo'u/Chå'guan' tåsi

Rhodophyta (red seaweeds),
Ulvophyceae (green seaweeds),
Phaeophyceae (brown seaweeds)
Seaweeds; Marine Macroalgae



HISTORIC AND CURRENT STATUS: Red algae represent the most diverse group of seaweeds in Guam. Historically, Guam's seaweed flora was believed to consist mainly of widespread Indo-Pacific species. However, recent phylogenetic studies have revealed that many species have limited geographic distributions, with a significant number likely endemic to Guam and the Mariana Islands. In recent decades, large-scale outbreaks of nuisance seaweeds have become an increasing concern in the Mariana Islands. In Guam, massive blooms of *Chaetomorpha vieillardii* began in 2012 and were later observed on Saipan. In 2024, Saipan experienced a significant outbreak of a *Palisada* species, which altered reef community composition. These blooms tend to outcompete native seaweed and other benthic organisms, disrupting the ecological balance of reef systems across the region. While short-term shifts in seaweed communities also occur naturally following tropical storms, these nuisance blooms represent a more persistent and damaging disturbance. Genetic studies indicate that several non-native seaweed species have become naturalized in Guam's waters.

THREATS: Marine heatwaves, water quality degradation, habitat loss, community-level shifts driven by outbreaks of nuisance species, introduction and spread of invasive species, and over-harvesting.

HABITAT: Lagoons, reef flats, patch reefs, forereefs, and estuarine environments.

GOAL: Preserve the unique diversity of Guam's seaweed communities as a sustainable resource for people and their vital role in supporting healthy reef ecosystems.

OBJECTIVES: Generate a DNA-barcoded reference library of Guam's native seaweed flora and document the presence of introduced species. Conduct a resource assessment of ecologically and culturally important seaweeds to (1) support the conservation of key reef ecosystem functions and (2) identify candidate species for sustainable mariculture in Guam.

ACTION PLAN:

- Collaborate with local and federal government agencies to establish a comprehensive baseline of Guam's seaweed diversity, supporting efforts to detect and prevent the introduction of non-native species and to identify indicator species for ecological disturbances and environmental change. Given its role as the main entry point formaritime traffic and the ongoing military build-up, Apra Harbor should be prioritized for intensive surveys.
- In parallel, engage with the local public to explore the potential for sustainable seaweed mariculture in Guam, including a valorization assessment to identify species that are both biologically suitable for cultivation and economically viable for sustaining local livelihoods.

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Chapter 4: Threats (Element 3)

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

1. Loss of key habitat types
2. Degradation of key habitat types because of invasive animals and plants
3. Limited information on many native species
4. Habitat and species management issues
5. Wildfire
6. Typhoons
7. Climate change

The loss of key habitat types across Guam has been driven primarily by military expansion, urban development, infrastructure construction, and large-scale quarrying operations. These activities have led to habitat fragmentation, reduced native forest cover, and the direct removal of critical ecosystems such as limestone forests. Beyond habitat loss, Guam's ecosystems are experiencing ongoing degradation due to invasive animals and plants. Species like the BTS, feral cats, rats, invasive amphibians, and ants prey upon or compete with native species, while invasive plants outcompete native vegetation and alter ecosystem structure and composition. For example, high densities of feral cats in the Munitions Storage Area, AAFB have hampered re-introduction efforts of the ko'ko' (DAWR, unpublished notes).

Compounding these threats is the limited biological information available for many of Guam's native species. This lack of data hinders effective conservation planning and limits understanding of species' specific habitat needs, population trends, and threats.

Habitat and species management challenges further complicate recovery efforts. For instance, re-introduction projects, such as those involving the endangered ko'ko', face setbacks from persistent invasive predator populations and insufficient habitat quality in managed areas.

In addition to these direct threats, wildfires contribute to the degradation of grassland and forest ecosystems, promoting the spread of fire-adapted invasive plants and further reducing habitat suitability for native species. Typhoons, which regularly impact Guam, cause both immediate habitat destruction and long-term ecological shifts, compounding pressures on already vulnerable species.

Finally, climate change acts as an escalating threat. Rising temperatures, shifts in rainfall patterns, and increased storm intensity are expected to further degrade habitats, exacerbate species declines, and complicate conservation efforts.

Habitat loss and degradation, invasive species impacts, knowledge gaps, management challenges, wildfire, typhoons, and climate change form an interconnected series of threats that must be addressed to ensure the survival of Guam's native species and ecosystems.

Loss of Key Habitats

Guam's rapid military expansion, housing development, and infrastructure projects are driving significant loss and fragmentation of native habitats. Military construction, residential clearing, and quarrying for limestone are reducing forest cover and threatening species recovery, particularly for SGCN and endangered species.

Military Expansion and Training

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

Development

A result of the ongoing military build-up is the high demand for housing. DAWR reviews an average of 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 continue to decline. This will become more of a challenge for protecting SGCN and delisting and downlisting ESA species.

For instance, in 2015, approximately 20 acres of the Cotal Conservation Area were cleared for a wind turbine pilot project intended to test the potential for renewable energy production for 30–40 homes. Although this project explored sustainable energy solutions, its location within a designated Conservation Area underscores the critical need to strengthen legal protections for conservation lands, an effort that remains both vital and challenging. The goal is to identify, secure, and protect additional conservation areas suitable for species recovery and management.

Quarrying

Increased military and urban development, along with infrastructure expansion, are major drivers of habitat loss in Guam. Beyond land clearing for residential, commercial, and military purposes, large-scale quarrying for limestone aggregate, critical for military construction and infrastructure projects while also keeping up with the local demand for housing and businesses, has removed entire ridges and limestone formations. Pinnacle karren, a unique limestone habitat that supports many SGCN and threatened and endangered species, is especially threatened through this quarrying activity.

Degradation of Key Habitats

The degradation of Guam's native habitats has been significantly accelerated by invasive animals and plants. Non-native species introduced intentionally or accidentally have disrupted ecological processes, outcompeted native species, and altered the structure and function of critical habitats. Invasive plants such as tangantangan and kadena de amor (*Antigonon leptopus,* chain of love) rapidly colonize disturbed areas, forming dense thickets that outcompete native vegetation and hinder native forest regeneration. At the same time, invasive animals, such as feral ungulates, cause direct damage to native flora through browsing, trampling, and predation, contributing to soil erosion and habitat degradation. The BTS has wiped out most of Guam's native forest birds, disrupting natural seed generation. Together, these invasive species degrade key habitat types such as limestone and ravine forests, savannas, wetlands, and coastal habitats threatening Guam's biodiversity and undermining conservation efforts aimed at protecting SGCN and endangered species. Addressing invasive species impacts is therefore central to restoring and sustaining Guam's remaining native ecosystems.

Invasive Animals

Brown Treesnake

In the 1940s, the BTS was accidentally introduced to Guam after World War II (Rodda et al., 1992; Richmond et al., 2015). The ecological damage caused by this snake to the island environment is well documented (Savidge, 1987; Jaffe, 1994; Conry, 1988; Engbring & Fritts, 1988; Wiles, 1987a; Rodda & 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). In 2020, the BTS was also discovered on Islan Dåno'. This nocturnal and arboreal snake can take 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 in Guam: the såli and yayaguak, along with two wetland species of birds, the pulattat and yellow bittern. Historically, the resident species (Guam's native, non-migratory forest bird species) were found throughout the forests of Guam (Seale, 1901; Baker, 1947; Marshall, 1949; Jenkins, 1983). The sasangat (*Megapodius laperouse,* Micronesian megapode*)*, *Anas platyrhyncos* (Mariana mallard), and *Poliomnas cinereus* (white-browed crake) were extirpated prior to the introduction of the BTS (Engbring & Fritts, 1988).

Rats

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

Amphibians

Guam historically had no native amphibian species, but the introduction of non-native amphibians has led to rapid and widespread colonization across the island. These introduced populations pose multiple threats to Guam's native species, both through direct predation on native species and by serving as an additional food source for the invasive BTS.

Since 1937, at least 13 frog and toad species have been introduced to Guam. Of these, at least five have established breeding populations: *Rhinella marina (*formerly *Bufo marinus,* cane toad), *Kaloula pulchra* (spotted narrow-mouthed frog), *Eleutherodactylus planirostris* (greenhouse frog), *Litoria falax* (green tree frog), and *Rana guentheri* (Gunther's amoy frog).

One species of particular concern is *Eleutherodactylus coqui* (coqui frog). This species is especially problematic because of its direct metamorphosis from egg to frog and it is not restricted to aquatic breeding sites. The coqui's high-pitched call, reaching up to 90 decibels, also adds to its nuisance. In April 2004, two live coqui frogs were found, one at a resort in central Guam and another at a plant nursery in Tumon. These discoveries led to changes in import regulations for live plants from Hawaii. However, despite stricter rules, two more individuals were later intercepted, one associated with a shipment of pallets from the Big Island of Hawaii and another with imported bromeliads. The establishment of this species' populations in Hawaii and Florida has led to millions of dollars in losses for the horticulture industry, declines in real estate values, and impacts on tourism (Bliss, 2015). Although Guam remains free of an established coqui population, the island is considered highly vulnerable to similar pathways of introduction, especially through imported live plants from infested areas. Recognizing this risk, Guam initiated a public awareness campaign in 2004, along with frog call surveys and inspections aimed at early detection.

Other amphibian introductions have had negative consequences as well. Greenhouse frogs were discovered in Guam in 2003, and surveys suggest they now inhabit nearly the entire island. *Eleutherodactylus* spp. (barking frog), likely introduced via aquaculture, has become a nuisance due to its loud call. Residents in southern Guam have reported disturbances from frog choruses and, in some cases, resorted to using caustic chemicals to manage them. *Rhinella marina* was intentionally introduced in 1937 as a biological control agent for insect pests and *Laevicaulis alte* (garden slug) and is now found island wide. More recently, two additional species, *Fejervarya cancrivora* (crab-eating frog) and *Fejervarya limnocharis* (Asian grass frog), have expanded their ranges on Guam. Notably, the crab-eating frog can tolerate brackish and seawater, potentially threatening native crab populations in coastal habitats. Beyond the nuisance factor, these amphibians further impact Guam's native ecosystems by indirectly supporting the BTS population and consuming native fauna.

Insects

Guam's fadang population has declined substantially due to the introduction of invasive *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 butterfly species, *Chilades pandava,* that lays its eggs on the newly emerging fadang leaves. The larvae consume the emerging leaves and further exacerbate the problem of recovery for this species.

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

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

Fish

In addition to habitat alteration, the introduction of non-native fish species poses a significant threat to Guam's native freshwater fish populations (Table 10). At least eleven non-native fish species have become established on the island, arriving through various pathways. Some, such as snakeheads and catfish, were introduced for aquaculture. Others, like guppies and swordtails, were released or escaped from home aquaria. Still others, including *Oreochromis mossambicus* (Mozambique tilapia) and *Tilapia zilli* (redbelly tilapia), were deliberately introduced for biological pest control.

These invasive fishes compete with native species for food and habitat or prey on them directly. Native predators such as eels, flagtails, and sleepers, rely on small fish and aquatic invertebrates, while native omnivores (e.g., *Awaous* spp., *Stenogobius* spp., and *Sicyopus* spp.) feed on both plant and animal matter. Native herbivorous genera like *Stiphodon* and

Sicyopterus graze on algae covering river substrates. Although species like *Awaous* and *Anguilla* are broadly distributed across the Indo-Pacific, others including *Stiphodon, Stenogobius,* and *Sicyopus,* have restricted ranges and are only known from the southern Mariana Islands.

While some native species can navigate reservoirs and reproduce, their larvae require access to the ocean soon after hatching to survive. Young fish trapped upstream of dams are unlikely to reach the sea, leading to reduced recruitment. Studies by DAWR have shown that rivers flowing into dammed reservoirs support lower biodiversity compared to undammed rivers.

Although data remained limited, anecdotal evidence gathered by DAWR suggests that non-native fishes are affecting native species. For example, tilapia competes with native species for food, while predators such as *Cichla, Channa*, and *Clarias*, feed on native fish and invertebrates. In rivers with dense non-native populations, native fish tend to be less abundant, or exhibit altered distributions.

Despite these concerns, there are currently no active control measures targeting established nonnative fish. Guam DAWR and USFWS do regulate new species introductions through a permitting system and shipment inspections. However, more comprehensive efforts, including early detection, prevention, and enforcement, are needed to protect native freshwater biodiversity from the continued threat of invasive species.

Aquatic Snails

Guam has at least seven species of non-native freshwater snails (Table 10). It is unknown if the introduced snails have had an impact on native flora or fauna, though herbivorous species probably feed on native aquatic plants. The introduced snails can pose a human health risk. Two introduced species (*Pomacea* sp. and *Pila* sp.) 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.

Other Invertebrates

Introduced snails have been a major factor in the reduction of native snail populations, along with predation by *Platydemus manokwari* (flatworm) (Hopper & Smith, 1992). *Euglandina rosea* (rosy wolf snail) and *Gonaxis* spp. were purposely introduced in the late 1950s to control *Achatina achatina* (giant African snail). It's likely *E. rosea* itself caused a lot of decline in native snail species. *Platydemus manokwari* came in later (1977-1984), and seems to, at least, have wiped out *E. rosea* and *Gonaxis* sp. and is still doing a number on all terrestrial snail fauna in Guam. Freshwater snails, such as *Pila conica*, *Pomacea canaliculata*, *Sinotaia magniciana*, *Lymnaea, Physa* spp., and *Planorbis* spp. compete directly for food and habitat with native genera, such as *Clithon*, *Neritina*, Neritodryas, *Septaria*, *Tarebia*, *Melanoides*, *Stenomelania,* and *Thiara*.

Invasive Plants

Invasive plant species have profoundly altered the composition, structure, and resilience of Guam's native ecosystems, both terrestrial and aquatic.
During the Forest Inventory Analysis in 2013 (Lazaro et al., 2020), the top five invasive plants species were *Vitex parviflora*, tangantangan, *Heterospathe elata*, kadena de amor, *Mikania micrantha*, *Averrhoa bilimbi*, and *Epipremnum pinnatum*. *Spathodea campanulata* and *Tabebuia heterophylla* are two other invasive tree species taking over conservation sites in Guam. These species contribute to habitat degradation by outcompeting native plants, altering nutrient cycles, and changing fire regimes. Control and removal efforts are ongoing but challenging due to their aggressive growth and widespread distribution.

Vitex parviflora is invading both limestone and ravine forests across Guam, outcompeting native tree species. Its rapid growth and ability to form dense stands prevent the regeneration of native plants, altering forest structure and reducing biodiversity, further threatening habitat quality for native wildlife. Though it is widespread across the island, certain areas, especially in the northwest and southern areas are showing more severe infestations. Without targeted management, *V. parviflora* is likely to continue displacing native species and altering key forest ecosystems across the island.

Following World War II, large-scale reseeding efforts by the US military introduced tangantangan across Guam's barren landscape. This fast-growing tree species continues to dominate many areas, outcompeting native species and slowly changing soil conditions that make reforestation and habitat restoration increasingly challenging (FSRD, unpublished data).

Table 10: Guam's Non-native Freshwater Species

	Family	Species	Common Name	Means of Introduction
Fishes	Clariidae	*Clarias batrachus*	Walking catfish	Escape from aquaculture facility
		Cichla ocellaris	Peacock bass	Purposeful introduction
		Oreochromis mossambicus	Mosambique tilapia	Purposeful introduction
		Tilapia zilli	red belly tilapia	Purposeful introduction
	Poeciliidae	*Cichlid* sp.	Flowerhorn Cichlid	Purposeful introduction
		Gambusia affinis	mosquito Fish	Purposeful introduction
		Poecilia reticulata	Guppy	*Pet trade
		Poecilia veliferum	sailfin molly	*Pet trade
		Xiphophorus helleri	Swordtail	*Pet trade
	Channidae	*Xiphophorus maculata*	Platy	*Pet trade
		Channa striata	Asian snakehead	Escape from aquaculture facility
Snails	Ampullaridae	*Pila conica*	apple snail	Escape from aquaculture facility
		Pomacea canalicula	apple snail	Escape from aquaculture facility
	Viviparidae	*Sinotaia magniciano*	live bearing	Escape from aquaculture facility
	Planorbidae	*Planorbid* spp. *(2)*	Ramshorn snail	*Pet trade
	Lymnaeidae	*Lymnaea viridis*		**Accidental/native
	Physidae	*Physid* sp.		*Pet trade
Plants	Lemnaceae	*Lemna minor*	Duckweed	Ornamental plant trade and escape from aquaculture
	Hydrocharitaceae	*Hydrilla verticillata*	water weed	Unknown
	Nymphaeaceae	*Nymphaea* sp.	water lillies	Ornamental plant trade
	Araceae	*Pistia stratiotes*	water lettuce	Ornamental plant trade
	Pontederiaceae	*Eichornia crassipes*	water hyacinth	Ornamental plant trade
	Alismataceae	*Echinodorus* sp.	Sword plant	Aquarium 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.

After major disturbances, such as typhoons or wildfire, fast-reproducing invasive species quickly colonize open areas and prevent slower-growing native species from re-establishing. For example, *H. elata* has taken over many of Guam's southern ravines and valleys after brush fires, where chiute (*Cerbera dilatata*), and lalaha (*Pouteria ovovata*) were historically dominant (Stone, 1970). Over time, these invasions may lead to the complete replacement of native vegetation and loss of critical habitats.

Vines such as kadena de amor and mai'ågas (*Cuscuta campestris,* dodder) are extremely aggressive, smothering native trees and shrubs by blocking sunlight and competing for water.

Guam's freshwater ecosystems face similar threats from invasive aquatic plants (Table 10). Many of these species were introduced through various pathways, including pet trade, aquaculture, and deliberate introductions by government entities.

While some species, such as duckweed, water lettuce, and water hyacinth remain confined to one or two water bodies, water lilies are widespread across ponds in private yards and public parks throughout Guam. The most problematic aquatic plant is *Hydrilla verticillata* (hydrilla), which is widespread in southern Guam. The plant clogs pumps at the Ugum Water Treatment Plant, requiring costly annual maintenance (Ron Topasna, *pers. comm.*).

Beyond invasive aquatic plants, freshwater ecosystems also face serious threats from human activities. Unregulated clearing of riparian vegetation raises water temperatures, while incidents of chemical contamination degrade water quality, reduce habitat suitability, and contribute to harmful algal blooms. Illegal practices, such as river bleaching can also result in large-scale mortality of native aquatic life, drastically delaying recovery of these species.

Together, these factors contribute significantly to the ongoing transformation of Guam's landscapes and waterways, threatening the island's unique biodiversity and reducing the ecological services these habitats provide.

Disease and Pathogens

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 natural resources. These threats pose significant risks to ecosystems already stressed by other factors. Addressing this issue requires proactive management, including strengthening biosecurity protocols, early detection and monitoring systems, and strong coordination between natural resource managers, public health authorities, and the local community.

Habitat and Species Management Issues

The loss of key habitats on island due to development is a problem that will have long-term effects on the restoration of SGCN. The major factors exacerbating habitat loss are ungulates, stochastic events, and the introduction of invasive plant and animal species. Nothing can be done to control stochastic events such as typhoons and wildfires. However, we can slow or halt the loss of habitat by controlling other factors. The most difficult and labor-intensive factor to control is likely damage by feral ungulates. These species have been in Guam since the arrival of the first European inhabitants of the island (Wiles et al., 1999). They have become an important part of the CHamoru culture. The three ungulate species common in the wild are binådu, babuen hålom tåno', and karabao (*Bubalus bubalis,* Asiatic water buffalo), and are found in native forests, wetlands, shoreline, grasslands, and a mosaic of other habitat types (Stone, 1970). These animals alter the forest composition by browsing on vegetation or by uprooting it. 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 langiti (*Ochrosia mariannensis)*, a plant not favored by binådu, have established monotypic stands (DAWR, unpublished notes).

Wildland Fire

Based upon our Guam Forestry and Soil Resources Division Fire Data and Mapping Efforts from 1979 to present, Guam has averaged roughly 730 wildfires a year, which is an annual average of approximately 4% of our island area burned annually (Pacific Fire Exchange, 2025) (Figure 4; Figure 5). This is a concerning rate when considering the size of our island compared to the continental U.S (DOAG-FSRD, 2025). Wildfire is a primary disturbance that affects forest and watershed health. Fire is a non-native disturbance that directly interferes with the establishment and expansion of native forests, threatens standing forests, leads to accelerated erosion, and contributes to the decline of the coral reef system. Fire plays a large role in altering native forest vegetation cover in Guam. Due to the moist conditions, fire is not a prevalent natural process. Certain fires are deliberately ignited by poachers, an unlawful activity unrelated to traditional or cultural practices, in an effort to attract wildlife to the new vegetation that emerges after a burn. Human-induced fires have impacted Guam for several millennia and continue to this day, leading to altered vegetation cover in savannas and grasslands that have since adapted to the prevailing fire regime. These altered vegetation types contribute to increased erosion following fires. Burned areas can yield 4 to 5 times more sediment than unburned savannas, and savannas/grasslands generally produce more sediment than densely forested areas. The goal of the SWAP is to align with the mission of Guam Forestry to support terrestrial habitats, reclaim badlands, and restore native forests. Rehabilitation of native forests is a necessary step in the management and recovery of species of concern.

Typhoons

Typhoons occur frequently in Guam, averaging about six storm events annually, with most either making

landfall or passing directly over the island. Only a small number of storms veer away before reaching Guam. The Pacific typhoon season typically begins in April, peaks in August and September with the most severe storms and extends through November. This frequent and intense disturbance regime plays a significant role in shaping Guam's habitats and affecting native species.

Typhoons can cause widespread defoliation, canopy breakage, and uprooting of trees, particularly in forests already compromised by invasive species. Invasive trees and shrubs dominating many of Guam's secondary forests, such as *V. parviflora* and *S. campanulata,* are not adapted to withstand typhoon-force winds. These species often exhibit irregular and delayed post-typhoon sprouting, disrupting typical successional recovery. They typically get uprooted faster than the native species, which are more adapted to typhoons.

The loss of native seed-dispersing birds, largely due to predation by the invasive BTS, exacerbates these effects. Without adequate seed dispersal, native plant species struggle to recolonize cleared areas, slowing post-typhoon forest regeneration.

SGCN, including endemic plants, forest birds, freshwater species, and marine species face compounded threats following typhoon events:

- Endemic and native plants suffer from direct damage and from competition with rapidly colonizing invasives.
- Land snails and native reptiles may experience population declines due to habitat loss from canopy opening and soil erosion.
- For freshwater and marine species, increased sedimentation and debris influx into streams, wetlands, and reef ecosystems after typhoons degrade aquatic habitat quality.
- Native birds and fruit bats, already in critically low numbers, are vulnerable to losing remaining habitat due to canopy destruction and food availability.

While typhoons are natural ecological processes in Guam, their effects are now intensified due to altered forest composition, introduced herbivores, and the loss of critical ecological interactions such as seed dispersal. This hinders the natural resilience of Guam's habitats and puts additional stress on SGCN already facing steep declines.

Climate Change

Climate change is significantly altering Guam's natural ecosystems with effects being seen in all environments: terrestrial, marine, and freshwater. The island's unique biodiversity is threatened by rising temperatures, increasingly extreme weather events, sea-level rise, coral reef loss, challenges to food security, threats to public health, and more (Keener et al., 2012).

Changing precipitation patterns and warming temperatures are affecting the range of plant and animal species, pushing them into smaller or less suitable habitats with limited access to resources. Native forests are extremely vulnerable to invasive species, storm damage, and anthropogenic effects such as wildfires.

Warming sea temperatures lead to coral bleaching, weakening reef structures and reducing habitat for fish and other marine species. Over-harvesting of food fishes decreases the overall numbers and health of our fish species. More frequent flooding and higher levels of erosion affect coastal communities and threaten nesting beaches for sea turtles. Ocean acidification further disrupts coral health and growth, negatively impacting biodiversity that communities depend on for food and livelihoods.

Climate change further impacts mangrove systems and reduces the availability of freshwater through saltwater contamination of aquifers. Freshwater resources are at risk from altered watershed dynamics and reduced rainfall, impacting the wetlands and streams that support our aquatic plants and animals.

In supporting our SGCN, it is vital that we work towards long-term ecosystem resilience with proactive management, vulnerability assessments, habitat restoration and management, invasive species control, and climate-smart conservation planning.

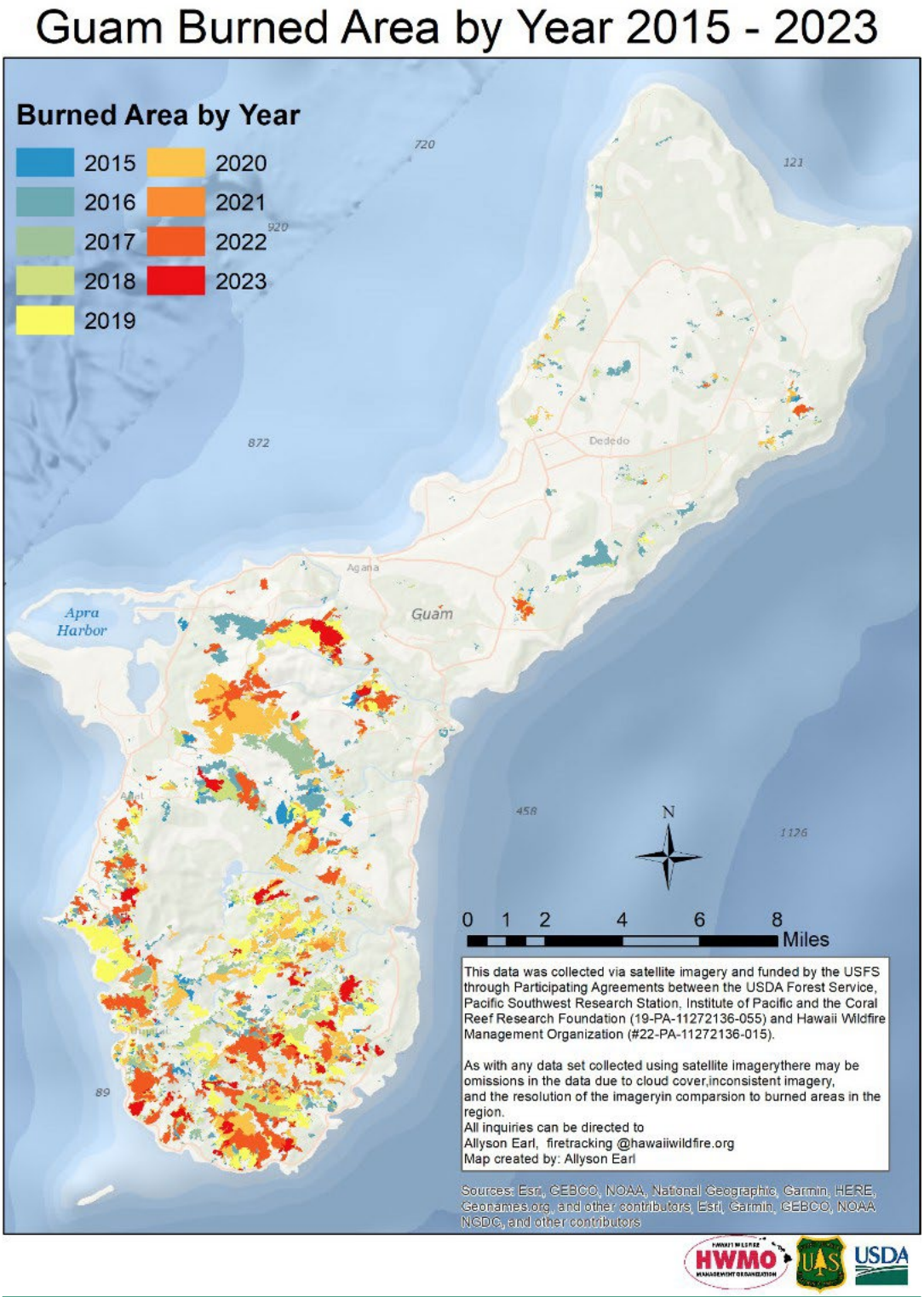


Figure 4: Burned Area, Guam, 2015-2023
(Pacific Fire Exchange)

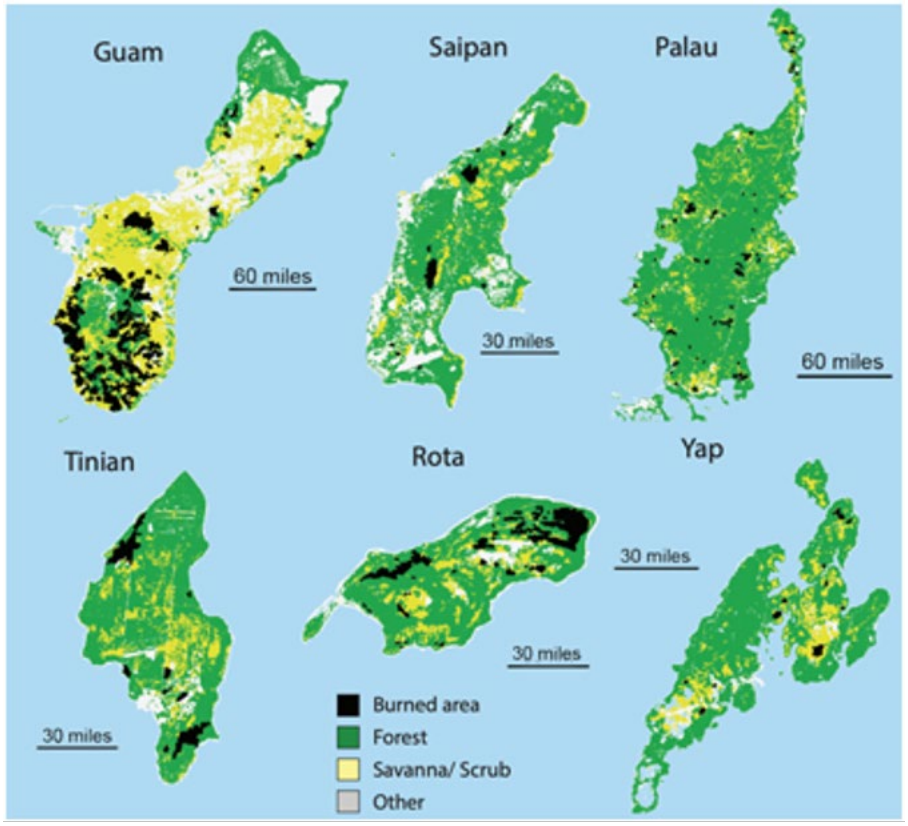


Figure 5: Burned Areas, Western Pacific, 2019 (Pacific Fire Exchange)

Chapter 5: Conservation Actions (Element 4)

The conservation actions outlined in this chapter were selected based on their feasibility and effectiveness in minimizing or eliminating the threats affecting SGCN and their habitats. The actions presented here follow a multi-faceted approach, organized by ecosystems, threats, and goals so that multiple species benefit from each action. While the species-specific actions listed in the SGCN species accounts and Table 11 address individual needs, they are closely aligned with the broader conservation strategies in this chapter. This approach reduces redundancy in addressing issues species-by-species and enables more holistic and efficient conservation planning. These broader actions also reflect the urgency and immediacy of interventions needed for certain SGCN.

These action priorities are not fixed; rather, they serve as adaptable placeholders that reflect current knowledge and feasibility. A more detailed prioritization framework will require further analysis using Best Management Practices provided by the Association of Fish and Wildlife Agencies (AFWA) prior to the next SWAP revision. In the meantime, one of the most urgent conservation priorities for Guam is securing legal protection for remaining suitable habitats. Without such protection, many of these lands are at risk of being repurposed for development, especially given the island's ongoing economic challenges.

Ecosystem-Based Actions

Terrestrial

The need to assess the state of habitats throughout the island is vital to understanding the rehabilitation needs of these areas before any re-introduction of native fauna can occur. This assessment will inform necessary actions, such as improved reforestation strategies and predator and ungulate control. The following objectives will be pursued to assess the current state of forests in Guam, with the aim of enhancing degraded habitat or maintaining native forests, as necessary:

- Develop plans to improve habitats in conservation areas, including, but not limited to, reforestation, fire prevention, and invasive vegetation control.
- Assist the Forestry and Soil Resources Division in developing forest recovery plans.
- Support plans, such as the Guam Habitat Conservation Plan (Guam HCP) (in development), that work towards sustainable economic development.
- Formulate a list of SGCN flora with cultural and ecological value to be used in propagation and outplanting.
- Improve man-made habitat at Masso reservoir for wetland species.
- Establish mechanisms to protect native forests from urban development.
- Develop sustainable harvest regulations for åmot and timber within Conservation Lands.
- Conduct research on SGCN to assess habitat needs and potential climate change impacts on their viability.

Marine

Guam's coral reef ecosystems are among the most biologically diverse in the world, supporting over 5,000 marine species, many of which are vital to local fisheries and essential fishing practices. Early aquatic management by DAWR focused on individual fishery species but by the mid-1980s, a significant decline in reef fish abundance prompted a shift toward ecosystem-based management efforts. This transition led to the establishment of Guam's marine preserves and the adoption of the Guam Coral Reef Initiative. Through partnerships like the Guam Coral Reef Initiative Coordinating Committee (GRICC), DAWR has helped identify major threats to reef ecosystems, such as coral diseases, unsustainable fishing, and land-based pollution.

To continue these efforts in addressing these challenges, the following objectives will be implemented:

- Conduct research monitoring reef fish, habitats, climate impacts, and management effectiveness, with emphasis on heavily fished species and coral reef ecosystems fisheries.

- Assess the effectiveness of marine preserves and continue long-term coral and watershed monitoring.
- Develop tools to support restoration in tropical coastal areas and explore adaptive management for seagrass and mangrove habitats.
- Strengthen enforcement of Guam's fishery laws, marine preserve regulations, and stormwater permitting.
- Enact laws to hold parties accountable for coral reef damage and pollution.
- Create and implement sustainable policies for managing nearshore fisheries.
- Develop fishing licenses and fee systems for commercial and non-commercial use.
- Implement management actions to protect marine SGCN.
- Continue and expand coral reef restoration efforts, including nursery enhancement and outplanting in Tumon Bay and other priority reef areas.
- Reduce damage from harmful land use practices such as off-roading and agriculture.
- Expand watershed restoration in priority areas (Manell-Geus, Piti-Asan, Tumon Bay/Yigo-Tumon), and upgrade stormwater infrastructure in urban and tourism zones.
- Enhance community involvement in science-based fisheries management and marine conservation.
- Engage the public, businesses, and leaders in reducing land-based pollution and adopting sustainable practices.
- Foster education and outreach programs and increase public awareness around climate adaptation and citizen science.
- Collaborate with the tourism sector to promote sustainable practices, educate visitors, and develop a climate adaptation plan for Tumon.
- Enforce existing plans that support responsible tourism and recreation.
- Engage community groups in promoting low-impact recreation on reefs.
- Continue implementation of Local Action Strategies (LAS), including pollution reduction, fisheries management, and outreach.
- Maintain and manage Guam's marine preserves.
- Integrate socio-economic factors into coral reef planning and promote alternative livelihoods to reduce pressure on reef resources.

Freshwater

Guam's freshwater ecosystems support a distinct group of aquatic species with many depending on natural stream flow and uninterrupted migration pathways to complete their life cycles. Species exhibiting rheotaxis migrate upstream to feed or spawn but are often obstructed by man-made barriers such as dams. When they reach these barriers with low or stagnant flow, they face increased predation and reduced habitat suitability. Even if upstream migration is successful, many species with amphidromous life cycles rely on downstream drift of juveniles to the ocean for survival. If these young individuals are trapped in these same areas, such as Fena Reservoir, they are not likely to survive. Research by DAWR has shown that rivers feeding into reservoirs support significantly lower diversity of native aquatic life compared to unimpeded streams.

To address these challenges, the following objectives will be pursued:

- Assess the impacts of dams and other man-made barriers on native freshwater organisms and their life cycles.
- Conduct a comprehensive biological inventory of freshwater taxa.
- Evaluate the presence and impacts of invasive species on native freshwater taxa.
- Develop and implement conservation programs to protect native freshwater organisms and their habitats.
- Identify and rehabilitate freshwater habitats suitable for re-introduction of SGCN species.
- Conduct vulnerability and risk assessments on freshwater ecosystems and the native species they support.
- Map and evaluate natural freshwater wetlands, including assessments of habitat extent and changes in response to drought, heavy rainfall, and breeding requirements of species such as the pulattat and freshwater invertebrates.

Threat-Based Actions

Control of Limiting Factors

Many of the threats affecting SGCN are exacerbated by ecological and biological limiting factors, such as invasive predators, ungulates, and destructive invertebrates. These factors reduce habitat quality, hinder species recovery, and prevent successful re-introduction or population growth. The following objectives will be pursued to control limiting factors affecting SGCN:

- Assess the abundance and distribution of invasive predators in conservation Aareas and priority habitats for recovery efforts and potential future re-introduction of SGCN.
- Implement targeted control of invasive predators, including BTS, feral dogs and cats, monitor

lizards, and rodents, in areas critical to SGCN recovery. Control strategies will be coordinated by DAWR, USDA, USGS, and other relevant partners.
- Evaluate the feasibility of a managed hunting program to reduce populations of ungulates in conservation areas and recovery habitats.
- Review and strengthen biosecurity protocols to prevent the introduction and spread of invasive species that threaten SGCN and their habitats.
- Develop and test effective control methods for priority invasive invertebrates, such as LFA, CRB, and *A. yasumatsui*, within areas supporting SGCN species.

Law Enforcement of Natural Resource Laws and Regulations

As stated previously, the Department's law enforcement section has the authority to enforce laws and regulations pertaining to the natural resources of Guam (Table 2). 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, equipment, and public education about the rules and regulations governing natural resources in Guam. By far, the biggest obstacle for enforcement is public outreach. The public must be properly educated on the laws and the reasons for these laws that protect natural resources. To aid in the protection and enforcement of natural resource laws and regulations, the following objectives will be implemented:

- Protect Guam's SGCN and endangered species from illegal harvesting or incidental take by enforcing Guam's natural resource regulations and developing regulations for SGCN not protected under current regulations.
- Protect Guam's marine preserves and conservation lands.
- Educate the public of Guam's natural resource regulations.
- Create and maintain a volunteer conservation officer program to aid with monitoring activities in conservation areasand other public lands.
- Maintain and promote 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 most vulnerable areas to climate change globally. Coastal communities are particularly vulnerable to even small changes in climatic variables, especially rainfall patterns, tropical storm patterns, ocean temperature, and sea level rise. Vulnerability results from high population densities and growth rates, and scarce natural resources, which are exacerbated by poorly developed and unmaintained infrastructure. As most harvested coral reef organisms are ectotherms (cold-blooded), it is crucial to formally study the observable changes in species' biology 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 to and minimize the threats to natural resources. To aid the efforts in protecting and minimizing the climatic variables of natural resources we will implement the following objectives:

- 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.
- Assist in a Guam Vulnerability Assessment to Climate Change Plan (funded under TAP-Guam-2016-2, Grant No D16AP00023)
- 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.
- Identify funding for utilizing the dynamically downscaled model of climate impacts in Guam (REF) with Software Assisted Habitat Modeling (SAHM) for VisTrails system to visualize impacts of climate change on critical habitats for SGCN and threatened and endangered species.
- Improve the technical capacity of DAWR with regard to tools, specifically, geographic information systems (GIS) and remote sensing in order to improve decision making, monitoring, and visualization of changes in critical habitats.
- Continue participation in working groups to establish adaptive management goals and actions to help minimize threats and address impacts for climate change to SGCN and habitats.
- Develop and implement policies to address protection for coral reef communities and other at-risk habitats in Guam.

Recreation Activities within the Conservation Areas

Guam's conservation areas have limited accessibility for the public. Hunters, hikers, and off-road enthusiasts are the main users of these areas. However, many individuals do not know about the island's conservation areas because of a lack of signage. By creating more opportunities for the public to get out and experience these areas firsthand, we can educate and instill

a sense of stewardship in our natural resources. By 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 and managing recreational activities within local conservation areas, we will implement the following objectives:

- Allow public hunting access to game species in conservation areas.
- Develop signage identifying Guam's Conservation Areas highlighting key habitat types, important fauna, geologic formations, and other key aspects of the area.
- Allow compatible public activities in conservation areas with proper enforcement.
- Educate the public about the negative impacts of off-roading in efforts to encourage the use of existing trails and limit overall frequency of the activity.

Goal-Based Actions

Re-introduction and Restoration of SGCN to Designated Habitats

The re-introduction and restoration of SGCN to designated habitats is the ultimate goal of all the management and conservation efforts put forth in the SWAP. The following objectives will be implemented for particular species and for all SGCN:

- Establish an inventory of conservation areas for caves and identify other potential cave sites for BTS control and translocation of yayaguak.
- Determine the genetic similarity and suitability of CNMI and Hawaiian populations of yayaguak for translocation and re-introduction purposes and to perform re-introductions in Guam if possible.
- Examine and determine the status of SGCN in conservation areas and other suitable habitats.
- Reintroduce native fauna and flora identified as SGCN into conservation lands, GNWR Overlay and other suitable areas (i.e., Safe Harbors).

Captive Breeding and Translocation

Captive breeding and translocation are essential management tools for natural resource managers who work with small populations. Currently, DAWR propagates two species of birds, ko'ko' and sihek. The DAWR facility can house and support up to 144 ko'ko' and 16 sihek. The Department envisions the creation of a new larger facility that would support additional conservation efforts in Guam. Most of Guam's SGCN would benefit from a large facility for mammals, birds, reptiles, gastropods, and other invertebrates that need captive propagation. For example, a captive rearing program for Guam's tree snails needs to be established. The University of Guam has initiated captive rearing for *H. o. marianensis*, under the supervision of Dr. George C. Fiedler and in collaboration with Dr. Else Demeulenaere, Associate Director of the UOG CIS and SG ICL. This work is being further developed by Matthew Putnam as part of his master's thesis. A pilot program to start captive rearing was funded through state wildlife grants. The progeny from captive breeding efforts would be released back into the wild. The beginning and/or continuation of the captive breeding (propagation) on Guam and the translocation efforts for regional endemics and endemic species for Guam will be addressed by the following objectives:

- Maintain and expand captive propagation facilities to further serve the needs of Guam's SGCN.
- Determine the need to captive breed other SGCN. Implement captive propagation of endemic species for release into the wild. Continue captive breeding of ko'ko' and sihek.
- Determine the feasibility of translocation of shared SGCN from the CNMI to support landscape-scale conservation.
- Provide an adequate diversity of SGCN plant species and sufficient numbers of individual 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 coordinate our conservation actions and standardize monitoring techniques for species shared between Guam and the CNMI, such as fanihi, haggan, and various seabird species. These agreements can also facilitate discussions on potential translocation of additional species between the CNMI and Guam.

Public Awareness and Education

The need to foster an informed population about conservation and the importance of natural resources is critical to the success of any long-term conservation effort. Guam DAWR and its partners in the SWAP 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 (GCRI) Coordinating Committee. For instance, the Guam Visitors Bureau (GVB) and the tourism industry previously worked with GCRI to create a tourism professional certification and resources to promote reef-friendly practices. GVB is now working with natural resource agencies to market Guam's coral reefs, particularly, the marine preserves. This new awareness of the economic value of our coral reef resources is beginning to create a sense of stewardship in the industry. 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 publications such as Man, Land and Sea, which is published through BSP.

Under DAWR, significant outreach and education projects were developed and implemented from 2012 to 2016. First, they developed a marine preserve campaign for Piti Bomb Holes Preserve, named "Piti Pride Tepungan Wide" with an extension of the campaign to showcasing the Tumon Bay Marine Preserve being well received. Second, a ridge to reef conservation program called, "Help Save Guam's Reefs" remains an ongoing effort island wide. With financial and technical support from Rare, an international, non-profit conservation organization, the DAWR Aquatic Education Resource Information and Education Officer received training in communication in conservation. GCRI has several staff members dedicated to community outreach. Each year, they conduct dozens of school visits and outreach events, reaching thousands of Guam's residents. They also run the Eyes of the Reef citizen science program, which trains community members to identify and report threats to Guam's reefs. In addition, GCRI supports the Guardians of the Reef educational program, where high school students are trained to teach 3rd graders about the importance of coral reefs and how to protect them. This program has been running for over 10 years, with our 2025 cohort recently completed. 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 the DAWR 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 on 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 DAWR 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, to increase awareness of the benefits of marine preserves and 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. To enhance sustainable tourism, GVB has offered to add marine conservation in their Guam Community College Tour Guide Certification Course, replace and repair conservation signs, and 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. Aside from the "Piti Pride" campaign, the local community will be conducting outreach activities themselves to ensure sustainability of conservation efforts. Starting with the efforts of the 2018 coral reef management fellow, BSP, GCRI, and partners created a series of educational signage for popular beaches throughout Guam that feature information on coastal stewardship and water safety. Signs have been installed at Tumon Bay and Piti Bomb Holes (Tepungan), along with other locations such as Talo'fo'fo' Bay and Hågat Marina.

Other recent educational efforts include:

- The Guardians of the Reef Program: This program trains high school students to teach elementary school students about coral reefs. Along with the help of marine biology or biology science teachers, HS students learn how to lead multiple educational activities, including stories and songs. The program was started by Dr. Romina King during her time as a coral reef management fellow and has been ongoing for over 10 years. The program has produced alumni that later pursued marine science related careers into the future.
- GCRI virtual field trips: Virtual field trips are guided interactive adventures with clickable elements that feature local photos and videos of Guam's environment. GCRI currently has virtual field trips for southern Guam watershed, seagrasses at Inalåhan Pools, mangroves at Sasa Bay Marine Preserve, and corals at Piti Bomb Holes Marine Preserve. The virtual field trip project was first launched during the pandemic with efforts from 2020-2022 coral reef management fellow and Simon Sanchez marine biology teacher (Ms. Mel Blas) to help students explore Guam's environment when unable to go in person. It continues to provide a way to experience environments when transportation is limited or liability issues prevent in-water activities. Students can experience Guam's wildlife and learn about ecosystem services without costly VR technology or the ability to swim. The virtual field trips are adaptable for use at outreach booths or in classrooms. Accompanying scavenger hunts allow teachers to use them as assignments and virtual field trips have been shared with teachers at various local educator symposiums and at other public tabling events.
- GCRI Education and Outreach Strategy: The 2024-2026 coral reef management fellow, Sabrina Medina, is currently based out of GCRI and working on gathering input and data from educators and students to improve future education and outreach programs. The information will be compiled into a report that will feature best practices and strategies to better support student and public programs.
- Eyes of the Reef: This program began in 2015 and was recently relaunched after the pandemic. The program provides training for community members to identify coral reef threats such as bleaching, marine debris, and invasive/nuisance species. Community members are encouraged to report any threats through a form to allow natural resource managers to respond.
- Seagrass Flower Citizen Science: This campaign shared flyers with various water users such as fishers, landowners, and recreationists to help spot seagrass flowers around the island and support attempts to find seeds for restoration purposes. Additionally, "paint and learn" events were held in the Inalåhan and Piti mayor's office community centers to help raise awareness of seagrasses and the citizen science campaign.
- Summer interns: Since 2022, the Department of Youth Affairs has offered summer internships to HS students and placed them in government agencies. DOAG-DAWR has hosted numerous summer interns, and led various field trips, hands-on activities, and educational presentations for them.
- Additional GCRI efforts: Field trips, classroom presentations, career day festival booths, lesson plans, videos, website and resource portals, and presentations at local educator symposiums.

To increase public awareness of Guam's natural resources, the following objectives will be implemented:

- Explore and evaluate social marketing methods to engage public participation and involvement for preserving Guam's wildlife and habitats.
- Develop, implement and utilize existing programs to increase public awareness of natural resources and issues pertaining to them.
- Develop outreach campaigns that educate the public and private industry of the value of preserving Guam's wildlife and habitats.
- Develop a plan to address public awareness and education of conservation issues including creating products that target audiences with appropriate messages, increasing public service announcements, and enhancing messages by including a call to action and facilitating public involvement in conservation efforts.
- Increase collaboration between environmental educators on island, including K-12 educators, higher education, local government, and other informal educators.
- Establish an internship program to implement conservation awareness programs.

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 the adjudication of 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 (5 GCA, §63121 and §63101-63117) also provides a list of species that are to be protected. 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.

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

- Develop cooperative agreements with federal and military partners, such as USFWS, US Air Force, and US Navy to include federal and Guam Conservation Lands as part of the Guam National Wildlife Refuge Overlay. Develop cooperative agreements for management, research and protection of SGCN and threatened and endangered species.
- Explore and pursue safe harbor agreements with private landowners adjacent to conservation lands and other areas where wildlife may benefit.
- Determine boundaries for all the conservation areas and further pursue the possibility of incorporating previously proposed conservation areas.
- Develop a Memorandum of Understanding (MOU) with the CNMI partners to facilitate conservation restoration measures of shared (historically) fauna and plants.
- Formulate regulations that prioritize climate change within sustainable development strategies and planning.
- Identify other Government of Guam lands for the use in species recovery efforts.
- Research and propose regulations that protect excess lands from unnecessary loss, destruction, or inappropriate usage.

Table 11: Summary of SGCN

Species **CHamoru name** *Scientific name* Common name	Local listing	Federal listing	Habitat	Threats	Status	Knowledge base	Action
Terrestrial Mammals							
Fanihi *Pteropus mariannus* Mariana fruit bat	E	E	Limestone and ravine forests	• BTS predation • Human exploitation • Habitat loss	• Estimated 200 individuals in Guam	Good	• BTS and ungulate control at colony • Implement recovery plan • Island wide surveys
Fanihi liyang *Emballonura semicaudata rotensis*,*** Pacific sheath-tailed bat	E	E	Caves and forested areas	• Human exploitation • Habitat loss • BTS predation	• Extirpated from the wild in Guam	Lacking	• Area-wide BTS control • Habitat preparation • Increase knowledge base
Forest Birds							
Ko'ko' *Hypotaenidia owstoni*,*** Guam rail	E	E	Limestone forests, scrub forests, and savanna complex	• BTS, feral cats, and rat predation • Competition with introduced game species • Habitat loss	• Captive population • Extirpated from the wild in Guam • ~ 1,200 ko'ko' re-introduced to Rota since 1989	Good	• Predator control at release sites • Re-introduction to Guam • Habitat preparation
Paluman åpaka'/fache' *Pampusana xanthonura*,*** White-throated ground dove	E		Limestone forests	• BTS, feral cat, and rat predation • Habitat loss • Human exploitation	• Extirpated in Guam • Recent visitor from Rota since 2004 (J. Quitugua, field notes)	Lacking	• BTS control • Investigate origin of individuals observed • Improve knowledge base via research studies
Totot *Ptilinopus roseicapilla*,*** Mariana fruit-dove	E	E	Limestone forests	• BTS, feral cat, monitor lizard, and rat predation • Habitat loss • Human exploitation	• Extirpated in Guam	Lacking	• Habitat preparation • Reintroduce to Guam • Research national history and biology of the sp.

Species **CHamoru name** *Scientific name* Common name	Local listing	Federal listing	Habitat	Threats	Status	Knowledge base	Action
Yayaguak *Aerodramus bartschi*,*** Mariana swiftlet	E	E	Cave dwelling; forages over savanna complex and ravine forest	• BTS predation • Pesticides	• 500-600 birds in a single colony in southern Guam. • Possibly two smaller populations in southern and northern Guam.	Good	• BTS control • Reintroduce to northern Guam • Continue monitoring existing pop. and caves • Investigate impacts to climate change • Investigate breeding rates and success
Sihek *Todiramphus cinnamominus*,*** Guam kingfisher	E	E	Limestone forests	• BTS, feral cat, monitor lizard, and rat predation • Habitat loss	• Extirpated in the wild. • ~70 individuals in mainland zoos. • Three males and one female at DAWR facility.	Good	• Continue captive breeding efforts • Continue support with Micronesian Kingfisher Species Survival Plan (MK SSP) • Reforestation • Area-wide predator control
Åga *Corvus kubaryi*,*** Mariana crow	E	E	Limestone forests	• BTS and other invasive predators • Small population • Loss of habitat • Human exploitation	• Extirpated in Guam • Rota population declining	Good	• Predator control • Supplement population • Monitor population • Investigate cause of declining population
Såli *Aplonis opaca guami*** Micronesian starling	E		Historically found in all habitats	• BTS, feral cats, and rat predation. • Habitat loss	• Two small populations in Northern Guam and Islan Dåno' • Small migration to central Guam (Dededo to Agana)	Good	• BTS control • Monitor population status • Investigate current home range, food source, and nesting • Develop såli SSP plan
Egigi *Myzomela rubratra saffordi*,*** Micronesian honeyeater	E		Found in all habitat types	• BTS, feral cats, and rat predation. • Habitat loss	• Extirpated in Guam	Lacking	• BTS control • Improve knowledge base via research studies • Habitat preparation
Wetland Birds							
Pulattat *Gallinula chloropus guami*,*** Mariana common moorhen	E	E	Freshwater habitat types (lake, pond, and springs)	• BTS, feral cat predation • Habitat loss • Climate change • Competition	• About 100 adult birds observed • Habitat preference model	Good	• Survey and monitor population • Predator control • Protect habitat

Species **CHamoru name** *Scientific name* Common name	Local listing	Federal listing	Habitat	Threats	Status	Knowledge base	Action
Gå'ga' karisu *Acrocephalus luscinius*,** Nightingale reed warbler	E	E	Areas in or near brackish water or marsh habitats	• BTS predation • Habitat loss • Human exploitation • Wildfires	• Extirpated in Guam	Limited	• BTS control • Habitat preparation • Reintroduce to Guam • Improve knowledge base via research studies
Seabirds							
Utak/Fakpe *Phaethon lepturus* White-tailed tropicbird	E		Roosts and nests on high cliff walls and tall trees	• BTS predation • Habitat loss	• Unknown, frequent visitor to Guam	Good	• BTS control • Determine distribution and abundance • Identify and prepare roost and nest sites
CHuchuko' Åtilong (dark morph) **CHuchuko' Åpaka'** (pale morph) *Egretta sacra* Pacific reef heron	E		Roosts and nests on islets on or near ground	• BTS predation • Habitat loss	• Unknown, frequent visitor to Guam	Good	• BTS control • Determine distribution and abundance • Identify and prepare roost and nest sites
Lu'ao *Sula leucogaster* Brown booby	E		Roosts and nests on high cliff walls	• BTS predation • Habitat loss	• Unknown, frequent visitor to Guam	Good	• BTS control • Determine distribution and abundance • Identify and prepare roost and nest sites
Dulili/Kålalang Migratory shore birds			Mud flats, tidal flats, and open fields	• Predators • Habitat loss	• Unknown	Limited	• Determine abundance and distribution • Reduce or prevent habitat loss and monitor important sites for contaminants and spills • Implement appropriate predation control
Terrestrial Reptiles							
Guali'ek hålom tåno' *Cryptoblepharus peocilopleurus* Snake-eyed skink	E		Coastal strand, loose sand soil	• BTS, feral cats, and Gehyra oceanica predation • Competition	• Unknown	Lacking	• Determine abundance and distribution • Implement appropriate invasive species and predation control
Guali'ek hålom tåno' *Emoia slevini* Slevin's skink	E	E	Forest floors, old fields, low tree trunks	• BTS, feral cats, and Gehyra oceanica predation • Competition	• Unknown	Lacking	• Determine abundance and distribution • Implement appropriate invasive species and predation control

Species **CHamoru name** *Scientific name* Common name	Local listing	Federal listing	Habitat	Threats	Status	Knowledge base	Action
Guali'ek hålom tåno' *Ornithuroscincus noctua* Moth Skink	E		Forested areas, large tree trunk	• BTS, feral cat predation • Competition	• Unknown	Lacking	• Determine abundance and distribution • Implement appropriate invasive species and predation control
Guali'ek hålom tåno' *Perochirus ateles* Micronesian gecko	E		Historically found in limestone forest and beach strand	• BTS and feral cat predation	• Unknown	Lacking	• Determine abundance and distribution • Implement appropriate predation control
Guali'ek hålom tåno' *Emoia atrocostata* Littoral skink	E		Limestone rocky foreshore areas (i.e. the littoral zone)	• Coastal development • Habitat degradation • Invasive species	• Unknown	Lacking	• Conduct population assessments and explore captive propagation • Implement appropriate invasive species and predation control • Prevent loss of key habitat
Terrestrial Arthropods							
Ayuyu *Birgus latro* Coconut crab			Limestone forests and beaches	• Over-harvesting • Habitat loss • Climate change	• Decreasing	Lacking	• Enforce no-take regulations • Support efforts to control CRB • Track population trends and reduce predators • Raise awareness and promote culturally grounded stewardship to reduce over-harvesting
Insects							
Hypolimnas octocula mariannensis Mariana eight-spot butterfly	E	E	Limestone forests	• Habitat loss for host plants • Predation of caterpillar by an ichneumonid wasp	• Unknown	Lacking	• Identify and map localities with *P. pedunculata* • Reduce encroachment of invasive vines • Study seasonal activity for the butterfly • Cultivate caterpillars in a safe, predator-free setting to rear for release
Vagrans egistina Marianas wandering butterfly			Limestone forests	• Habitat loss for the host plant luluhut • Predation by parasitoid wasps and ants	• Unknown	Lacking	• Identify and map localities with *P. pedunculata* • Reduce encroachment of invasive vines • Study seasonal activity for the butterfly • Cultivate caterpillars in a safe, predator-free setting to rear for release

Species **CHamoru name** *Scientific name* Common name	Local listing	Federal listing	Habitat	Threats	Status	Knowledge base	Action
Terrestrial Gastropods							
Akaleha' *Partula gibba* Humped tree snail	T	E	Limestone and ravine forest	• Habitat loss and modification • Predation by alien snail and flatworm • Wild grassland fires	• Declining	Good	• Survey population • Predator control • Reforestation • Supplement smaller populations • Captive rearing
Akaleha' *Partula radiolata* Guam tree snail	T	E	Limestone forests	• Habitat loss and modification • Predation by alien snail and flatworm • Wild grassland fires	• Declining	Good	• Survey population • Predator control • Reforestation • Supplement smaller populations • Captive rearing
Akaleha' *Samoana fragilis* Fragile tree snail	E		Limestone and ravine forest	• Habitat loss and modification • Predation by alien snail and flatworm • Wild grassland fires	• Declining	Good	• Survey population • Predator control • Reforestation • Supplement smaller populations • Captive rearing
Terrestrial Plants							
CHacha *Cyathea lunalata* Tree fern	E		Ravine forest edge, usually on muddy hill slopes	• Habitat loss • Typhoons • Wild grass land fires	• Rare	Good	• Determine distribution and status • Protect habitat • Collect fronds with mature spores and propagate seedlings • Collect plant tissue for tissue culture to produce seedlings • Outplant seedlings
Fadang *Cycas marianensis* Federico Nut		T	Limestone forest, ravine forest, coastal areas, and savanna summits	• Asian cycad scale infestation • Ungulate damage • Wild grass land fires • Typhoons	• Common throughout Guam, most affected by Asian cycad scale	Good	• Determine distribution and status • Protect habitat • Biological control for Asian cycad scale • Collect healthy seeds and pups and propagate seedlings • Ungulate control • Collect plant tissue for tissue culture to produce seedlings • Outplant seedlings
Ufa hålom tåno' *Heritiera longipetiolata*	E	E	Limestone forest	• Herbivory and damage • Rare fruiting occurrence • Typhoons	• Rare	Lacking	• Determine distribution and status • Protect habitat • Collect seeds • Propagate seedlings in the nursery • Ungulate control • Outplant seedlings

Species **CHamoru name** *Scientific name* Common name	Local listing	Federal listing	Habitat	Threats	Status	Knowledge base	Action
Faniok *Merilliodendron megacarpum*			Limestone forests, occasionally in ravine forest	• Herbivory • Typhoons • Development	• Rare	Good	• Determine distribution and status • Protect habitat • Ungulate control • Collect seeds • Propagate seedlings in the nursery • Ungulate control • Outplant seedlings
Håyun lågu *Serianthes nelsonii* Fire tree	E	E	Limestone and ravine forests	• Herbivory • Insect damage • Typhoons • Lack of propagation	• Rare	Good	• Determine distribution and status • Protect habitat • Collect seeds • Propagate seedlings in the nursery • Ungulate control • Outplant seedlings • Store seeds
Tabernaemontana rotensis		E	Limestone forests	• Typhoons • Development • Ungulate browsing of new seedlings	• Common but not abundant	Good	• Determine distribution and status • Protect habitat • Collect seeds • Propagate seedlings in the nursery • Ungulate control • Outplant seedlings
Bulbophyllum guamense		T	Limestone cliff lines	• Habitat loss • Development • Typhoons • Wildland fires • Predation by slugs	• 10,000 individuals in Guam	Lacking	• Determine distribution and status • Protect habitat • Collect seeds • Propagate vegetatively • Propagate seedlings in the nursery • Ungulate control • Outplant seedlings • Control non-native slugs • Minimize fires
Dendrobium guamense		T	Epiphyte on trees in moist habitats	• Habitat loss • Development • Typhoons • Wildland fires • Predation by slugs	• Over 13,000 individuals across the Marianas with 14 populations in Guam	Lacking	• Determine distribution and status • Protect habitat • Collect seeds • Propagate vegetatively • Propagate seedlings in the nursery • Ungulate control • Outplant seedlings • Control non-native slugs • Minimize fires

Species **CHamoru name** *Scientific name* Common name	Local listing	Federal listing	Habitat	Threats	Status	Knowledge base	Action
Eugenii bryanii		E	Windy exposed cliff lines and ravines	• Habitat loss • Development • Typhoons • Non-native species • Ungulate browsing	• Around 1,600 individuals	Lacking	• Determine distribution and status • Protect habitat • Collect seeds • Propagate seedlings in the nursery • Ungulate control • Outplant seedlings
Hedyotis megalantha		E	Savanna	• Habitat loss • Development • Wildland fires • Non-native species • Typhoon • Recreational vehicles	• Fewer than 1,000 individuals in Southern Guam	Lacking	• Determine distribution and status • Protect habitat • Collect seeds • Propagate seedlings in the nursery • Ungulate control • Outplant seedlings • Manage recreational vehicle use where the sp. occurs • Minimize fires
Maesa walkeri		T	Upland limestone, open edges, higher altitudes (Mt. Lamlam area and toward Mt. Alifan)	• Habitat loss • Development • Wildland fires • Non-native species • Typhoon	• Less than 30 individuals in Guam	Lacking	• Determine distribution and status • Protect habitat • Collect seeds • Propagate seedlings in the nursery • Ungulate control • Outplant seedlings • Manage recreational vehicle use where the sp. occurs • Minimize fires
Nerivilia jacksoniae		T	Shady areas on sandy soil, upland limestone forests	• Habitat loss • Development • Non-native species • Fires • Typhoons • Predation by non-native slugs	• Around 350 individuals in Guam	Lacking	• Determine distribution and status • Protect habitat • Collect seeds • Propagate seedlings in the nursery • Ungulate control • Outplant seedlings • Minimize fires • Manage land use where sp. occurs
Phyllanthus saffordii		E	Savanna	• Habitat loss • Development • Wildland fires • Non-native species • Typhoons • Recreational vehicles	• Fewer than 1,400 individuals on Southern Guam	Lacking	• Determine distribution and status • Protect habitat • Collect seeds • Propagate seedlings in the nursery • Ungulate control • Outplant seedlings • Manage recreational vehicle use where the sp. occurs • Minimize fires

Species **CHamoru name** *Scientific name* Common name	Local listing	Federal listing	Habitat	Threats	Status	Knowledge base	Action
Aplokating palao'an *Psychotria malaspinae*		E	Limestone edges and understories	• Habitat loss • Development • Non-native species • Typhoons	• Around 10 individuals in Guam	Lacking	• Determine distribution and status • Protect habitat • Collect seeds • Propagate seedlings in the nursery • Ungulate control • Outplant seedlings • Manage land use where sp. occurs
Berenghenas hålom tåno' *Solanum guamense*		E	Limestone cliffs and terraces near the ocean	• Habitat loss • Development • Non-native species • Typhoons • Ungulate damage and browsing	• No known occurrences	Lacking	• Determine distribution and status • Protect habitat • Collect seeds • Propagate seedlings in the nursery • Ungulate control • Outplant seedlings • Manage land use where spp. occurs
Tinospora homosepala		E	Forest ecosystem	• Habitat loss • Development • Non-native species • Typhoons • Potential loss of sexual reproduction	• 150 known individuals in Guam	Lacking	• Determine distribution and status • Protect habitat • Collect plant material • Propagate in the nursery • Ungulate control • Outplant seedlings • Manage land use where spp. occurs
Tuberolabium guamense		T	Shady forest ecosystem	• Habitat loss • Development • Non-native species • Typhoons • Herbivory by slugs • Low genetic representation	• Nearly 100,000 individuals in Guam	Lacking	• Determine distribution andstatus • Protect habitat • Collect seeds • Propagate vegetatively • Propagate seedlings in the nursery • Ungulate control • Outplant seedlings • Control non-native slugs • Minimize fires
Trongkon niyok *Cocos nucifera* Coconut Tree			All habitats in Guam	• CRB	• Exact numbers unknown	Lacking	• Removal of CRB • Research methods to address CRB
Åmot Native Medicinal Plants			All habitats in Guam	• Land loss	• Exact numbers unknown	Lacking	• Determine species status • Develop and support community-led conservation efforts • Record and safeguard traditional TEK • Engage community through place-based education • Protect and restore habitats • Enforce laws to protect åmot

Species **CHamoru name** *Scientific name* Common name	Local listing	Federal listing	Habitat	Threats	Status	Knowledge base	Action
Dokduk *Artocarpus mariannensis*			Limestone and volcanic substrates	• Ungulates	• Exact numbers unknown	Lacking	• Determine distribution and status • Protect habitat • Collect seeds • Propagate vegetatively • Propagate seedlings in the nursery • Ungulate control • Outplant seedlings • Control non-native slugs • Minimize fires
Bulbophyllum raulersoniae			Limestone forests	• Habitat loss	• Exact numbers unknown	Lacking	• Determine distribution and status • Protect habitat • Collect seeds • Propagate vegetatively • Propagate seedlings in the nursery • Ungulate control • Outplant seedlings • Control non-native slugs • Minimize fires
Claoxylon marianum			Limestone forests	• Non-native species • Typhoon • Ungulate damage and browsing	• Exact numbers unknown	Lacking	• Determine distribution and status • Protect habitat • Collect seeds • Propagate seedlings in the nursery • Ungulate control • Outplant seedlings
Pe'echalan *Deeringia ameranthoides*			Limestone forests	• Habitat loss • Non-native species • Typhoon • Ungulate damage and browsing	• Exact numbers unknown	Lacking	• Determine distribution and status • Protect habitat • Collect seeds • Propagate seedlings in the nursery • Ungulate control • Outplant seedlings
Drypetes dolichocarpa			Limestone forests	• Habitat loss • Non-native species • Typhoon • Ungulate damage and browsing	• Exact numbers unknown	Lacking	• Determine distribution and status • Protect habitat • Collect seeds • Propagate seedlings in the nursery • Ungulate control • Outplant seedlings

Species **CHamoru name** *Scientific name* Common name	Local listing	Federal listing	Habitat	Threats	Status	Knowledge base	Action
Tupun ayuyu *Elatostema calcareum*			Limestone forest	• Habitat loss • Non-native species • Typhoon • Ungulate damage and browsing	• Exact numbers unknown	Lacking	• Determine distribution and status • Protect habitat • Collect seeds, cuttings • Propagate seedlings in the nursery • Ungulate control • Outplant seedlings
Fagraea berteroana			Limestone forests in Southern Guam	• Non-native species • Typhoon • Ungulate damage and browsing	• Exact numbers unknown	Lacking	• Determine distribution and status • Protect habitat • Collect seeds • Propagate seedlings in the nursery • Ungulate control • Outplant seedlings
Freshwater Fish							
Atot *Stiphodon* sp. Stream goby			Freshwater streams	• Introduced fish and plants • Degradation of water quality	• Abundant	Limited	• Public outreach • Protect habitat • Monitoring
Atot *Sicyopus* sp. Redbellied goby			Freshwater streams	• Introduced fish and plants • Degradation of water quality	• Unknown	Limited	• Public outreach • Protect habitat • Monitoring
Atot *Stenogobius* sp. Marianas goby			Rivers, soft sandy or muddy substrates	• Loss of habitat • Degradation of water quality	• Common	Limited	• Public outreach • Protect habitat • Monitoring
Umatan *Kuhlia rupestris* Flagtail			Rivers and streams	• Introduced fish and plants • Degradation of water quality	• Common	Limited	• Public outreach • Protect habitat • Monitoring
Asuli *Anguilla marmorata* Giant marbled eel			Rivers and streams	• Overfishing • Habitat modification	• Common	Limited	• Public outreach • Protect habitat • Monitoring
Freshwater Crustaceans							
Uhang Atyidae Atyid shrimps			Rocky and hard substrates in rivers	• Introduced predators	• Common	Limited	• Public outreach • Monitoring
Uhang *Macrobrachium* spp. Tahitian prawns			All freshwater habitats	• Introduced predators • Habitat loss • Overfishing • Destructive fishing method	• Common	Limited	• Public outreach • Protect habitat • Monitoring

Species **CHamoru name** *Scientific name* Common name	Local listing	Federal listing	Habitat	Threats	Status	Knowledge base	Action
Varunidae Varunid crabs			Rocky and hard substrates in rivers	• Introduced predators • Loss of water quality	• Common	Limited	• Public outreach • Monitoring
Freshwater Gastropods							
Akaleha' Neritidae Nerite snails			Rocky and hard substrates in rivers	• Introduced predators	• Common	Limited	• Protect habitat • Monitoring
Akaleha' Thiaridae Thiarid snails			Soft substrates in rivers and lakes	• Introduced predators • Habitat loss	• Common	Limited	• Protect habitat • Monitoring
Freshwater Plants							
Guafak uhong/ **Umok sensonyan** *Ceratopteris thalictroides* Water ferns			Slow moving or stagnant water, ponds, lakes	• Introduced predators • Habitat loss	• Common	Limited	• Protect habitat • Monitoring
Chaiguan gaddok *Potamongeton mariannense* Pond weed			Slow moving stretches of rivers with soft or muddy substrates	• Introduced plants and animals • Substrate loss	• Uncommon	Limited	• Protect habitat • Monitoring
Nipa *Nypa fruticans* Nipa palm			River mouths, estuarine conditions	• Introduced species • Over-harvesting	• Lacking current numbers	Lacking	• Determine species status • Remove introduced species • Maintain stocks in nursery • Collect and store seeds if possible • Outplant at appropriate sites
Marine Mammals							
Bayena *Balaenoptera edeni* Bryde's whale		E	Temperate to tropical waters, oceanic and inshore bounded by latitude 40˚ N and S or 20˚ isotherm	• Seismic operations • Collision with vessels • Entanglement • Defense operations • Pollution • Loss of prey species	• Unknown	Lacking	• Public outreach • Monitoring

Species **CHamoru name** *Scientific name* Common name	Local listing	Federal listing	Habitat	Threats	Status	Knowledge base	Action
Bayena *Balaenoptera borealis* Sei whale		E	Oceanic, warm water breeding grounds, cold water feeding grounds, between 40˚ N and S.	• Seismic operations • Collision with vessels • Entanglement • Pollution • Rarity of low latitude feeding • Over-harvest for scientific studies	• Unknown	Lacking	• Public outreach • Monitoring
Bayena *Megaptera novaeangliae* Humpback whale		E	Antarctic pelagic in summer, temperate to sub-tropical in winter, tropical coastal areas	• Human disturbance • Coastal seismic operations • Defense operations • Collision with vessels • Entanglement • Pollution	• Unknown	Lacking	• Public outreach • Monitoring
Bayena *Ziphius cavirostris* Cuvier's beaked whale		E	Tropical to sub-polar deep oceanic waters	• Entanglement • Competition for food source • Pollution	• Unknown	Lacking	• Public outreach • Monitoring
Bayena *Physeter macrocephalus* Sperm whale		E	Pelagic, offshore, deep water, temperate-tropical	• Unknown	• Unknown	Lacking	• Public outreach • Monitoring
Bayena *Koiga sima* Dwarf sperm whale		E	Oceanic, apart from colder waters, more coastal than pygmy whale	• Seismic operations • Collision • Entanglement • Defense • Operation • Pollution	• Unknown	Lacking	• Public outreach • Monitoring
Bayena *Koiga breviceps* Pygmy sperm whale		E	Oceanic, apart from colder waters	• Seismic operations • Collision • Entanglement • Pollution • Toxicity	• Unknown	Lacking	• Public outreach • Monitoring
Bayena *Peponocphala electra* Melonheaded whale		E	Pelagic and oceanic, primarily tropical and sub-tropical, temperate (< 25˚)	• Illegal and incidental fishing • Capture • Entanglement • Pollution	• Unknown	Lacking	• Public outreach • Monitoring

Species **CHamoru name** *Scientific name* Common name	Local listing	Federal listing	Habitat	Threats	Status	Knowledge base	Action
Bayena *Orcinus orca* Killer whale		E	Oceanic, pelagic, neritic, in warm and cold waters	• Heavy metals and organo-chlorine accumulation • Reduction of food resources • Entanglement	• Unknown	Lacking	• Public outreach • Monitoring
Bayena *Globicephala macrorhynchus* Shortfinned pilot whale		E	Tropical to temperate oceanic waters approach coastal seas	• Entanglement • Lost and discarded • Competition • Pollution	• Unknown	Lacking	• Public outreach • Monitoring
Tuninos *Grampus griseus* Risso's dolphin			Tropical, sub-tropical, temperate, subantarctic waters	• Incidental and illegal capture • Entanglement • Pollution	• Unknown	Lacking	• Public outreach • Monitoring
Bayena *Stenella longirostris* Spinner dolphin			Primary pelagic, can be neritic in same regions, tropical, sub-tropical, and temperate waters	• Incidental and • Illegal catching • Capture • Entanglement • Pollution	• Unknown	Lacking	• Public outreach • Monitoring
Bayena *Stenella coeruleoalba* Striped dolphins			Pelagic, deep water, and outer continental slope	• Incidental catch • Direct and indirect catch • Entanglement • Pollution	• Unknown	Lacking	• Public outreach • Monitoring
Dugong dugon Dugong		E	Shallow tropical waters throughout Indo-Pacific region	• Habitat loss • Direct take • Collisions with small vessels	• Unknown	Lacking	• Public outreach • Monitoring

Species **CHamoru name** *Scientific name* Common name	Local listing	Federal listing	Habitat	Threats	Status	Knowledge base	Action
Marine Reptiles							
Haggan *Chelonia mydas* Green sea turtle	E	E	All marine habitats	• Predation • Human take • Habitat loss • Oil spills • Marine debris	• Common in Guam's marine habitat; Numbers increasing in recent decade	Good	• Monitoring • Public outreach
Haggan karai *Eretmochelys imbricata* Hawksbill turtle	E	E	All nearshore habitat types	• Introduced fish and plants • Degradation of water quality	• Rare	Good	• Monitoring • Public outreach
Marine Fish							
Tanguisson *Cheilinus undulates* Humphead wrasse/ Napoleon wrasse			Coral-rich lagoons to outer reef slopes	• Overfishing • Habitat loss	• Heavily fished, adults rarely seen	Limited	• Marine Preserves • Public outreach • Monitoring
Atuhong *Bolometopon muricatum* Bumphead parrotfish			Outer lagoon and seaweed reefs	• Overfishing • Habitat loss	• Exceptionally rare	Limited	• Marine Preserves • Public outreach • Monitoring
Acanthuridae Surgeonfish			Inshore to lagoons and seaweed reefs	• Overfishing • Habitat loss	• Unknown	Limited	• Marine Preserves • Public outreach • Monitoring
Scaridae Parrotfish			Lagoons and seaweed flats, some in reef flats (seagrass or dense algae beds)	• Overfishing • Habitat loss	• Declining	Limited	• Marine Preserves • Public outreach • Monitoring
Lethrinidae Emperors			Lagoons and seaweed reefs	• Overfishing • Habitat loss	• Declining	Limited	• Marine Preserves • Public outreach • Monitoring
Serranidae Groupers			Lagoons and seaweed reefs	• Overfishing • Habitat loss	• Declining	Limited	• Marine Preserves • Public outreach • Monitoring
Siganidae Rabbitfish			Varies	• Overfishing • Habitat loss	• Unknown	Limited	• Marine Preserves • Public outreach • Monitoring
Lutjanidae Snappers			Varies	• Overfishing • Habitat loss	• Unknown	Limited	• Marine Preserves • Public outreach • Monitoring

Species **CHamoru name** *Scientific name* Common name	Local listing	Federal listing	Habitat	Threats	Status	Knowledge base	Action
Mullidae Goatfish			Reef flats; young in sandy substrate, adults in seaward reefs (300 ft. depth)	• Overfishing • Habitat loss	• Unknown	Limited	• Marine Preserves • Public outreach • Monitoring
Chaetodontidae Butterflyfish			Coral reefs	• Capture for aquarium trade • Habitat loss	• Unknown	Limited	• Marine Preserves • Public outreach • Monitoring
Pomacanthidae Angelfish			Reef flats, clear lagoons, seaward reef slopes, channels	• Capture for aquarium trade • Habitat loss	• Unknown	Limited	• Marine Preserves • Public outreach • Monitoring
Cirrhitidae Hawkfish			Closely associated to coral reefs	• Overfishing • Capture for aquarium trade • Habitat loss	• Unknown	Limited	• Marine Preserves • Public outreach • Monitoring
Labridae Wrasses			All coral reef habitats	• Overfishing • Habitat loss	• Unknown	Limited	• Marine Preserves • Public outreach • Monitoring
Carangidae Jacks and Trevallies			Reef flats; young usually	• Overfishing • Habitat loss	• Unknown	Limited	• Marine Preserves • Public outreach • Monitoring
Skates and Rays							
Hafula' *Mobula alfredi* Reef Manta Ray			Coral reef, sea banks, epipelagic and mesopelagic zone at 200-350 meters	• Bycatch • Disturbance and harassment • Environmental impacts	• Estimated population of 300 individuals in resident colony	Lacking	• Assess and establish baseline data on population size, structure, movement patterns, and genetic distribution • Collaborate with CNMI on populations
Hafula' *Mobula birostris* Oceanic manta ray			Coastal regions, sea mounts, banks, open ocean environments	• Overfishing • Bycatch • Environmental impacts	• Population declining worldwide	Lacking	• Enforce regulations • Prioritize gathering baseline population data • Collaboration with CNMI

Species **CHamoru name** *Scientific name* Common name	Local listing	Federal listing	Habitat	Threats	Status	Knowledge base	Action
Hafula' *Mobula tarapacana* Sicklefin devil ray			Continental shelves, coral reefs, areas with abundant plankton	• Bycatch • Targeted fishing for gill plates • Environmental impacts	• Population declining worldwide	Lacking	• Enforce regulations • Prioritize gathering baseline population data • Collaboration with CNMI
Corals							
Cho'cho' Scleractinia Hard coral Subclass			Highly variable, mangrove swamps, estuaries, reef flats and reef slopes to 100m deep	• Pollution • Sedimentation • Recreational misuse • Climate change • Disease	• Declining	Good	• Monitoring • Marine preserves • Public outreach
Octocorallia Soft coral Subclass			Varies in depths up to 100m; The most conspicuous octocorals in Guam are found on shallow reef flats	• Sedimentation • Chemicals • Climate change • Destruction • Disease	• Declining	Good	• Monitoring • Marine preserves • Public outreach
Cho'cho' *Acropora globiceps*		E	Upper reef slopes, reef flats and adjacent areas in depths of 0-8 meters	• Ocean warming • Disease • Ocean acidification • Sedimentation plumes • Land-based pollution • Recreational misuse	• Declining	Lacking	• Determine distribution and status • Monitoring • Restore vegetation within watersheds • Manage recreational users • Public outreach
Echinoderms							
Balåti *Actinopyga echinites* Deepwater red fish			Sandy reef flats	• Commercial harvesting	• Declining	Lacking	• Determine distribution and status • Monitoring • Prohibit harvesting • Intercept exports
Balåti *Actinopyga varians* Surf red fish			Wave-battered outer margins of reef flats	• Commercial harvesting	• Declining	Lacking	• Determine distribution and status • Monitoring • Prohibit harvesting • Intercept exports

Species **CHamoru name** *Scientific name* Common name	Local listing	Federal listing	Habitat	Threats	Status	Knowledge base	Action
Balåti *Holothuria fuscogilva* Brown teatfish			Deep outer reef slope, usually below 20m depth on sandy bottoms	• Commercial harvesting	• Declining	Lacking	• Determine distribution and status • Monitoring • Prohibit harvesting • Intercept exports
Balåti *Holothuria whitmaei* Black teatfish			Shallow outer reef slope, usually below 20m depth on sandy bottoms	• Commercial harvesting	• Declining	Lacking	• Determine distribution and status • Monitoring • Prohibit harvesting • Intercept exports
Balåti *Thelenota ananas* Pineapple sea cucumber			Shallow outer reef slope, usually below 20m depth on sandy bottoms	• Commercial harvesting	• Declining	Lacking	• Determine distribution and status • Monitoring • Prohibit harvesting • Intercept exports
Balåti *Thelenota anax* Giant sea cucumber			Deep outer reef slope, usually below 20m depth on sandy bottoms	• Commercial harvesting	• Declining	Lacking	• Determine distribution and status • Monitoring • Prohibit harvesting • Intercept exports
Marine Arthropods							
Mahonggang *Paniluris* spp. Spiny lobster			Surf zone, reef front, reef flats	• Overfishing • Habitat loss	• Unknown	Limited	• Marine Preserves • Public outreach • Monitoring
Marine Gastropods							
Charonia tritonis Triton's trumpet			Rich coral growth areas	• Overfishing • Habitat loss	• Unknown	Limited	• Marine Preserves • Public outreach • Monitoring
Bivalves							
Hima *Tridacna derasa* *Tridacna maxima* *Tridacna squamosa* *Hippopus hippopus* Giant clams			Reef flats and seaward reefs in depths up to 60 ft.	• Overfishing • Habitat loss	• Unknown	Limited	• Marine Preserves • Public outreach • Monitoring

Species **CHamoru name** *Scientific name* Common name	Local listing	Federal listing	Habitat	Threats	Status	Knowledge base	Action
Marine Plants							
Lo'u/Chå'guan tåsi *Enhalus acoroides* Tape seagrass			Reef flats and lagoons	• Sedimentation • Marine heatwaves • Water quality degradation • Outbreaks of nuisance species • Habitat loss • Disease and recreational impacts	• Declining	Limited	• Assess population structure and distribution • Protect critical habitat • Minimize anthropogenic impacts
Lo'u/Chå'guan tåsi *Halodule uninervis* Narrowleaf seagrass			Reef flats and lagoons	• Sedimentation • Marine heatwaves • Water quality degradation • Outbreaks of nuisance species • Habitat loss • Disease and recreational impacts	• Unknown	Limited	• Assess population structure and distribution • Protect critical habitat • Minimize anthropogenic impacts
Lo'u/Chå'guan tåsi *Halophila nipponica* Japanese Halophila			Reef flats and lagoons	• Sedimentation • Marine heatwaves • Water quality degradation • Outbreaks of nuisance species • Habitat loss • Disease • Recreational impacts	• Unknown	Limited	• Assess population structure and distribution • Protect critical habitat • Minimize anthropogenic impacts
Lo'u/Åcho' tåsi *Rhodophyta:* Corallinophycidae, Peyssonneliales Calcifying Red Algae			Marine and estuarine environments from shore to twilight zone	• Marine heatwaves • Water quality degradation • Habitat loss • Disease	• Unknown (species-specific)	Lacking	• Assess species diversity of calcifying red algae across reef habitats • Identify indicator species that reflect reef health and ecological conditions. • Use indicators to support monitoring and reef management strategies • Preserve healthy algal communities to enhance reef resilience and recovery • Prioritize conservation of rare and potentially endemic species in the Marianas • Document the diversity of rhodolith communities, which are poorly studied in the region

Species **CHamoru name** *Scientific name* Common name	Local listing	Federal listing	Habitat	Threats	Status	Knowledge base	Action
Lo'u/Chå'guan' tåsi *Rhodophyta* (red seaweeds) Ulvophyceae (green seaweeds) Phaeophyceae (brown seaweeds) Seaweed; Marine Macroalgae			Marine and estuarine environments from shore to twilight zone	• Sedimentation • Marine heatwaves • Water quality degradation • Outbreaks of nuisance species • Habitat loss • Disease • Recreational impacts	• Unknown (species-specific)	Lacking	• Partner with government groups to establish a baseline of Guam's seaweed diversity • Support detection of non-native species and identification of ecological indicators • Prioritize intensive surveys in Apra Harbor due to high maritime activity • Engage local communities to explore sustainable seaweed mariculture • Assess species for cultivation potential and economic viability

Chapter 6: Proposed Monitoring and Incorporation of New Information (Elements 5)

The conservation actions outlined in Chapter 5 represent Guam's strategic response to the threats and challenges facing its SGCN and their habitats. However, effective conservation requires more than action alone; it also demands careful evaluation. Chapter 6 outlines how Guam will monitor the outcomes of these actions, assess the condition of species and ecosystems over time, and incorporate new scientific information into future planning. This adaptive approach ensures that conservation efforts remain effective, data-driven, and responsive to emerging threats and opportunities. Together, these chapters form an integrated framework for conserving Guam's biodiversity through both targeted action and continuous learning.

Monitoring and Evaluation

The approach to monitoring and evaluation is based on expanding existing efforts to be cost effective, considering limited financial resources (Schoonmaker & 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. The SWAP encompasses monitoring and evaluation in nine areas:

1) Surveys of species and habitats
2) Effectiveness of proposed strategies
3) Ten-year revision of the SWAP
4) Habitat suitability models to identify and prioritize areas capable of supporting target species, providing a science-based foundation to guide conservation actions, habitat restoration, and management efforts.
5) Tracking of population numbers and population size
6) Monitoring habitat degradation and loss due to a wide variety of threats such as invasive fauna and flora, fire, development, and climate change
7) Assessing the health of augmented individuals and overall population health
    a. Flora: survival, growth rates, self-reproducing populations
    b. Fauna: self-reproducing populations
8) Development of a database to track monitoring efforts
9) Development of a detailed monitoring program

Terrestrial Surveys

Monitoring Habitats and Conservation Areas

The SWAP entails the management and monitoring of restorative actions within conservation areas in Guam. Many conservation areas in Guam, both on military and Government of Guam lands, are in dire need of restoration because of ungulate damage (Wiles et al., 1999). Conservation actions proposed by existing plans to rehabilitate designated forest habitats are essential for restoring these areas to favorable habitat conditions for native fauna species.

Loss of native habitat around Guam is driven by multiple factors including fire, ungulate damage, development, and invasive species. Some areas heavily impacted by ungulates have changed into monospecific plant communities that consist of primarily plants that are less palatable to ungulates. For example, langiti is a native species that easily develops monotypic stands because binådu do not favor them. Many 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*, outcompetes with native ravine forest species and is now dominating in some areas.

Goal: To monitor the progress of restoration efforts of habitats listed in the conservation strategies.

Objective 1: Develop a GIS maps of historic and current distribution of SGCN for Guam.

Objective 2: Develop maps that illustrate the reduction of habitat degradation and loss as control measures for invasive flora and fauna are implemented in conservation areas.

Vegetation GIS Maps for Guam

- Establish and strengthen partnerships with DOAG's Forestry Division, US Forest Service, FSRD, and private forestry to provide support and assistance for a completed vegetative analysis for Guam. This research will provide an assessment on habitat availability at a broad scale and will support ongoing native forest restorations. Monitoring long-term trends in forest types in Guam to aid managers in proposing effective management to recover habitat and SGCN species.
- The map will be updated as information is made available. The map will be used to identify important trends in habitat restoration in 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 area. 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 priority actions to improve the habitat for fauna and flora. Many areas principally need a reduction in feral ungulate populations.
- Develop and implement reforestation techniques in conservation areas and national wildlife refuge overlay lands.

Many of Guam's flora and fauna are extirpated, extinct, or found only in captivity or in low numbers. For those species still extant in Guam, monitoring of these populations as conservation actions are implemented will be important to conservation evaluations.

To ensure that observations are consistent and appropriate for the target species or habitat type, personnel will be trained in tailored identification and survey methods. Such training will include identification of calls for certain species, recording of the number of animals observed, and use of standard bird survey techniques incorporated in Ramsey and Scott (1981).

Goals: Monitor the long-term population trends of SGCN.

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 that evaluate the relationship between SGCN abundance and ongoing efforts to improve the quality and extent of limestone and ravine forest habitats.

Terrestrial Mammals

- Continue to conduct quarterly counts of all colonies at a minimum. As new colonies are found, they will be monitored quarterly as well.
- Continue to conduct an island-wide survey every 5 years using randomly stratified fixed survey stations.
- Continue efforts with Joint Region Marianas, GNWR, and NPS to work collaboratively in managing the recovery of fanihi in Guam, especially in military installations, Ritidian refuge, and NPS lands.

Native Birds

- Direct Monitoring-A combination ofradio telemetry and the re-sighting of banded birds will continue to be used for monitoring extant bird populations, as well as captive reared birds that are released into the wild. DAWR currently conducts quarterly auditory playback surveys and aims to implement long-term camera monitoring. The Department will also resume using radio telemetry within the next year. In the future, as captive flocks of ko'ko' and sihek are large enough for release into the wild in Guam, these monitoring methods will be valuable in determining the survivorship of released birds. DAWR also actively monitors såli and pulattat (as staff are available). 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 åga population in 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 åga are re-introduced to Guam, playback surveys will be reinstated. Playback censuses are also important in monitoring ko'ko' released on Rota and Islan Dåno'. Other re-introduced bird species could be surveyed with this method as well.

- Roadside Counts – Annual May roadside counts along 23 survey routes 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.
- Yayaguak Surveys – Yayaguak 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 yayaguak population for a cave is then estimated by subtracting the number of departures, from the number of arrivals, and adding the estimated number of yayaguak 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 yayaguak entering a cave and the third person counting the number of birds exiting. In addition to cave exit surveys, surveys should be carried out to search for new caves being used by yayaguak.
- Shorebird Surveys – Surveys 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 the community involved in birding and teach individuals the best management practices in sharing field observations.
- Investigate impacts of prolonged weather conditions to breeding pulattat and invertebrates.

Terrestrial Reptiles

- Conduct annual surveys to determine the status of each SGCN reptile. 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 species.

Terrestrial Gastropods

- As the populations of remaining native snails are very small, visual surveys of native snails in areas known to contain them will be conducted to determine the current population numbers. Initial surveys will be conducted in the Hila'an, 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.

Insects

- 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.
- Identify sites where consistent, long-term monitoring can be conducted for *H. o. marianensis*. Host plant health assessments and monitoring will be performed at these sites alongside *H. o. marianensis* population surveys.
- Perform updated surveys of sites where *H. o. marianensis* were identified. These surveys will help form a better understanding of the species' current population dynamics.
- Maintain a population of captive *H. o. marianensis* to protect against extinction and to augment wild populations where possible.
- Identify host plant-dense sites where *H. o. marianensis* may be introduced to create populations.

Terrestrial Plants

- Conduct regular assessments of the status, distribution, and population trends of terrestrial plant SGCN.
- Conduct periodic surveys of lesser-known or data-deficient terrestrial plant species to improve knowledge and inform management needs.
- Identify priority areas across Guam where consistent, long-term monitoring can take place.
- Integrate habitat quality assessments into species monitoring efforts, including vegetation health, invasive species presence, and habitat connectivity.
- Develop and maintain captive populations, seed banks, or other *ex situ* conservation measures for terrestrial plant SGCN to reduce extinction risk and support future re-introduction efforts if necessary.
- Implement and support habitat restoration projects in degraded areas to increase habitat suitability for terrestrial plant SGCN.

- Collect and store seeds of SGCN plant species, maintain stocks in nurseries, and outplant at appropriate sites.

Freshwater Surveys

Major threats to Guam's aquatic species include 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 freshwater organisms and are amplified throughout the watershed and impact marine organisms as well. Partners such as the FSRD, GEPA, NPS, and the University of Guam are 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 nearshore reef communities, pollution levels in coastal waters, and settling and recruitment rates of corals.

Guam's native freshwater flora and 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 DAWR to monitor the existing stocks and to evaluate improvement from management activities.

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

Assessing Impacts of Dams

- Conduct a long-term study of the effect a man-made 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.
- Survey seven Guam rivers annually to monitor the effects of dams 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 quadrate will be randomly chosen and surveyed, for a total of 20 sample sites per river.
- Data collected at each quadrate 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 quadrate, area of quadrate, depth of water in quadrate, and average water velocity in quadrate, as well as observers, location, date and time.

Baseline River Inventory

- Continue biological river inventory for Guam to obtain baseline biological data important for management of freshwater resources. Of over 100 named rivers and streams, DAWR has biological information on about 67 rivers. DAWR will be surveying rivers with no known biological information. Data collection includes visual surveys, as well as specimen collection using net and electrofishing.

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.

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.

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 large area in Guam, broad scale monitoring will be used to assess the conditions of these habitats. Appropriate partnerships will be developed as some of these areas are privately or federally owned.
- Habitat suitability models will be evaluated for their ability to predict species presence, focusing on pulattat and other native freshwater organisms.

By identifying areas with the highest likelihood of supporting target species, these models can inform site selection for habitat restoration or protection efforts. Model outputs will guide conservation actions, such as prioritizing wetland enhancement, controlling invasive species, or restoring hydrology, thereby increasing the suitability of these areas for native species and enhancing overall habitat quality.

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 andabundance, 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. DAWR staff will also assist GEPA with biological surveys.

Marine 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 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

- 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.
- Continue gathering limited biological data that will add to a long-term historical database of 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

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

Visual Stock Assessment Surveys of Marine Preserves and Control Sites

- 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.
- 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 Habitat Monitoring and Evaluation

Since healthy fish populations require healthy reef habitat, DAWR and its partners also monitor coral reef habitat through several 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 life they contain.

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

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

Objective 3: Participate in the National Coral Reef Monitoring Program (NCRMP) 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-government 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

- Assess Piti Bomb Holes Preserve and Fouha Bay, areas with current and future erosion control projects, and two appropriate control sites for detailed monitoring.
- 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.
- Install and monitor thirty sediment traps monthly 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, macroinvertebrates, 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 DAWR staff. The EMAP program will assess the physical and chemical condition of Guam's 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.

National Coral Reef Monitoring Program (NCRMP)

- Guam DAWR will continue participation in NCRMP cruise trips. The NCRMP is intended to be a long-term monitoring program with research cruises scheduled bi-annually. The cruise is usually comprised of staff from the NOAA Coral Reef Ecosystem Investigation Program, DAWR, 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.

Marine Preserve Monitoring: Guam DAWR Fish Population Surveys

- 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.
- 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 50m long permanent transect, each counting all target fish within 2.5m of their side of the transect. All target fish within this 250m^2 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 (<15cm, 15cm-30cm, >30cm). 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 using two-tailed paired t-tests (Sokal & Rohlf, 1995) 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 andevenness 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 non-parametric test will be conducted (Sokal & Rohlf, 1995).

Guam Long-term Coral Reef Monitoring Program

The Guam Long-term Coral Reef Monitoring Program (GLTMP) is a jurisdictional coral reef monitoring program operated by the University of Guam Marine Laboratory and funded by the NOAA Coral Reef Conservation Program and the Guam Coral Reef Initiative. The program involves the regular, intensive collection of data for a suite of coral reef ecosystem health indicators at priority reef areas around Guam, as well as critical support for coral bleaching response and other activities carried out by the multi-partner Guam Coral Reef Response Team.

- The priority reef areas were selected for long-term monitoring by a group of managers and biologists at the program's inception including the seaward slope in the Tumon Bay Marine Preserve and a control site in East Agana Bay, the seaward slope of the Achang Reef Flat Marine Preserve and a control site along the eastern Cocos Barrier Reef, and the seaward slope of Piti Bomb Holes Marine Preserve. While the program currently does not monitor a control site for the Piti Bomb Holes Marine Preserve, the National Park Service has conducted regular monitoring of the reef in the adjacent Asan Bay. Additionally, a recent collaborative effort between the NOAA Pacific Islands Fisheries Science Center and the GLTMP yielded a significant amount of reef fish survey data for reef areas along the seaward slope in the Piti Bomb Holes Marine Preserve and Asan Bay. The results of this effort can be found in this report available at: https://repository.library.noaa.gov/view/noaa/61256/.
- Stationary point count fish surveys, benthic photo transects surveys, macro-invertebrate belt transect surveys, and chain-length rugosity surveys are carried out on a regular basis at numerous (20 or more) 30m-long transects within each priority reef area. The Tumon and East Agana sites are visited annually, while the Piti, Achang, and CocosEast sites are visited biennially.
- The most recent report published by the GLTMP is available at: https://www.guamcoralreefs.info/s/GLTMP-Decade-of-Change-Report-Aug2023.pdf.
- While the analyses of GLTMP data conducted in-house provide an indication of status and trends within each priority area, it is recommended that researchers be hired to integrate the fish and benthic datasets collected by the GLTMP, as well as other available data, to evaluate the relationship between the fish and benthic communities at each site and, if appropriate, make explicit comparisons between the marine preserve sites and the nominal control sites.
- In addition to the monitoring of priority reef areas, the GLTMP has participated in multiple island-wide coral bleaching response survey efforts and in 2021 established 20 permanent coral bleaching response and recovery sites at shallow (5m) reef front sites around the island. At least one of these sites occurs in the Pati Pt., Tumon Bay, PitiBomb Holes, and Achang Reef Flat marine preserves. Currently, three 30m-long benthic photo transects are surveyed at each of the sites during and between bleaching events. Fish surveys are not currently conducted at the island-wide sites, but if program capacity increases, it may be possible to add fish and macro-invertebrate surveys.

University of Guam Reef Flat Monitoring Program

- The University of Guam's Reef Flat Monitoring Program (RFMP), led by Dr. Laurie Raymundo and supported by the NOAA CRCP, Guam CRI, and GLTMP, collects coral size and condition data on a semi-annual basis at five shallow reef flat sites on the central-western coast of Guam. Two of the RFMP sites are located within locally managed preserves, including one in the Tumon Bay Marine Preserve and one in the Piti Bomb Holes Marine Preserve. Sites at West Hagåtña Bay, Tanguisson Pt., and Luminao Reef are also monitored. The

results of the most recent analysis of RFMP data are presented in the "Decade of change on Guam's coral reefs" report available on the guamcoralreefs.info website.

Guam Environmental Monitoring and Assessment Program – Coastal Waters

- 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 non-parametric test will be conducted (Sokal & Rohlf, 1995).
- 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.

Predator and Invasive Species Surveys

The introduction of non-native species to Guam, whether intentional or accidental, has had drastic negative impacts on native species and their environment. The introduced BTS has 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 BTS must be combined with habitat restoration, captive breeding and translocations, and removal or control of other predators such as cats, dogs, and rats. Monitoring the abundance of BTS is important in determining the efficacy of BTS control measures. In addition, monitoring the presence and distribution of other invasive species must also be emphasized.

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

Objective 1: Monitor monthly abundance of BTS and other predator species in conservation areas designated for restoration and where BTS control is being implemented to evaluate the efficacy of BTS 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 placing barriers in conservation areas slated for the release or re-introduction of SGCN.
- Continue to support studies into improving predator control techniques.
- Assess predator control threshold for non-federally listed forest bird species and other SGCN.
- Monitor the abundance of invasive species in Guam and determine feasible methods to be employed to reverse the threats to SGCN.
- Implement area-wide multi-species predator control by trapping and/or barriers in conservation areas slated for release of SGCN.
- Continue to support studies improving predator control techniques.
- Assess predator control threshold for non-federally listed forest bird species and other SGCN.
- Monitor the abundance of invasive species in Guam and determine feasible methods to be employed to reverse the threats to SGCN.

Effectiveness of Measures

To effectively achieve the goals and objectives identified in the Guam SWAP, the Department must strategically allocate conservation resources. Numerous partners carry out conservation actions within their own organizational boundaries and funding resources, each aligned with specific mandates or purposes.

To align and track these efforts, the Department will develop project-specific result chains (AFWA, 2011) that visually represent how specific actions are expected to lead to desired outcomes and ultimately contribute to the overarching goals of SWAP and its partner organizations. For example, the Department launched a biosecurity awareness campaign encouraging boaters traveling from the main island to Islan Dåno', an area historically free of rodents and BTS, to inspect their vessels for these invasive species. Similarly, a partner agency like the Guam Invasive Species Council Office may initiate a campaign urging boaters traveling to the CNMI to inspect and clean their boats to prevent the spread of BTS and marine invasives such as algae.

While implemented by different agencies and in different contexts, these actions address common threats (e.g., invasive species), and the result chains for these efforts may be very similar. This illustrates the importance of coordination and consistent evaluation frameworks.

In Chapter 4, the identified threats are broad, spanning multiple conservation approaches and requiring flexibility depending on the agency carrying out the action. DAWR will collaborate with technical expert partners to evaluate the effectiveness of actions and ensure they are contributing meaningfully to conservation goals.

To measure the effectiveness of conservation actions, the Department employs a Three-Level Approach:

Level 1: Initial implementation of the conservation action.
Level 2: Evaluation and refinement of methods based on outcomes.
Level 3: Adaptive management to modify strategies and optimize success.

This approach allows for ongoing learning and adjustment, ensuring conservation actions remain responsive, relevant, and results driven.

Data Management and Archiving

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

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

Goal: Management and dissemination 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 to partners and community groups.
- Partner with technical and statistical experts to analyze data and publish scientific work happening in Guam.

Establishment of a Monitoring Group

As mentioned in the 2005 and 2015 SWAPs, establishing a monitoring group is essential to support the synthesis of information collected through the monitoring of SGCN and their habitats. Unfortunately, this group was not formed in the ten years following the 2015 plan. Moving forward, efforts will focus on assembling a group of technical experts to review project objectives, approaches, and results. The monitoring group will include representatives from relevant local and federal agencies such as the Department of Agriculture, GCMP–Marine, NOAA, USDA–NRCS, USFWS Ecological Services, Guam National Wildlife Refuge (GNWR), USDA–Wildlife Services, the Department of the Navy (DON), USGS–BRD, and the UOG. In addition, non-governmental organizations, graduate students, and researchers will be invited to participate. The Department will initiate this process by sending invitations to request participation and involvement.

This group will be responsible for reviewing the progress of ongoing projects by evaluating methodologies and data collected to determine whether conservation actions are effectively addressing key limiting factors. Based on their assessments, the group will help develop adaptive management recommendations to improve project outcomes. The group will also evaluate the effectiveness of conservation strategies in addressing priority actions for species and habitats using adaptive management principles.

Chapter 7: Collaborative Development and Public Participation (Elements 7 and 8)

Coordination with Federal, State, and Local Partners

At the beginning of the revision process, the Department and UOG CIS and SG ICL identified potential partners from various federal, state, and local agencies. The UOG CIS and SG ICL team sent emails requesting partner participation and an initial meeting was held to present the approach to the SWAP revision including candidate species to be added, how the team would go about collecting updated data and information, and a general timeline to meet the deadline of October 1, 2025. Throughout this process, partners were invited to provide concerns, input, and assistance.

Various partners assisted in the revision of the SWAP, while the Department and UOG CIS and SG ICL teams facilitated the comprehensive review of the plan. These partners were involved through review and editorial contributions. They reviewed, commented on, and edited portions of the 2015 SWAP that were relevant to their field of expertise or provided input through personal communication (Table 12). Once feedback was received, the suggested changes were incorporated into an overall working document for the 2025 SWAP.

Marianas Landscape-scale Conservation

While the Guam SWAP and CNMI SWAP exist independently, the plans share many SGCN. Species found in the Mariana archipelago have distribution ranges across the islands, not accounting for political or geographic borders. The respective Guam and CNMI SWAP teams recognized the importance of establishing landscape-scale conservation priorities across the Mariana Islands.

Collaboration with the CNMI Division of Fish and Wildlife (DFW) began in September 2024 when representatives from Guam DOAG-DAWR, UOG CIS and SG ICL, and CNMI DFW began meeting to discuss the need to produce a Marianas landscape-scale conservation framework. Building on these efforts, representatives from CNMI DFW, Guam DOAG-DAWR, and UOG CIS and SG ICL held a two-day interisland workshop in April 2025. In this workshop, the teams set out to identify opportunities for collaboration toward conservation actions for shared priority SGCN. The group set out to specifically identify (1) regionally important species, (2) priority areas for conservation work, and (3) relevant regional companion plans. The results of the workshop are detailed in Table 13.

Table 12: Partners Involved in the Revision Process

Name	Affiliation	Technical Expertise
Diane Vice	DOAG-DAWR	Wildlife
Dr. Tammy Mildenstein	University of Guam	Bats
Jeried Calaor	Cherokee Federal	Bats
Juan-Carlos Mungaray	UOG CIS and SG ICL	Bats
Dr. Maia Raymundo	University of Canterbury	Bats
Matthew Putnam	UOG CIS and SG ICL	Insects and gastropods
Christopher Rosario	DOAG	Insects
Jonathan Richmond	US Geological Survey	Terrestrial reptiles
Robert Fisher	US Geological Survey	Terrestrial reptiles
Mario Martinez	NAVFAC Marianas	Terrestrial plants
CJ Paulino	Tåno, Tåsi, yan Todu	Terrestrial plants
Gerard Chargualaf	NAVFAC Marianas	Terrestrial plants
Nathan Sablan	ARC Environmental Services	Terrestrial plants and reptiles
Aubrey Moore	UOG CNAS	Terrestrial plants
Joseph Tuquero	UOG Cooperative Extension	Terrestrial plants and åmot
Dr. Else Demeulenaere	UOG CIS & SG ICL	Terrestrial plants and åmot
Caley Jay Chargualaf	UOG CIS & SG ICL	Terrestrial plants and åmot
Lourdes Manglona	Yo'åmte (traditional healer)	Åmot
Frances Meno	Yo'åmte (traditional healer)	Åmot
Rosalia Mateo (Mama Chai)	Yo'åmte (traditional healer)	Åmot
Dr. Martin Kastner	Virginia Tech	Birds
Megan Volsteadt	DOAG-DAWR	Birds
Lauren Thompson	DOAG-DAWR	Birds
Brent Tibbatts	DOAG-DAWR	Freshwater and marine species
Dr. Tom Schils	UOG Marine Lab	Marine plants
Jonelle Sayama	UOG MAGIC	Mangroves
Cara Lin	DOAG-DAWR/GCRI	Mangroves
David Burdick	UOG Marine Lab	Corals
Diona Drake	UOG Marine Lab	Sharks
Dr. Brett Taylor	UOG Marine Lab	Reef fish
Leilani Sablan Naden	UOG CIS and Sea Grant	Reef fish
Addie Ferguson	UOG CIS and Sea Grant	Sea turtles
Dr. Laurie Raymundo	UOG Marine Lab	Corals
Dr. David Combosch	UOG Marine Lab	Corals and mollusks
Remedy Rule	DOAG-DAWR/GCRI	Corals
Olivia Banez	DOAG-DAWR/GCRI	Corals
Dr. Alexander Kerr	UOG Marine Lab	Echinoderms
Julie Hartup	Micronesia Conservation Coalition	Rays
Ajalyn Omelau	DOAG-Forestry	Wildfire

Table 13: Results from Inter-Island Workshop

Shared Priority Species of Greatest Conservation Need	
Terrestrial	Host plants* for SGCN, such as *Hypolimnas octocula marianensis* (Mariana eight-spot butterfly) and damselflies**.
	Medicinal plants (åmot)
	Plants that could benefit from genetic diversity (*S. nelsonii*, *M. walkeri, T. rotensis*, *H.longipetiolata*)
	Fanihi (*Pteropus mariannensis*, Mariana fruit bat)
	Yayaguak (*Aerodramus bartschi*, Mariana swiftlet)
	Åga (*Corvus kubaryi*, Mariana crow)
	Emoia slevini (Slevin's skink)
	Land snails
	*These host plants are not SGCN but their importance for SGCN granted their inclusion as priority species in this workshop. **Damselflies are not found on Guam.
Marine	Mollusks (Giant clams, *Charonia tritonis*)
	Balåti (sea cucumbers)
	Sea grasses
	Spiny lobster and slippery lobster
Freshwater	Gobies
	Atyid shrimp

Priority areas identified for conservation work	
Freshwater/riparian zones	EEZ
Watersheds	Sandy beaches/beach strand
Limestone forests	Coral reefs
Watersheds	Lagoons
Cultural landscapes	Seagrass
Urban/rural areas	Estuaries/mangroves
Wildland/urban interface	Sabana areas

Relevant regional companion plans to the SWAPs	
Regional Wildlife Management Plans	Regional Biosecurity Plan
Forest Action Plans	Coral Reef Resilience Strategy
Fisheries Management Plan	Marianas Avifauna Conservation Plan (does not include Guam)

Additional needs identified
Cross-jurisdiction support
Gap analysis of the species that reside in both Guam and the CNMI but that were identified as SGCN by one plan but not the other
Identification and support of projects with multi-species benefits
Establishment of standard protocol/procedures and data needs for shared SGCN
Research on impacts of non-native species on native SGCN (biosecurity)
Funding to link monitoring with restoration projects
Identification of established conservation actions in both SWAPs that cover landscape-scale needs discussed in the interisland workshop

Public Participation

The approach to gaining community input for the SWAP involved presenting at conferences, tabling at various outreach events, and sharing an online survey to garner responses concerning species needing conservation. The UOG CIS and SG ICL and DOAG-DAWR hosted a public forum event early in the revision process. Despite a low turnout at the public forum, there were many other opportunities to garner public engagement with the SWAP. The teams made their presence through presentations and by tabling at several events such as the Conference on Island Sustainability, Marianas Terrestrial Conservation Conference, Feral Swine Perimeter Fence Program workshop, DOAG Loves GU event, and the Spring Farmers Market event. At each of these events, attendees were able to view outreach materials, ask questions about the plan, and fill out an online survey to provide feedback on species needing conservation. Through tabling and presenting, the teams were able to interact with a total of over 500+ event participants.

Survey Results

In Spring 2025, the revision team launched a public Google survey to gather community input for the SWAP. The goal was to ensure the plan reflects the environmental concerns and priorities of Guam's residents.

After a public forum in January, the survey link was shared widely across the island through WhatsApp chats, Instagram and Facebook, outreach events, classrooms, and multiple conference presentations. The survey QR code was displayed at the team's outreach table at three different conferences and also reposted by partner organizations on social media. In total, 312 people participated in the survey.
Google Survey Questions:

1. Please tell us your age.
2. Village of residence?
3. How did you hear about this survey?
4. How aware are you of local wildlife species in Guam?
5. What is **one** plant or animal you feel needs to be conserved? (This could be because the plant/animal is important to our environment, culture, or economy.)
6. Is this species environmentally, culturally, or economically important to Guam? If so, how?
7. What are the threats facing this species and how significant are the threats? (ex. invasive species, development, etc.)
8. What factors are needed for this species' survival? (ex. healthy forest, pest control, etc.)
9. Where have you seen this species? What habitats do you find them in? (ex. specific villages, limestone, wetlands, savannas, coastal areas, etc.)
10. What actions are needed to protect this species?
11. What made you interested in this species?
12. Do you know anyone knowledgeable of this species that we could talk to?
13. Are there any other species you would like to learn more about?

Respondents ranged in age from under 17 to 64, with over half being 17 or younger, a strong showing from Guam's youth. Participants represented a wide range of villages. Most people heard about the survey through school presentations (over 43%), followed by WhatsApp and outreach events. Around 58% described themselves as "somewhat aware" of local wildlife, suggesting a solid foundation for engagement with room for growth.

Community concern for native species was clear throughout the responses. The ko'ko' was most frequently mentioned, appearing in 24% of responses. Native plants, especially the trongkon niyok were also commonly submitted. Other notable species included the fanihi, sihek, and haggan. People also mentioned corals, reef fish, birds, and "boonie dogs," reflecting a sense of care for Guam's biodiversity and its deep cultural significance, especially for the CHamoru people.

Invasive species were the top concern, particularly BTS and CRB, both of which have severely impacted native ecosystems. Habitat loss from development, land clearing, and feral ungulates were also frequently mentioned. These responses show widespread public awareness of the threats facing Guam's wildlife.

Respondents made connections between species' survival and conservation actions. Commonly cited priorities included pest control, healthy forests, stronger enforcement, habitat restoration, and public education. Some people brought up the importance of school-based programs and community outreach, which shows strong overlap between public knowledge and effective conservation strategies.

The ko'ko' was often quoted as a symbol of hope and natural heritage, especially in its decline due to the BTS. Some respondents demonstrated an understanding of ecological interdependence, for example, how bird loss can lead to beetle overpopulation and coconut tree decline. Cultural

concerns were also discussed, including the impact of CRB damage on traditional materials still used in CHamoru practices. Frustration over gaps in enforcement, particularly around land clearing and invasive species control, was a recurring theme. Military land use was also mentioned as a challenge. Some responses reflected confusion around species status, emphasizing the need for expanded environmental education.

People's interest in Guam's flora and fauna often stemmed from personal experiences, cultural and family ties, or classroom experiences. Conservationists, elders, teachers, and agency staff were named as knowledgeable sources. When asked what other species they wanted to learn about, respondents mentioned everything from marine life to terrestrial plants, showing curiosity for future outreach.

The survey results provide clear guidance for the implementation of the 2025 Guam SWAP. Community members, especially youth, want to protect native and culturally significant species, address invasive threats like the BTS and CRB, and restore habitats. There is strong support for environmental education and better enforcement of conservation laws. The survey results are a solid foundation for shaping conservation efforts that reflect the priorities, knowledge, and values of Guam's people.

The public was also engaged through notices published in a local newspaper on August 12 and 13, 2025. The public comment period ran from July 22, 2025 to August 20, 2025. A digital copy of the GWAP 2025 was made available on the Department of Agriculture's website and could be accessed via a QR code.

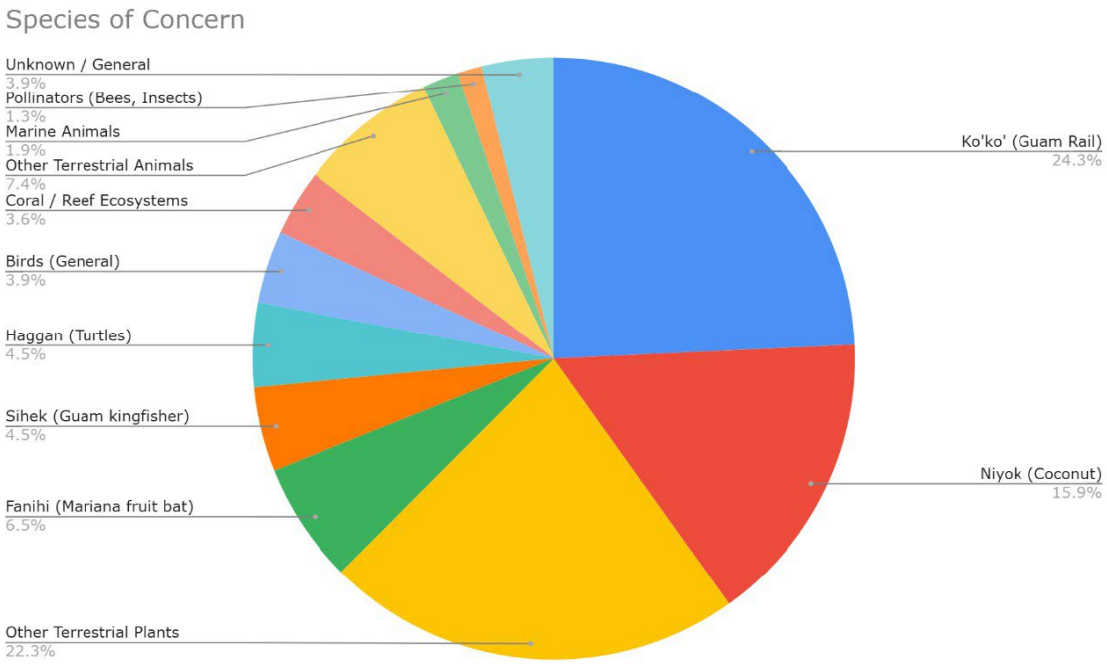


Figure 6: Survey Results for Species of Concern

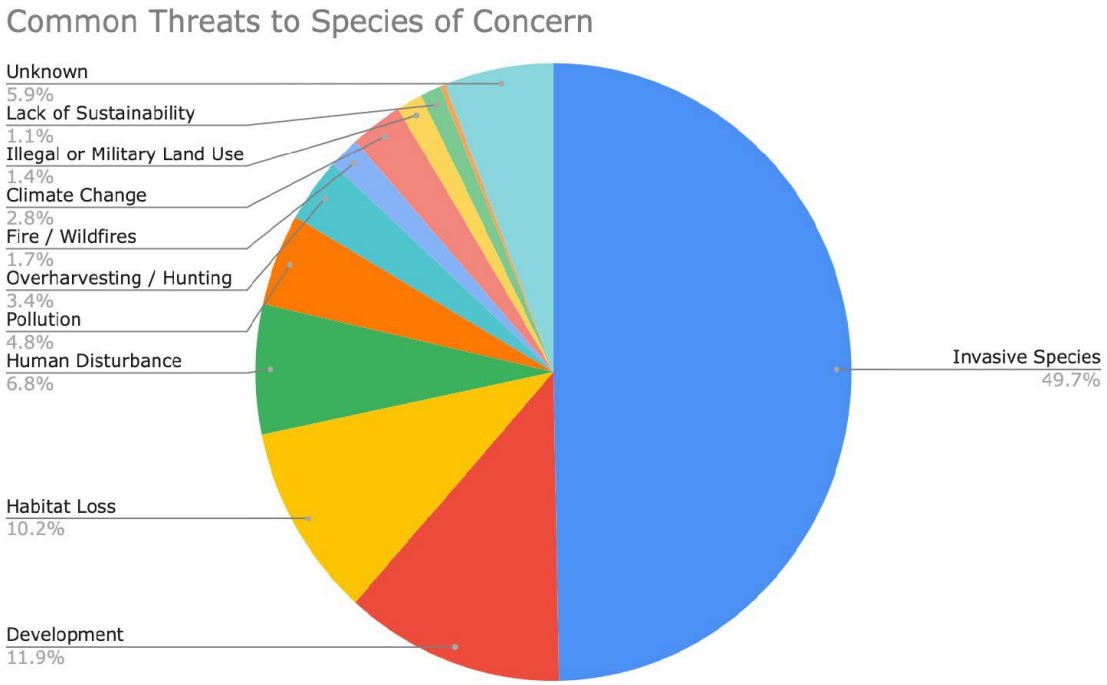


Figure 7: Survey Results for Common Threats to Species

Public Involvement in the Implementation of the Plan

The Department engages the public in conservation and education efforts of the SWAP through a variety of programs, outreach events/workshops, and community groups.

Youth Programs

- Upon teacher or school request, presentations are conducted at schools with the goal of educating and encouraging students on how to respect and conserve island resources. Over 100 presentations are given each year on topics such as endangered/ threatened species, invasive species, Guam's watersheds, and marine/reef ecosystems. Additionally, the Department donates vegetables to schools that make requests for classroom and/or school-wide gardens.
- Guam's youth can learn about freshwater species, habitats, and sustainable fishing practices through programs such as the annual Kid's Fishing Derby, which began in 1990, and the annual Masso' Reservoir Youth Fishing Derby, which was started in 2013.

Outreach Events

- At annual community events, such as Earth Day and Charter Day, interactive educational booths are set up by the Department. During the annual Arbor Day festivities, the Division of Forestry engages students and community members in the planting and care of native trees. Additional tree planting events are held in the Cotal Conservation Area, Geus-Manell, Pago Bay and Masso watershed areas.
- The Division of Forestry coordinates with landowners to provide native plants and trees and information/support to those wishing to replant such species.
- The Division of Forestry partners with DAWR and other organizations to continue the promotion of the Munnga ma songge Guahan ("Don't Burn Guam") campaign with a goal of addressing wildfires during the island's dry season. This campaign continues to create opportunities for students and community members, specifically residents in the south, to be involved and informed on Guam's restoration and conservation efforts.
- An annual Pig Hunting Derby was started in 2012 by the Department to educate and instruct the community on safe hunting practices while encouraging assistance in ungulate control, specifically regarding babuen hålom tåno' that have a low harvest interest. The first derby had only 10 hunters with 30 harvests. Since then, the two-day event has grown to include over 100 hunters with an average of 60 pigs harvested.
- The weekend following the derby, a free public event called Pork in the Park is held to encourage awareness on how to safely prepare and enjoy feral pork. Culinary teams compete for various prizes while the public is afforded the opportunity to taste the pork. The Department pairs with a local hotel for additional 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 this family event.

Community Groups

- The Hunter's Education Program was initiated by the Department in hopes of empowering trained hunters to teach classes and improve the rate of licensed hunters in Guam.
- The Haggan Watch, a volunteer program started in 2005, engages volunteers to aid in supplementing Department staff surveys. Since its inception, the program has grown to over 400 members 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 as partners overseas. HH acts as a working group for sea turtle recovery management in Guam. The partners 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 sea turtles.
- Friends of Islan Dåno' is a local volunteer group dedicated to the eradication of BTS on Islan Dåno'. The group was formed in response to the confirmation of a breeding population of BTS on Dåno' in 2020. Friends

of Islan Dåno' has since established a weekly search schedule with participation from over 375 individual volunteers (Kastner, *pers. comm.*). DAWR partnered with APHIS Wildlife Services to provide four operational snake searches for three nights per week. Night searches by DAWR and Friends of Islan Dåno' have removed BTS consistently through March 2024 with over 130 removed since the initial sighting. BTS sightings have declined, although the BTS population remains active at some low, difficult-to-detect level. In September 2025, Friends of Islan Dåno' conducted its 150th search and plans to continue with removal efforts.

Next Steps

The Department will look into improving approaches in gaining community feedback for the SWAP revision. A key aspect will be revitalizing the Department's website to increase accessibility for the public to view the SWAP and provide comments throughout the plan's term. The Department is also committed to continuing their presence at outreach events and conferences to promote public involvement in the SWAP.

Chapter 8: Periodic Review of Strategy (Element 6)

Guam DAWR developed the first edition of the Guam State Wildlife Action Plan in 2005, formerly known as the Comprehensive Wildlife Conservation Strategy. As mandated by Congress, a ten-year revision took place in 2015. This 2025 revision reflects the necessary update to facilitate the effective implementation of the SWAP's conservation actions and continue receiving SWGP funding.

As was the case in 2015, the critical status of the island's native ecosystems and the importance of protecting and recovering native species are acknowledged as the foundation of the SWAP. Identifying and protecting suitable habitats in Government of Guam owned lands and intact native communities is recognized as a high priority and major focus for conservation efforts. On an ecological level, the 2025 Guam SWAP takes a habitat management approach and landscape view that accounts for the complex relationships among species and their habitats, and the significant need for change and adaptability. This revision also incorporates the Guam and CNMI collaboration for landscape conservation across the Mariana Islands. The comprehensive approach in 2025 was to build on information from the 2015 SWAP by identifying cooperative efforts and implementing new information from the past ten years.

Much of the 2015 SWAP remained relevant and was the foundation on which to continue conservation efforts detailed in this revision. The overall structure of the document was retained as much as possible. The content of the 2015 SWAP was reviewed, evaluated, and updated by DAWR staff, UOG CIS and SG ICL, and various species experts who may use the plan for funding or collaborative efforts for specific projects. Special attention was paid to knowledge gaps, new threats and challenges, and changes in conservation strategies and management approaches. There was also a focus on climate change effects and the need to strengthen legal frameworks set in place for conservation efforts.

Emphasis for the next 10 years will focus on improving efficiency in collecting ongoing data and research, public outreach approaches, identifying new species and habitat threats, and establishing action priorities for addressing outlined conservation needs in the SWAP. The 2025 Guam SWAP will be fully reviewed by 2035 with interim performance reports (reviews) every year of projects funded by State Wildlife Grants. The interim performance reports will be used as a tool for DAWR's technical experts to evaluate the success or failure of management objectives, adjust management actions accordingly, and review project proposals (needs, objectives, and approach) addressed in the SWAP. The revision process will take place through the following actions listed below:

- The proposed management actions for Guam's SGCN will be updated as new information is gathered from these reviews. The Department will coordinate with technical experts to carry out a complete assessment of the strategy on a needed basis. The findings will be compiled and shared using all available media for public review, and comments will be incorporated into 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. DAWR will consult with public and privatepartners to clearly describe the revision process.
- A review of the priority levels will be made to ensure SGCN needs (conservation actions) are being addressed. The Nature Conservancy threat assessment tool will be utilized to aid in the determination of the priority levels for SGCN and conservation actions in the plan. Rankings will be established and clearly defined, being determined at the species or group level (i.e. hard corals).
- The Department will publish research papers with data collected during SGCN conservation activities to support the selection of future species. These publications will also serve to educate the public about historical, current, and trending

species needs to gain more informed community feedback for future actions and research areas.

- The Department will seek to hire a SWAP coordinator to engage with conservation partners (local agencies, federal agencies, and other community and non-government groups) and seek their participation for the duration of the SWAP revision. The coordinator will be tasked with facilitating coordination between these partners to summarize goals and objective outcomes and compile new information on species, habitats, threats and actions for SGCN.
- By the next review of the SWAP, DAWR will also focus on creating partnerships with various cultural groups to improve upon information regarding culturally valued species, with special considerations for the sensitivities surrounding certain cultural practices. Their input and participation will be key to updating information on culturally significant SGCN and gaining input for the potential inclusion or removal of other species based on traditional knowledge.
- The next revision shall start at least two years before the tenth year and be completed by the end of the tenth year. The countdown to revision shall commence on October 1, 2025, and the full revision shall be completed and submitted for review and approval by October 1, 2035.

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Appendices

Appendix A: Record of Marine Mammals in Guam

Species	Record	Reference
Balaenoptera borealis 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
Balaenoptera edeni Bryde's Whale	A decomposed carcass washed ashore some 500 m north of Sella Bay, Guam, on August 31, 1978.	Davis, 1978
Balaenoptera musculus Blue Whale	One sighting near Guam. Blue whale song has been recorded near Guam by NOAA researchers.	Tibbatts, 2025
Delphinus delphis Common Dolphin	One unconfirmed sighting in 1990 near Guam	Tibbatts, 2025
Dugong dugon Dugong	One recorded a single verified sighting of a dugong at the southern end of Cocos Lagoon in 1975. El-dredge (2003b) also mentions that several dugong sightings along the southeastern coast of Guam were reported in 1985. Sketches made by observers at the time matched the description of a dugong.	Randall et al., 1975
Feresa attenuata Pygmy Killer Whale	Rarely seen around Guam. Photographed in 2013 and 2014.	Tibbatts, 2025
Globicephala macrorhynchus Shortfinned Pilot Whale	A large school of about ten individuals were reported near Uruno Point, Guam. The first known beaching of an individual in Guam was reported on July 6, 1980.	Birkeland, 1977a Kami & Hosmer, 1982; Donaldson, 1983
Globicephala melas Long Finned Pilot Whale	Few sightings of this species around Guam. Could be misidentifications of the Short Finned Pilot Whale	Tibbatts, 2025
Grampus griseus 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
Kogia breviceps Pygmy Sperm Whale	A partially decayed specimen was found at NSD Beach at Naval Station (Apra Harbor), Guam on February 9, 1989.	Sherwood, 1989
Kogia sima 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.	Kami & Lujan, 1976 Darling & Mori, 1993 Stinson, *pers. comm.* Anon., 1996
Orcinus orca 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
Peponocephala electra Melonheaded Whale	A stranded male melon-headed whale was reported from Inalåhan, Guam, on April 1980.	Kami & Hosmer, 1982

Species	Record	Reference
Physeter macrocephalus 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, Inalåhan, 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
Pseudorca crassidens False Killer Whale	Occasionally seen in Guam's nearshore waters. Photographed and video taken several times since 2010	Tibbatts, 2025
Stenella attenuate Pantropical Spotted Dolphin	Regularly seen near Guam, frequently in pods of up to 200 individuals.	Tibbatts, 2025
Stenella coeruleoalba Striped Dolphin	A single freshly dead female was found at Dadi Beach, Hågat Bay, Guam on July 24, 1985. One additional record occurs from Guam.	Nitta, *pers. comm.* Wilson et al., 1987
Stenella longirostris 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 Malesso' throughout the late 90's and were the subjects of a dolphin-watching tourist industry.	Rock, 1984 Naughton, *pers. comm.* Paulay, *pers. comm.*
Tursiops truncate Common Bottlenose Dolphin	Occasionally sighted in nearshore waters around Guam. Appears to be migratory	Tibbatts, 2025
Ziphius cavirostris Cuvier's Beaked Whale	This species has been reported in the Mariana and Bonin Islands area. Several individuals have stranded in Guam in the past 20 years	Masaki, 1972, DAWR 2015, DAWR 2025

Appendix B:

List of Potential Scleractinia Corals of Opportunity (COO):

Corals of opportunity (COO) are colonies or fragments that have been detached from the reef by wave action, storms, ship grounding, etc. COO fragments may be damaged or in poor health, and depending on the species, may not thrive in a nursery setting (e.g., *Heliopora coerulea*) or be appropriate for nursery inclusion (e.g., *Millepora platyphylla* [fire coral]). Using COO to start a coral nursery is not recommended, but an established nursery can be augmented by COO. Using COO in an established nursery can expand the diversity of species in the nursery without causing additional stress to wild reefs and provide refuge to fragments that may otherwise die. Larger COO fragments or colonies may be better suited to a more permanent nursery structure, such as spiders or ropes. Nearly any coral that does not pose a risk to human health (e.g., fire coral) and is not mobile (e.g., *Cycloseris*) has the potential to be included in a nursery as a COO.

Potential target species to be included in the nursery were selected based on the factors listed below. This list may change as more data becomes available.

- **Ease of collection:** How hard will this species be to collect and include in the nursery? Can wild stock be collected by snorkeling from shore, or will it require a boat and/or SCUBA? Will specialized tools be required?
- **Availability:** How easy will it be to locate this species? Is there a known population?
- **Abundance:** Is the source population very small? Are there nearby colonies of the same coral, or is this the only colony in the vicinity? Is this a coral that would benefit from inclusion in the nursery? Is this a coral whose population is very small and needs safeguarding?
- **Depth:** At what depths is this coral species normally found?
- **Environment:** Will this coral thrive in the nursery and planned outplant site? Or does it prefer a different environment (e.g., shallow reef flats, turbid forereefs, etc.)?
- **Growth rate:** Will this coral grow quickly enough in the nursery to meet project goals?
- **Growth type:** Which nursery structure is best for this type of coral? Does the nursery structure have space for this species? Is this a species that will support our restoration goals? Is this growth type already well-represented within the nursery?
- **Site diversity:** Can multiple coral species be collected at a site to increase efficiency?

Appendix C: Table of Potential Scleractinia Species for Inclusion in Coral Restoration

Species	Record
Acropora granulosa	Delicate, fast-growing species, good habitat for fish and inverts. Very uncommon.
Acropora humilis	Fast growing, sturdy species. Uncommon.
Acropora latistella	Fast growing, abundant in some places, likely to do well in the nursery and outplanted into shallow areas.
Acropora surculosa/hyacinthus	Fast growing, sturdy species, difficult to find.
Acropora valida	Fast growing species, fairly common.
Acropora abrotanoides	Hardy.
Alveopora sp.	Reported to grow quickly but is difficult to find.
Asterospicularia randalli	Only one known location on Guam--this species would benefit from a genetic reserve.
Diploastrea heliopora	Hardy, iconic species. Likely to grow slowly.
Echinopora pacificus	Rugose, relatively fast growing according to aquaria forums.
Euphyllia cristata	E. cristata is a better choice because it has more compact corallites than E. glabrascens
Galaxea fascicularis	Common, but seems to grow quickly and has done well in nurseries from other studies.
Galaxea horrescens	Uncommon species, likely to grow quickly and similar to G. fascicularis.
Gardineroseris planulata	Hardy, but slow growth rate. Does not appear to have been in a nursery before. Good species to compare to wild growth rate.
Goniastrea pectinata	Hardy, easy to source.
Goniastrea stelligera	Hardy, easy to source.
Goniopora fruticosa	Relatively fast growing, according to aquaria forums. Easy to find.
Isopora palifera	Abundant at Jinapsan beach, sturdy reef flat species.
Leptoria phrygia	Common, hardy, easy to source, may not grow quickly, good candidate for spider nurseries.
Lobophyllia hemprichii	Would take as a coral of opportunity but not a target species due to size of corallites and slow growth. Iconic species, hardy. Would be a good candidate for spider nurseries.
Lobophyllia corymbosa	Would take as a coral of opportunity but not a target species due to size of corallites and slow growth. Iconic species, hardy. Would be a good candidate for spider nurseries.
Montipora verrucosa	Fast-growing.

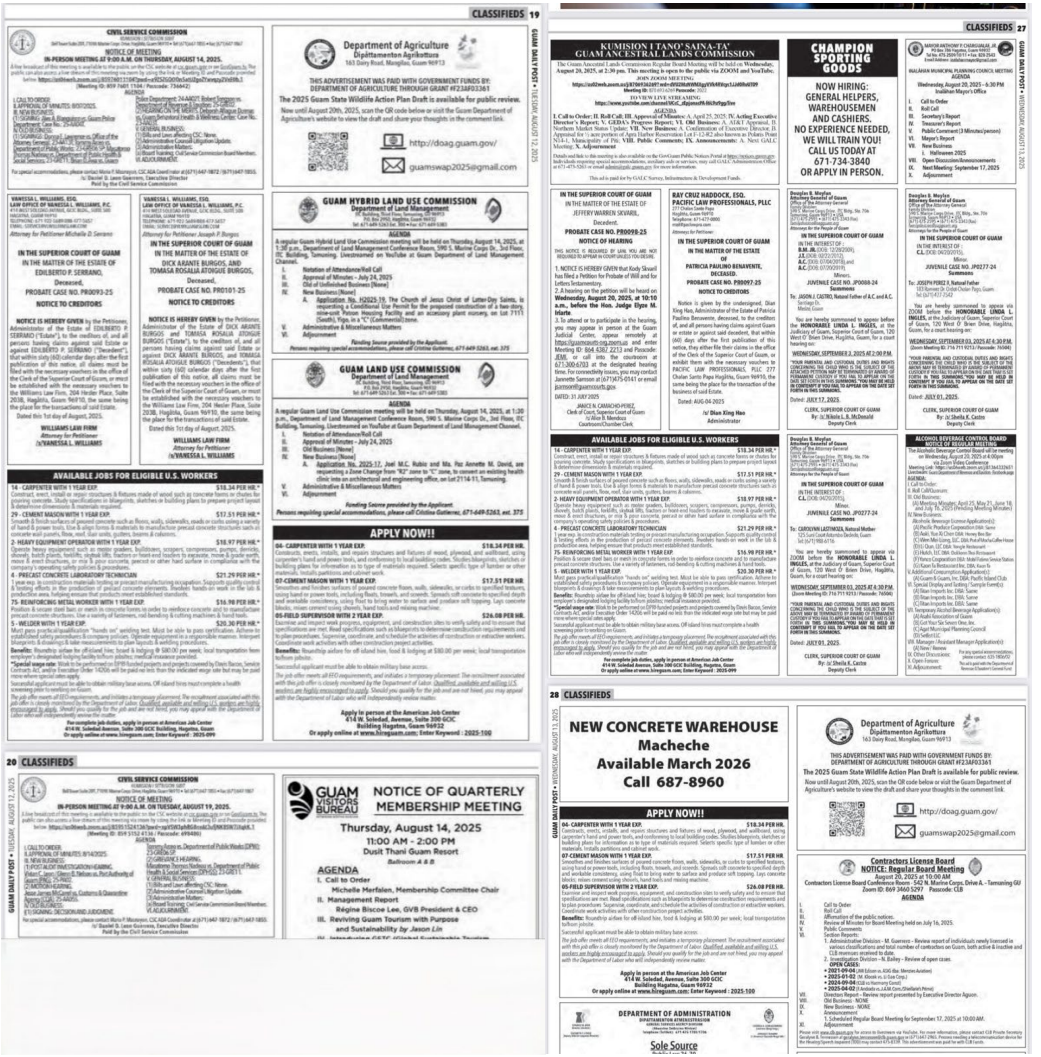
Species	Record
Pachyseris speciosa	Uncommon, foliose growth form not represented by other species. Likely to grow quickly.
Pavona decussata	Common reef flat species, likely to grow quickly
Pavona duerdeni	Similar to P. clavus in growth form, and much easier to find. Growth rates may be low though.
Pavona explanulata	Encrusting coral, a growth form not represented.
Platygyra daedalea	Iconic species, mounding
Plerogyra sinuosa	Chernin et al. found this near Nimitz Beach in 1977. Very rare.
Pocillopora grandis	Uncommon but easily sourced at the mouth of Apra Harbor. Grows quickly and provides good habitat for fishes and invertebrates. Likes ropes.
Pocillopora meandrina	Common, colorful, supports fish and inverts, likely to grow quickly.
Pocillopora setchelli	Common, colorful, supports fish and inverts, likely to grow quickly.
Porites deformis	Rugose species, but may grow slowly.
Psammocora haimiana	Columnar species that resembles P. clavus in morphology. Common in Hågat and Tumon Marine Preserve.
Psammocora profundacella	Uncommon species, likely to grow quickly, very easy to find coralliths (i.e., circumrotatory mobile colonies) at Asan Beach (pending collection permit) and highly rugose.
Stylophora pistillata	Uncommon species, but unusually abundant at Nathan's Dent. Likely to grow quickly.

Appendix D: Table of Potential Scleractinia Species for Nursery Inclusion as COO

Acanthastrea echinata	*Acropora abrotanoides*	*Acropora aculeus*	*Acropora acuminata*	*Acropora aspera*
Acropora cerealis	*Acropora corymbosa*	*Acropora digitifera*	*Acropora echinata*	*Acropora florida*
Acropora gemmifera	*Acropora gibbosa*	*Acropora globiceps*	*Acropora granulosa*	*Acropora humilis*
Acropora hyacinthus	*Acropora intermedia*	*Acropora latistella*	*Acropora longicyathus*	*Acropora loripes*
Acropora millepora	*Acropora monticulosa*	*Acropora muricata*	*Acropora nana*	*Acropora nasuta*
Acropora palmerae	*Acropora pulchra*	*Acropora robusta*	*Acropora secale*	*Acropora selago*
Acropora speciosa	*Acropora squarrosa*	*Acropora striata*	*Acropora studeri*	*Acropora tenuis*
Acropora teres	*Acropora tubicinaria*	*Acropora valida*	*Acropora verweyi*	*Alveopora allingi*
Alveopora japonica	*Alveopora verrilliana*	*Astrea curta*	*Astreopora gracilis*	*Astreopora listeri*
Astreopora myriophthalma	*Astreopora ocellata*	*Astreopora randalli*	*Coscinaraea species*	*Cyphastrea chalcidicum*
Cyphastrea flabelliformis	*Cyphastrea microphthalma*	*Cyphastrea serailia*	*Diploastrea heliopora*	*Dipsastraea favus*
Dipsastraea helianthoides	*Dipsastraea matthaii*	*Dipsastraea pallida*	*Dipsastraea rotumana*	*Dipsastraea speciosa*
Echinophyllia aspera	*Echinophyllia species*	*Echinopora lamellosa*	*Echinopora pacifica*	*Euphyllia cristata*
Euphyllia glabrescens	*Favites abdita*	*Favites complanata*	*Favites exesa*	*Favites favosa*
Favites flexuosa	*Favites magnistellata*	*Favites speciosa*	*Favites valenciennesii*	*Fungia fungites*
Galaxea acrhelia	*Galaxea astreata*	*Galaxea fascicularis*	*Galaxea horrescens*	*Galaxea longisepta*
Galaxea paumotensis	*Gardineroseris planulata*	*Goniastrea edwardsi*	*Goniastrea pectinata*	*Goniastrea retiformis*
Goniastrea stelligera	*Goniopora arbuscula*	*Goniopora columna*	*Goniopora fruticosa*	*Goniopora lobata*
Goniopora pedunculata	*Goniopora somaliensis*	*Goniopora tenuidens*	*Heliopora coerulea*	*Herpolitha limax*
Homophyllia australis	*Hydnophora agassizi*	*Hydnophora exesa*	*Hydnophora microconos*	*Isopora brueggemanni*
Isopora palifera	*Leptastrea botta*	*Leptastrea foliosa*	*Leptastrea purpurea*	*Leptastrea transversa*
Leptoria phrygia	*Leptoseris explanulata*	*Leptoseris gardineri*	*Leptoseris hawaiiensis*	*Leptoseris incrustans*
Leptoseris mycetoseroides	*Lithophyllon concinna*	*Lithophyllon repanda*	*Lithophyllon spinifer*	*Lobactis scutaria*
Lobophyllia corymbosa	*Lobophyllia costata*	*Lobophyllia cylindrica*	*Lobophyllia hataii*	*Lobophyllia hemprichii*
Merulina ampliata	*Merulina cylindrica*	*Merulina pacificus*	*Micromussa regularis*	*Millepora dichotoma*
Millepora exaesa	*Millepora foveolata*	*Millepora latifolia*	*Millepora platyphylla*	*Montipora acanthella*
Montipora aequituberculata	*Montipora berryi*	*Montipora caliculata*	*Montipora conicula*	*Montipora danae*

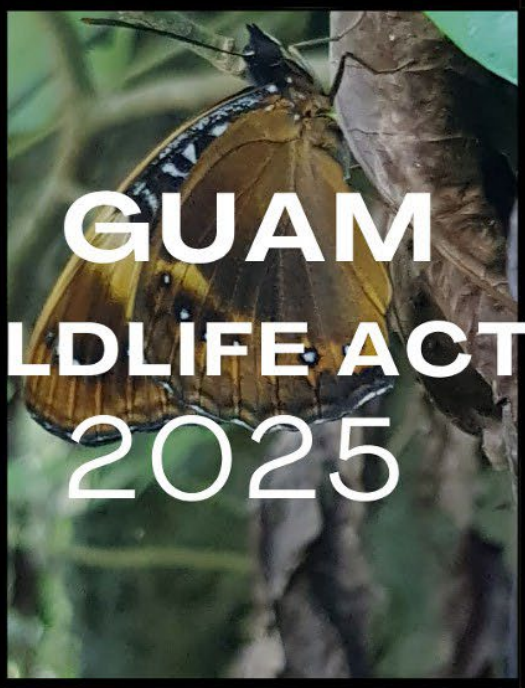
Montipora efflorescens	*Montipora ehrenbergii*	*Montipora elschneri*	*Montipora floweri*	*Montipora foliosa*
Montipora foveolata	*Montipora granulosa*	*Montipora grisea*	*Montipora hoffmeisteri*	*Montipora informis*
Montipora lobulata	*Montipora millepora*	*Montipora monasteriata*	*Montipora patula*	*Montipora spumosa*
Montipora tuberculosa	*Montipora undata*	*Montipora venosa*	*Montipora verrilli*	*Montipora verrucosa*
Mycedium elephantotus	*Oulophyllia crispa*	*Pachyseris astreata*	*Pachyseris speciosa*	*Paragoniastrea australensis*
Paragoniastrea russelli	*Pavona cactus*	*Pavona chiriquiensis*	*Pavona clavus*	*Pavona venosa*
Pectinia lactuca	*Platygyra daedalea*	*Platygyra lamellina*	*Platygyra pini*	*Platygyra sinensis*
Plerogyra sinuosa	*Plesiastrea coccinea*	*Plesiastrea versipora*	*Pocillopora acuta*	*Pocillopora ankeli*
Pocillopora brevicornis	*Pocillopora damicornis*	*Pocillopora elegans*	*Pocillopora grandis*	*Pocillopora ligulata*
Pocillopora meandrina	*Pocillopora verrucosa*	*Pocillopora woodjonesi*	*Porites annae*	*Porites australiensis*
Porites cocosensis	*Porites compressa*	*Porites cylindrica*	*Porites deformis*	*Porites densa*
Porites duerdeni	*Porites fragosa*	*Porites hawaiiensis*	*Porites horizontalata*	*Porites lichen*
Porites lobata	*Porites lutea*	*Porites matthaii*	*Porites monticulosa*	*Porites murrayensis*
Porites myrmidonensis	*Porites rus*	*Porites solida*	*Porites superfusa*	*Porites valenciennesii*
Porites vaughani	*Psammocora columna*	*Psammocora contigua*	*Psammocora digitata*	*Psammocora haimiana*
Psammocora nierstraszi	*Psammocora profundacella*	*Pavona decussata*	*Pavona divaricata*	*Pavona duerdeni*
Pavona explanulata	*Pavona frondifera*	*Pavona maldivensis*	*Pavona minuta*	*Pavona varians*
Pavona vaughani	*Psammocora stellata*	*Psammocora talpina*	*Seriatopora aculeata*	

Appendix E: Public Comment Notices













GUAM
STATE WILDLIFE ACTION PLAN
2025